Endoscopic Surgery of Solid Abdominal Organs

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	Prof. dr. M.A. Cuesta Valentin
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	Prof. dr. I.H.M. Borel Rinkes
	Prof. dr. J. Jeekel

Voor Jetske en ons (nog ongeboren?) kleintje

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Chapter 1

Introduction

1.1 DEFINITIONS

The term '*endoscopy*' is derived from the Greek words endon (= in, inside) and skopein (= to look at or survey) and describes a procedure of investigation of an existing cavity of the body, a hollow organ, or a (surgically) created space.

Laparoscopy is derived from the Greek lapara (= the soft part between the ribs and hip, flank, loin) and refers to the endoscopic inspection of the peritoneal cavity. Endoscopic or laparoscopic visualisation is possible through a rigid tube containing lenses, which casts light on an object and transmitsan image of the object: the scope. The scope is àttached to a camera, which digitalizes the recorded images. These images are projected on a television screen. It should be noted that some organs, for example the adrenal glands are situated in the retroperitoneal space and can be approached both through the peritoneal space (laparoscopically) and from posterior directly through the retroperitoneal space (endoscopically).

'*Laparoscopically assisted'* describes an operative procedure that is performed partly by laparoscopy, followed by a (small) incision to complete the procedure or to extract (a part of) an organ.

1.2 HISTORY OF ENDOSCOPIC SURGERY.

For centuries, physicians have tried to inspect the human body to advance their knowledge of disease. One of the first Hippocratic principles however is 'primam nihil nocere'; first do no harm, warning the doctor, not to worsen the patients' condition in the process of investigation and therapy. Therefore, since the beginning of medicine, people have sought for ways to enter, inspect and manipulate inside the human body through natural orifices and small incisions, to minimise undue damage.

The ancient Egyptians, Greeks and Romans knew clysters for enemas[1]. The earliest description of a rectal examination using a speculum is found in Hippocrates' treatment of anorectal fistulas (460-375 BC) [2,3]. Similar devices were used to inspect vagina, cervix, nose and ears. Although open tubes were later

designed, their use was limited due to the inability of day light to illuminate body cavities.

Figure 1.*The 'Lichtleiter' of Philippe Bozzini*

In 1805 Philippe Bozzini, a German obstetrician, developed a light guide system, using a housing in which a candle was placed and a mirror that reflected the light towards the organ [4,5]. Bozzini had definite views as to which organs could be investigated with his 'lichtleiter' (figure 1), and even speculated on surgery on the uterus with the help of his newly invented device. He also intended to mirror wounds in the abdomen, to recognise injury to the abdominal contents. Several years later, in 1853, Antonin Jean Desormaux, used a mixture of alcohol and turpentine and a converging lens to increase intensity of the light and achieve a brighter illuminated spot for urogenital examination [6,7]. In 1870, Kussmaul used reflected sunlight to demonstrate the possibility of inspecting the stomach with a rigid tube using a professional sword swallower as a subject. Julius Bruck (1867), a dentist from Breslau used an electrically overheated platinum wire in a cover filled with water for inspection of the mouth, thus producing the first internal light source [1].

The idea of electrical lighting, really took off after the invention of Edison's glowing light bulb (1879), and was modified to fit together with lenses into the tip of a cystoscope by Max Nitze [7,8]. This concept was shortly thereafter adapted by Mikulicz to create the first electrical gastroscope in 1881 [9].

During the 1890s, Georg Kelling constructed a gastroscope with a rigid proximal part and a flexible distal part and introduced the idea of gastro-intestinal insufflation of air for examination purposes[10]. At the turn of the century, Kelling experimented on animals with insufflation of air into the abdominal cavity to stop gastro-intestinal bleeding, a procedure he named 'Lufttamponade'. Later he used this technique in combination with his fascination for endoscopes to perform the first celioscopy (Gr. koilia = belly) [11,12,13]. However, the investigator who is generally regarded to be the man responsible for popularising the technique in humans was a Swedish internist, named Hans Christian Jacobeus, who published his first results in 1910. Jacobaeus' efforts were not confined to examining the abdomen but also the thorax. It was Jacobeus who first coined the term 'laparo-thoracoscopy' [14,15].

Figure 2. *Hans Christian Jacobeus*

Further developments included adoption of the Trendelenburg position and the trocar-endoscope by Nordentoft (1912) and the dual trocar technique and 135 degrees angled-viewing optique by the German hepatologist Kalk (1929). In 1951 professor Kalk reported a personal series of 2000 laparoscopies without any

deaths [16,17,18,19]. As early as 1918 the radiologist Goetze developed an automatic pneumoperitoneum needle for safe puncture and insufflation[20]. The spring-loaded version of such a needle, invented by the Hungarian Janos Verress (1938) remains almost unchanged to the present day and is (unfortunately) the standard device to create a pneumoperitoneum in many modern hospitals [21,22]. Several refinements in the years thereafter of laparoscopic instruments and optics have set the stage for today's definition of laparoscopic surgery and enhanced acceptance of laparoscopy as a diagnostic procedure, one of the most crucial being the implementation of the 'cold-light' fibreglass illumination by Fourestier in 1952 and a new optical system by the British physicist Hopkins in 1954. Hopkins dramatically improved resolution and contrast of optical systems by incorporating rod shaped glass lenses as light transmitters while previously air-interspaced optical relays were used [23,24].The Hopkins rod-lens system remains the basis of the modern rigid endoscope, used for laparoscopic surgery.

Throughout the 1960s and 1970s, laparoscopy became a vital part of gynaecologic practice. During this period Kurt Semm, a German engineer and gynaecologist, played a vital role in the development of laparoscopic surgery. He was the inventor of the automatic insufflation device, which is used to maintain a pneumoperitoneum, whereas prior to his invention a syringe was used. He improved intra- and extra corporeal knot techniques and invented the instruments to use them. He also constructed an irrigation/aspiration device and a tissue morcellator (for removal of large pieces of organs or tissue). Semm devised a number of laparoscopic procedures to replace open surgical procedures [25,26]. The first laparoscopic appendectomy is attributed to Semm in 1983, however in fact the Dutchman De Kok had reported this procedure already in 1977, for an audience of sceptical Dutch surgeons [27,28].

Despite the technical advantages in the 1960s, 1970s and early 1980s allowing for safe and effective laparoscopy, only gynaecologists used the technique. Few general surgeons recognised the diagnostic and therapeutic value of this new technique even before laparoscopic cholecystectomy had been performed. Berci, Cushieri, Sugerbaker and others already used laparoscopy for diagnostic purposes, mainly to diagnose and stage intra-abdominal cancer. The main problem at that time was the fact that it was very difficult for other members of the operating team to see what the operating surgeon was seeing and doing and therefore almost impossible to assist in more complex surgical procedures [29,30,31]. The introduction of the computer chip television camera attached to the

laparoscope in 1986 enabled more than one surgeon at a time to operate with a clear view of the operative field and permitted the assistant to interact with the surgeon so that the laparoscope could truly be integrated into the discipline of general surgery.

The first surgical procedure that was performed laparoscopically on a broader scale was a cholecystectomy. Laparoscopic cholecystectomy in humans was performed before the videolaparoscopic era by Luckichev and colleagues in 1983 [32]. Laparoscopic biliary surgery including cholecystectomy was done in pigs by Cushieri and colleagues in 1987 [33]. Eric Müehe, a German surgeon performed a series of laparoscopic cholecystectomies in humans in 1985 using Semm's instruments and a specially designed 'Galloscope' that had side view and instrumentation channels [34,35]. These pioneers in laparoscopy probably did not receive the attention they deserved and it was not until the French gynaecologist Phillipe Mouret performed the first acknowledged laparoscopic cholecystectomy in 1987 that the interest of general surgeons in laparoscopy increased tremendously (Figure 3).

Figure 3. *Pioneers in endoscopic surgery: Miguel Cuesta (left) and Phillipe Mouret.*

Dubois in communication with Mouret published their first experiences in 1989, shortly thereafter followed by Perissat, Reddick, Cushieri and Berci [33,36]. After its tumultuous debut laparoscopic surgery mushroomed over the world and in 1992, more than half of the over one million cholecystectomies in the United States were performed laparoscopically [37]. Within years, a vast number of surgical procedures were converted to a laparoscopic approach.

1.3 RATIONALE FOR THE ENDOSCOPIC APPROACH TO SOLID ABDOMINAL ORGANS.

Before the laparoscopic era, the reigning surgical dogma was; 'the larger the incision the better the surgeon'. The rapid acceptance of the technique of laparoscopic surgery, especially of laparoscopic cholecystectomy, in the general population, stimulated the quest for minimal invasive techniques.

At the outset of laparoscopic surgery it was by no means clear if the broad acceptance of laparoscopic surgery for removal of the gallbladder and other procedures was justified. Many suggested and expected advantages of the laparoscopic technique over conventional surgery were at first not at all scientifically proven. The general frenzy that accompanied the introduction of laparoscopy in the general surgery practice brought many to embark on laparoscopy unprepared and unknowing of the consequences. In retrospect it was no surprise that the number of accidental lesions to the biliary tree multiplied in the first years of laparoscopic cholecystectomy [38-42]. Laparoscopic cholecystectomy has therefore been called jokingly 'the biggest uncontrolled revolution in general surgery' (A. Cushieri). It is true that within a short period numerous reports on the blessings of laparoscopy appeared in the surgical literature, but most studies reported merely small uncontrolled series. Only after several years, randomised trials and meta-analyses irrefutably confirmed the, until then, supposed advantages of laparoscopic cholecystectomy [43-48].

A smaller surgical trauma decreases the chance of postoperative complications. Wound infections in particular but also pulmonary complications are strongly correlated to the length of the surgical incision [51-54]. Moreover, a smaller incision leads to demonstrable less postoperative pain. Patients evidently are sooner out of bed and sooner capable to take care of themselves [55,56]. Furthermore, the cosmetic aspect of abdominal surgery has strongly improved with the introduction of laparoscopic surgery. In the longer term it can be concluded that the smaller

incisions associated with endoscopic surgery preserve the integrity of the abdominal wall integrity, whereby typical long term complications such as abdominal wall 'bulging' due to neuropraxis and incisional hernias are less frequent [57,58]. It is also suggested that laparoscopic surgery has less traumatic effects on the peritoneum and other abdominal organs so that intra-abdominal adhesion formation appears less and the chance to develop an obstructive ileus is diminished [59,60]. Normal bowel motility is disrupted through abdominal surgery in general but appears to regain normal activity sooner after laparoscopic surgery enabling the patient to resume a normal diet more quickly. All of these factors contribute to a faster postoperative convalescence and earlier discharge from the hospital, which has a considerable benefit for hospital admission costs. Many patients are able to resume their normal daily activities, professional occupation and sports much sooner after laparoscopic surgery.

- **Smaller incisions**
- **Less wound infections**
- **Less postoperative pain**
- **Less incisional hernias**
- **Better cosmesis**
- **Less peritoneal adhesions**
- **Shorter postoperative ileus**
- **Faster convalescence**
- **Shorter hospital stay**
- **Faster resumption of normal activity**

Table 1. *Advantages of endoscopic surgery.*

It was only to be expected that the remarkable results of laparoscopic cholecystectomy would inspire surgeons to adopt laparoscopic techniques for other operative procedures. Within short time the surgical literature was overrun with reports of laparoscopic 'firsts': Esofagectomy (Buess 1989), highly selective vagotomy (Dubois 1989), truncal vagotomy and seromyotomy (Katkhouda and Mouiel 1990), ligature of bullae, pleurectomy (Cushieri 1990), abdominal cardiomyotomie, total- and partial fundoplication (Cushieri 1991) partial gastrectomy (Goh 1992), gastrojejunostomy, splenectomy, adrenalectomy, resection of liver metastases, colon resection, loop colostomy, hernioplasty, inguinal herniorraphy, etc. The list of surgical procedures that are performed

laparoscopically is seemingly endless. In fact, nowadays there are hardly any conventional procedures left that have not also been performed laparoscopically. However, this does not mean that many of these procedures are part of the endoscopic routine.
Many endoscopic procedures, including endoscopic surgery of solid abdominal organs, are considered too complex to perform or too time consuming. Some of the target organs are difficult to approach laparoscopically (adrenals/pancreas), or hard to control laparoscopically in case of major bleeding (liver/splenic surgery). Some diseases are relatively rare so that expertise on laparoscopic treatment can arise only after many years (insulinomas), while other procedures are still relatively new so that long-term results are needed (nephrectomy).

Endoscopic solid organ surgery definitely holds a promise for the future, because it combines the proven benefits of the minimally invasive approach with the often complex field of abdominal surgery of solid organs. It is impossible to lump the advantages of the endoscopic approach to all organs together. In general, it can be stated that the advantages of endoscopic surgery are most downright when for a relatively small lesion a large incision is needed to approach the organ in the conventional way. Some procedures do not even recquire the extraction of a tissue sample or organ (cysto-gastostomy, drainage of hepatic cyst) so that no additional incision is needed. To elucidate the implications of endoscopic solid organ surgery a short discussion of the separate solid abdominal organs is necessary. Some procedures are so seldom performed world wide, that emphasis is put on technique and feasibility, while other procedures are far better known so that perfectionizing the procedure, surgical dilemmas and implications of the operation on the longer term are addressed in more detail.

THE ADRENAL GLANDS

Many conventional techniques are available for adrenalectomy. The conventional ‘open’ approach varied according to pathological findings, diameter of the adrenal tumour, location of the lesion and the patient’s morphological features such as obesity or previous surgery. However, the conventional approach often involves large incisions and chronic pain syndromes are not unusual. Associated morbidity can be as high as 40% and mortality in the range of 2-4% [61-63].
The first laparoscopic adrenalectomy was performed in 1992 [64] and it soon became clear that the minimally invasive approach to the adrenals was not only

feasible, but could also be very advantageous for the patient with regard to morbidity, pain and convalescence [65-67]. Although no randomised controlled studies exist, several large case controlled studies have underlined these advantages, so that nowadays, endoscopic adrenalectomy for benign tumors is regarded as the gold standard by many surgeons. Nevertheless, some questions regarding the endoscopic approach of the adrenals remain unanswered. First of all there is the question of the best approach to the retroperitoneum. As in open surgery, the adrenals can be reached both transperitoneally and retroperitoneally. The retroperitoneal approach has certain theoretical advantages. Many surgeons claim that the transabdominal approach offers a clearer view and more familiar landmarks and orientation [65-68]. However this advantage is lessened by the more difficult mobilisation of overlying intra-peritoneal organs such as the spleen, the pancreatic tail, and the hepatic and splenic flexure of the colon [69]. The endoscopic retroperitoneal approach (ERA) allows access to the adrenal gland exclusively extraperitoneally. The adrenalectomy takes place in an artificially created space that provides direct access to the gland and enables to maintain a steady gas pressure, without interference by other organs.
Despite these advantages reports on ERA are scarce in literature and larger series were absent. At the university hospital in Rotterdam there is an extensive experience with the retroperitoneal approach to the adrenals. Objective of the study was to examine safety and effectiveness of ERA. In the present thesis the operative technique of retroperitoneal endoscopic adrenalectomy is explained in detail and results of a series of 111 patients (one of the largest series at present) who underwent ERA in lateral decubitus position is discussed.

Another controversy exists about the endoscopic resection of pheochromocytomas. A pheochromocytoma is an adrenal tumor arising from the adrenal medulla that is disreputable for its production of vasoactive agents, the so-called catecholamines. Tumor manipulation during surgery can cause a release of catecholamines that can give rise to life threatening tachycardia and hypertension. The advantages in endoscopic adrenal surgery have also put the endoscopic treatment of pheochromocytoma on stage. Some authors demonstrated feasibility and safety of transabdominal endoscopic resection of pheochromocytomas, emphasizing the need for early ligation of the adrenal vein in order to avoid discharge of catecholamines from the tumor into the circulation [70-74]. However, in the retroperitoneal approach to the adrenal gland, the adrenal vein is

reached and ligated only late during the procedure. Furthermore it is suggested that the insufflation of CO_2 in the narrow retroperitoneal space during ERA could lead to more catecholamine release and subsequent hemodynamic instability. Were reports on retroperitoneal endoscopic adrenalectomy scarce, series of retroperitoneal treatment of pheochromocytoma were practically non-existent. The question remaining therefore was if the advantages of the retroperitoneal approach to the adrenals also would hold in case of a pheochromocytoma, without compromising the safety of the patient with regard to hemodynamic stability. In this thesis the largest series of retroperitoneal endoscopic resection of pheochromocytoma is presented and discussed.

THE PANCREAS

The pancreas is due to its distinct anatomical position dorsal in the abdomen with overlying stomach and colon an organ that cannot easily be reached. Moreover, its proximity to the large mesenteric and splenic vessels and the vulnerable spleen plus the risk of postoperative leakage of aggressive pancreatic fluids make pancreatic surgery one of the most daunted areas in general surgery. Traditionally, pancreatic surgery required large incisions for adequate exposure, however the advances in laparoscopic surgery and laparoscopic ultrasonography (LUS) have also brought endoscopic pancreas surgery within reach. Two afflictions of the pancreas in particular were subject of study: the insulinoma and the pseudocyst.

The majority of insulinomas is benign, intrapancreatic and solitary [75-77]. Furthermore, most insulinomas are only a few centimeters in diameter. These qualifications make insulinomas theoretically very suitable for curative minimally invasive resection. One of the problems in surgery of insulinomas is the matter of adequate detection and localization [78,79]. Preoperative imaging techniques have often disappointing sensitivity. One of the best modalities being direct intraoperative ultrasonography of the pancreas combined with palpation of the entire organ [80,81]. Of course palpation is not possible in conventional laparoscopy. Whereas before studies on laparoscopic resection of insulinomas were limited to case reports, we combined all cases from both the university hospital of the ‘Vrije Universiteit’ in Amsterdam with those from the university hospital ‘Dijkzigt’ in Rotterdam, to produce one of two largest series of laparoscopic treatment of insulinomas in the literature. Objective was to determine accuracy of LUS in detection of an insulinoma and feasibility of laparoscopic resection.

A pancreatic pseudocyst is a late complication after pancreatitis and can cause chronic debilitating abdominal pain and passage problems after meals. Especially large and symptomatic pseudocysts are at risk for complications such as: infection, bleeding and rupture and can be treated with different modalities, all of which entail some form of drainage of the cyst. Classic cysto-gastrostomy is probably one of the most successful treatment modalities, with good results and low recurrence rate [83,84]. However, in order to reach the pseudocyst, a relatively large incision is needed for adequate exposure of the operation area. The fact that for cysto-gastrostomy no specimen or organ is extracted from the abdomen and access to the stomach suffices to perform the procedure, again makes it theoretically very suitable for endoscopic surgery. The difficulty of the procedure lies mainly in adequate localization of the cyst, for which LUS is indispensable. Although feasibility of laparoscopically assisted cysto-gastrostomy has been reported earlier in case reports, larger experience is wanting. In this thesis a series of 6 patients is presented. The place of minimal invasive cysto-gastrostomy among other therapies for pancreatic pseudocysts is extensively discussed in this thesis.

THE SPLEEN

Delaitre performed laparoscopic splenectomy (LS) as early as 1991[85]. Since then, a large number of studies have demonstrated feasibility and safety of laparoscopic splenectomy for various hematological conditions and for splenomegaly [86,87]. Not only can the spleen easily be reached laparoscopically and dissected from its surroundings (especially in right lateral decubitus position); the parenchymatous splenic tissue can be easily morcellated before extraction so that no large incisions are needed for extraction, which adds to the minimally invasive character of the procedure. There has been mounting evidence, though not from randomized controlled studies, that laparoscopic splenectomy is pre-eminently a procedure that maximizes the distinct advantages, which are more or less characteristic of laparoscopic solid organ surgery, compared to conventional splenectomy. For this reason, many surgeons regard laparoscopic splenectomy as ‘the gold standard’ [88,89].

However, patients who undergo LS for Idiopathic Thrombocytic Purpura (ITP) face the problem of recurrence of disease if splenic tissue is left behind in the abdominal cavity. The problem of a so-called ‘relapse’ can become manifest years after initial splenectomy. It is suggested that the laparoscopic approach to the spleen can lead to more residual splenic tissue in the patient by means of missed

accessory spleens and increased spillage of splenic tissue [90-92]. This problem of hematological control in the long run after LS for ITP has been subject of debate for many years now. In this thesis, a series of patients who underwent LS for ITP is compared to a historic series of patients who underwent open splenectomy for ITP. The considerable follow-up in both groups enables comparison of hematological control in the long run, and can therefore significantly add to the discussion on the role of LS in the treatment of ITP.

THE KIDNEY

Transplant surgery in the Netherlands has historically been part of the general surgery practice. Therefore, it was merely a matter of time until the implementation of advanced laparoscopic techniques in the daily surgical practice also oozed into the field of transplant surgery. For a healthy kidney donor, the minimally invasive extraction of a kidney has many theoretical advantages such as: less post operative pain, faster convalescence and better cosmesis.

Feasibility of endoscopic nephrectomy for urological reasons had already been demonstrated with great success [93-95]. However, unlike many other surgical procedures, the procedure of a nephrectomy in a healthy individual, with the scope to transplant that organ into another patient, requires extraction of the organ in optimal condition. Although early reports from the US described feasibility of laparoscopic live donor nephrectomy and reported favorable post operative results for kidney donors, little was known about post operative results for recipients and transplant function in the long run [96-98]. The operative procedure was still in a developmental stage, leaving room for laparoscopic pioneers to shape the operative procedures according to their own ideas. At the University Hospital Dijkzigt in Rotterdam, the two conditions for a successful laparoscopic kidney transplant program were present: a vast experience with living related kidney transplantation and extensive experience with advanced laparoscopic surgery. Thus, in Rotterdam the first laparoscopic live donor nephrectomy program in the Netherlands and indeed one of the first in Europe, started [99]. In this thesis the results of the first series of patients is described. Objectives of the study were first of all to examine feasibility and safety of this revolutionary new operative technique. Special emphasis is put on difficult technical aspects of the operative outcome both for donors and recipients, unanswered questions in the literature among others being: What is the role of a pneumoperitoneum and a prolonged warm ischemia time on transplant function and what is the preferred side for

kidney harvest. [100-103]. The results are compared to a historical series of conventional live donor nephrectomies.

THE LIVER

Although laparoscopic surgery for solid abdominal organs has gained growing acceptance, the experience with laparoscopic liver surgery is limited. The technical complexity of hepatic surgery, the risk of life threatening bleeding and the supposed risk of gas embolism during dissection in a high pressure environment have withheld many to embark on laparoscopic liver surgery [104,105]. In this thesis the technical considerations of laparoscopic liver surgery are discussed. Feasibility of laparoscopic surgery of the liver in a selected group of patients is demonstrated and clarified with photos.

1.4 CONCLUSION

In endoscopic solid organ surgery prospective randomized trials are scarce, not to say non-existent. Some feel this to be an insurmountable shortcoming of the technique. It is indeed used as an argument not to embark on endoscopic surgery as a whole. And the sceptics are partly right. Before accepting a new technique, the surgical community must be very cautious of adverse short- and long term effects and each new procedure must be scrutinized before embracing it as a new gold standard. This thesis does not pretend to fill the scientific void that exists in laparoscopic literature. However, it does try to contribute to the implementation of a new valuable technique in the surgical practice. That such an extensive development cannot take place overnight is clear. Small steps ultimately must lead to more evolved endoscopic techniques, tailored surgical procedures and finally improvement of quality in surgical care. When this thesis can make a small contribution to this goal, it has succeeded in its intention.

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Chapter 2

The Adrenal Gland

Adapted from the original articles:

Endoscopic retroperitoneal adrenalectomy.
Berends FJ, Bruining HA, De Herder WW, Bonjer HJ.
Acta Chirurgica Austriaca 1999;31:200-2.

Endoscopic retroperitoneal adrenalectomy: lessons learned from 111 consecutive cases.
Bonjer HJ, Sorm V, Berends FJ, Kazemier G, Steyerberg EW, de Herder WW, Bruining HA.
Annals of Surgery. 2000 Dec;232(6):796-803.

Safe endoscopic retroperitoneal resection of phaeochromocytomas.
Berends FJ, Kazemier G, de Herder WW, Bruining HA, Bonjer HJ.
World Journal of Surgery 2002 May;26(5):527-31.

2.1 GENERAL INTRODUCTION

The adrenal glands are located deeply in the retroperitoneal space in between the upper pole of the kidney and the diaphragm. Traditionally, small adrenal tumors were removed either through the posterior approach which involved resection of the 11th or 12th rib, or through a lumbotomy [44]. Morbidity of these conventional extraperitoneal approaches to the adrenal glands is considerable. Postoperative pain, pulmonary problems, wound infections, hospital stay and return to normal activity are all correlated to the extent of the surgical trauma. Employing an endoscopic approach to adrenal pathology is considered to be associated with reduced surgical trauma and therefore lessens postoperative discomfort and improves recovery.

The adrenal gland can be approached endoscopically using either a transperitoneal or a retroperitoneal access. The majority of endoscopic surgeons prefers transperitoneal adrenalectomy because this approach offers clear anatomical landmarks and the opportunity to ligate the adrenal vein in an early phase of dissection, which is considered particularly important in surgery for pheochromocytomas. However, in transperitoneal adrenalectomy extensive dissection, particularly on the left side is required to visualize the adrenal gland. For right transperitoneal adrenalectomy, cephalad retraction of the right liver lobe and medial retraction of the duodenum are necessary to expose the right adrenal gland. Intraperitoneal adhesions due to previous abdominal surgery or inflammation can hamper the transperitoneal route to the adrenal glands. The discussion on whether to use the transperitoneal or retroperitoneal approach to adrenal disease bears resemblance to the debate on the optimal approach to inguinal hernias. Although transperitoneal inguinal hernia repair was commonly used in the first years of endoscopic inguinal hernia repair, preperitoneal access to inguinal hernias has become the preferable approach in the Netherlands. From an anatomical point of view, intraperitoneal pathology demands a transperitoneal approach and retroperitoneal pathology a retroperitoneal approach. Prior to the introduction of endoscopic techniques in general surgery, small adrenal tumors were removed through the posterior paravertebral approach at the University Hospital Rotterdam. Experience with this technique provided a good basis to embark on endoscopic retroperitoneal adrenalectomy.

ANATOMY

The retroperitoneal space is a virtual space and, therefore, relatively short of anatomical landmarks which renders orientation during retroperitoneal surgery more difficult. Himpens has studied extraperitoneal anatomy extensively, and has described the different extraperitoneal compartments with their respective fasciae. [28] The boundaries of the lumbar retroperitoneum on the right side are the diaphragm (cephalad), parietal peritoneum (medial), quadratus lumborum and psoas muscle (floor) and thoracic cage (lateral). In caudal direction, the lumbar retroperitoneum is in continuity with the iliac retroperitoneum. The kidney, adrenal gland and perirenal fat, enveloped by Gerota's fascia are the most important anatomical structures in the lumbar retroperitoneum. The posterior layer of Gerota's fascia fuses with the fascia overlying the quadratus lumborum and psoas muscles. Laterally, the lateroconal fascia connects Gerota's fascia with the lateroposterior parietal peritoneum (figure 4) The lateroconal fascia divides the lumbar retroperitoneum into an anterior and posterior pararenal space. The adrenal gland is located in the anterior pararenal space.

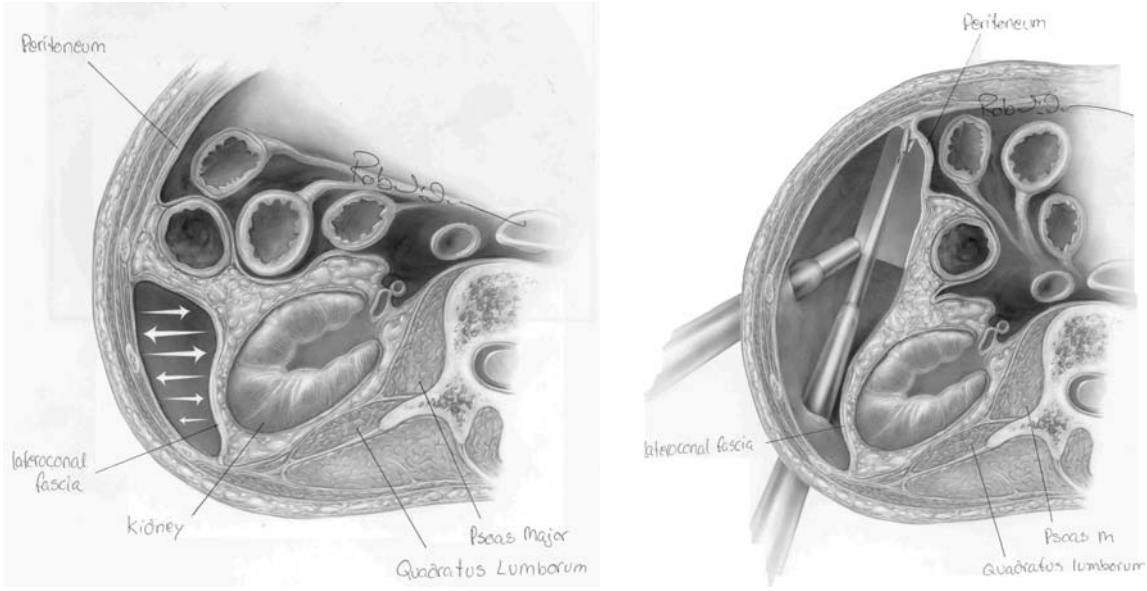

Figure 4. *Cross-section of the retroperitoneal space. The right picture demonstrates how the retroperitoneal working space is enlarged with aid of instruments.*

OPERATIVE TECHNIQUE OF RETROPERITONEAL ENDOSCOPIC ADRENALECTOMY

Patients with hypercortisolism are given corticosteroids intra- and postoperatively. Patients with pheochromocytomas receive alpha- and beta-adrenergic blockade and plasma expansion, when necessary, for at least 10 days prior to adrenalectomy. A Swan-Ganz catheter monitors hemodynamics in these patients intra-operatively. Antibiotics are not given routinely. In endoscopic retroperitoneal adrenalectomy, the patient is placed in lateral decubitus position (figure 5). A beanbag facilitates proper positioning of the patient.

The surgeon faces the back of the patient and the assistant, the abdomen of the patient. One of the advantages of the retroperitoneal approach is that, particularly in patients with hypercortisolism, the adipose abdominal wall "falls away" from the operative field, and has not to be traversed as in transabdominal surgery. An alternative to the lateral decubitus position is the prone position, which has been advocated by Mercan et al. [37] .The advantage of the prone position is that the patient can remain in the same position in bilateral disease. We prefer the lateral decubitus position because access to the retroperitoneum is easier in case of conversion.

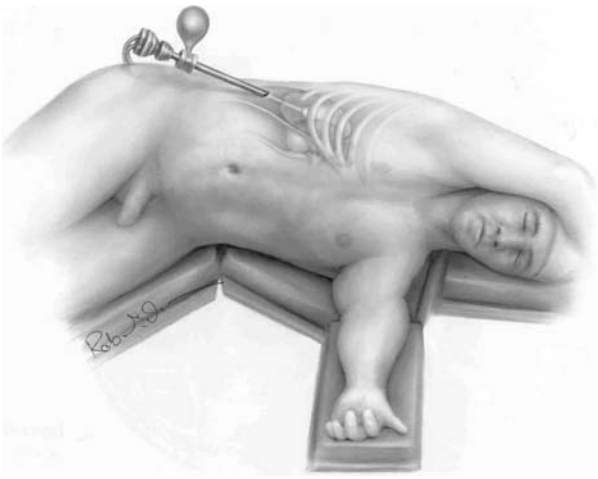

Figure 5. *Lateral decubitus position. The tip of the eleventh rib is the landmark for the entrypoint of the first trocar.*

Through a muscle splitting 2 cm incision in the midaxillary line just caudally to the tip of the eleventh rib, a dissecting balloon (Origin, Medsystems, Inc, USA) is introduced to create a retroperitoneal space. Other distension devices such as a glove tied over an inflated Foley's catheter can also be used. [21] The dissecting balloon should be aimed vertebral to prevent laceration of the peritoneal sac on the abdominal side. After replacement of the balloon by a trocar, CO2 is insufflated to a maximal pressure of 12 mm Hg. In most cases, a 0° scope will suffice. However, in some cases a 30° scope can improve the view of the operative field. A second trocar of 5 mm is placed on the vertebral side of the first trocar. It is important to place all trocars close to the costal margin to prevent instruments impinging on the iliac crest. The first step of the operation is to mobilize the anterior part of the peritoneal sac that is adherent to the anterior abdominal wall. This is necessary to allow safe trocar insertion without penetration of the peritoneum. Thereafter, a third and fourth trocar (10 mm and 5 mm) can be inserted on the abdominal side of the first trocar. There should be enough space in between the trocars to prevent ‘sword fighting’ (figure 6).

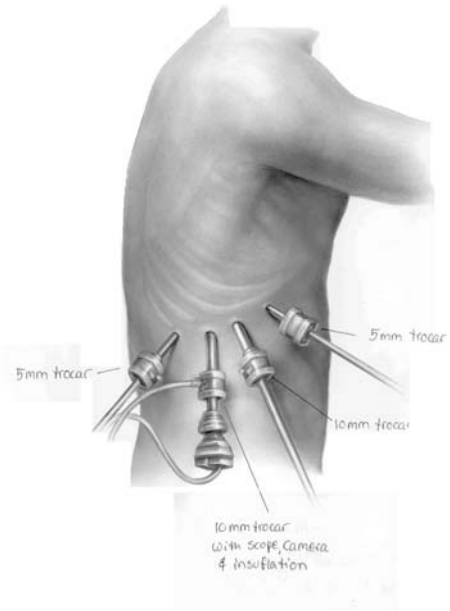

Figure 6. *Trocars are inserted in the flank to enable retroperitoneal adrenalectomy.*

A greyish translucent fascia is noted extending from the floor to the ceiling of the operative field. This is the lateroconal fascia. This fascia should be opened in a caudocephalad fashion close to the quadratus lumborum muscle to avoid opening the peritoneal sac. If this occurs, however, the working space is only reduced

slightly due to the lateral decubitus position of the patient. After opening the lateroconal fascia, the kidney can be identified. Dissection of the superior pole of the kidney is the next step of the operation. Teasing away all fatty tissue between the upper pole of the kidney and the lateral abdominal wall facilitates adrenal dissection. Usually the inferior rim of the adrenal gland is visualized first. On the left side, a small venous branch is running perpendicularly over the lower border of the adrenal. When a small adrenal tumor cannot readily be found, it is usually hiding in the floor of the operative field. Dissection of the adrenal gland is started peripherally and anteriorly. In the top of the field, either the right lobe of the liver on the right side or the pancreatic tail and spleen on the left side can be seen. While dissection proceeds in a latero-medial fashion, the adrenal gland can be lifted atraumatically to facilitate dissection. The adrenal should not be grasped because the fragile adrenal tissue easily disintegrates, which causes tedious bleeding. In right adrenalectomy, the adrenal vein is encountered after dissection of the caval vein (figure 7). Subtle retraction of the adrenal gland is necessary to prevent tearing of the adrenal vein. The vein can be clipped and transected. In some cases (approximately 5 %), a second adrenal vein draining into the right hepatic vein, exists.

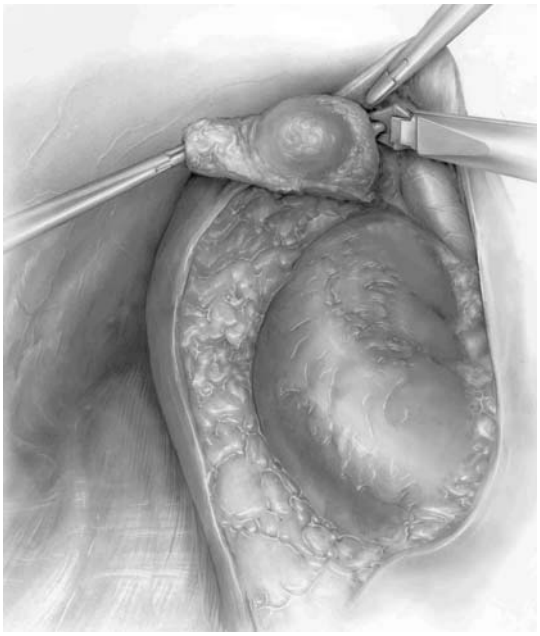

Figure 7. *The adrenal gland is dissected from the surroundings and the vein is ligated with titanium clips.*

The arterial branches on the medial side of the adrenal gland can either be cauterized or clipped. In left adrenalectomy, the adrenal vein is encountered during dissection of the inferior border of the adrenal. To provide a good view of the left adrenal vein, retraction of the upper pole of the kidney is frequently necessary. On the left side, an additional adrenal vein draining in a diaphragmatic vein can be found. If conversion to open adrenalectomy is necessary, a lumbotomy through the ninth intercostal space is preferable. This approach allows rapid control of vascular structures. Drainage after endoscopic retroperitoneal adrenalectomy is indicated only if there is oozing. Postoperatively, patients are stimulated to mobilize freely and resume a normal diet. In Cushing patients, corticosteroids should be given orally when tolerated, to shorten hospital stay.

2.2. ENDOSCOPIC RETROPERITONEAL ADRENALECTOMY: LESSONS LEARNED FROM 111 CONSECUTIVE CASES

INTRODUCTION

The first endoscopic adrenalectomy was reported in 1992 by Higashihara et al [26]. This report was followed by other early experiences with minimally invasive removal of adrenal tumor [8,9,17,18,27,45,49]. At the University Hospital Rotterdam laparoscopic transperitoneal adrenalectomy with the patient in supine position was replaced by endoscopic retroperitoneal adrenalectomy with the patient in lateral decubitus position in 1995. A case-control study, comparing our pilot series of endoscopic retroperitoneal adrenalectomy to conventional posterior adrenalectomy, showed that the endoscopic approach was associated with less blood loss, less postoperative pain and reduced postoperative hospital stay [3]. The objective of this study was to evaluate the effectiveness of endoscopic retroperitoneal adrenalectomy for a variety of pathology and to determine its limitations after experience with 111 consecutive cases.

METHODS

The medical charts of all patients who underwent adrenalectomy at the university hospital Rotterdam from January 1994 to December 1999 were reviewed. Those patients, in whom endoscopic retroperitoneal adrenalectomies had been

attempted, were selected for further analysis. Clinical characteristics, operative details and postoperative courses were recorded. Preoperative hormonal analysis included 1 mg dexamethasone suppression test and plasma or urinary catecholamines measurements in all patients. Plasma aldosterone and renine were assessed in patients with coexistent hypertension and hypokalemia. Adrenal androgens were only assessed in women with hirsutism or virilization. All patients had either computed tomography or magnetic resonance imaging of the abdomen. Patients with pheochromocytomas had ^{123}I-meta-iodobenzylguanidine (MIBG) scanning to exclude extra-adrenal or contralateral pheochromocytomas.

Patients with hypercortisolism were given corticosteroids intra- and postoperatively. Patients with a known pheochromocytoma received alpha- and, in case of refractory tachycardia, beta- adrenergic blockade and plasma expansion when necessary, for at least 10 days prior to surgery. A pulmonary artery catheter to allow accurate monitoring of cardiac output and systemic vascular resistance monitored hemodynamics in patients with pheochromocytomas intra-operatively.

Patients with either hypercortisolism Cushing's adenomas or Cushing's disease were given one dose of cephazolin at induction of anaesthesia. A urinary catheter was installed only in patients undergoing bilateral adrenalectomy. Only patients with benign adrenal tumors less than 6 cm in size were selected for endoscopic retroperitoneal adrenalectomy. Previous perirenal surgery was a contra-indication for endoscopic retroperitoneal adrenalectomy.

Patients were allowed a normal diet and mobilization on the first postoperative day.

Patients were discharged from the hospital when they did not require intravenous medication, tolerated a normal diet and were mobile. Follow-up data were collected through medical correspondence.

Analysis

Body mass index was determined by the quotient of body mass (kg) and the square of body length (m). Operating time was defined as the period of time between the first incision until complete closure of all incisions. Postoperative stay was calculated by assigning the operative day as day zero. Wound infection was defined as a condition, which required surgical drainage. Malignancy of adrenal tissue was defined as "a van Slooten index" greater than 8 [36].

The mean or median values and standard errors of the continuous variables were calculated. Analysis of patients who required conversion to open adrenalectomy

was performed on the basis of intention to treat. The Mann-Whitney test for non-parametric variables was used to determine possible differences between left, right and bilateral procedures. A p-value less than 0.05 was considered to represent a significant difference.

RESULTS

From January 1994 until December 1999, 140 patients underwent adrenalectomy. Ninety-five patients had endoscopic retroperitoneal adrenalectomy, 11 patients had laparoscopic transperitoneal adrenalectomy and 35 open adrenalectomy. The distribution of approaches during the study period is shown in figure 7. In the first minimally invasive adrenal surgeries, laparoscopic transperitoneal adrenalectomy was performed with the patient in supine position.

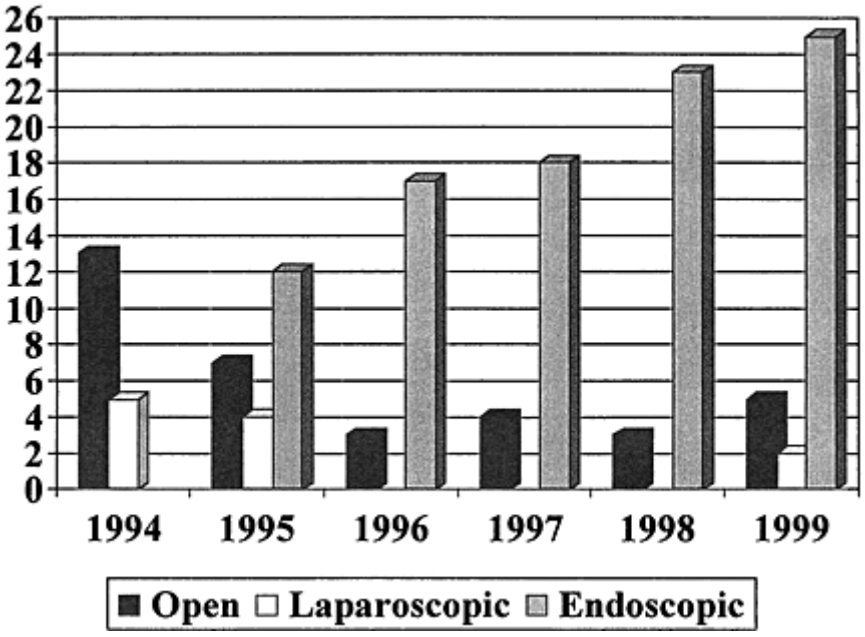

Table 2. *Distribution of approaches in adrenalectomy*

The left adrenal gland was approached through the transverse mesocolon laterally to the inferior mesenteric vein, which had been the standard conventional anterior open approach to adrenal tumors of moderate size [4]. However, the laparoscopic transmesocolic approach to the left adrenal gland proved to be very difficult because simultaneous retraction of both pancreatic tail and descending colon was necessary to expose the adrenal gland [45]. Therefore, this approach was

abandoned in 1995, and endoscopic retroperitoneal adrenalectomy was started. Laparoscopic transperitoneal adrenalectomies in 1999 were only performed with the patient in lateral decubitus position in two patients. One patient had food dependent Cushing's syndrome with a 7.5 cm right adrenal tumor and a 5 cm left adrenal tumor. The right adrenal was removed through transperitoneal laparoscopic surgery while the left was resected by endoscopic retroperitoneal approach. The other patient, with a left 4 cm Cushing's adenoma, who had a transperitoneal adrenalectomy, had undergone a lumbotomy for a renal concrement in the past.

Seventy-nine patients with unilateral disease and 16 patients with bilateral disease underwent endoscopic retroperitoneal adrenalectomy. Patient and adrenal tumor characteristics are listed in figure 8. Conn's adenoma was the most prevalent indication. Two patients had extra-adrenal pheochromocytomas (paragangliomas). In these patients, the normal adrenal gland was removed in continuity with the paraganglioma.

	Unilateral Adrenalectomy	**Bilateral Adrenalectomy**
Number	79	16
Gender (Male/ Female)	27/52	2/14
Age (years)	50 (17-83)	47 (27-67)
Body Mass Index	26.7 (19-42)	26.9 (16-34)
Tumor Size (cm)	3.4 (0.2-7.0)	3.2 (0.1-8.0)
Side of Lesion(Left/ Right)	46/33	8/8
Cushing's Syndrome	22	-
Cushing's Disease	2	6
Ectopic ACTH Syndrome	-	6
Conn's Adenoma	25	-
Pheochromocytoma	16	3
Incidentaloma	11	-
Adrenocortical Carcinoma	1	-
Metastasis	1	-
Virilizing Tumor	1	-
Adrenogenital Syndrome	-	1

Table 3. *Patient and adrenal tumor characteristics*

Of all endoscopically removed adrenal tumors, two exceeded 6 cm in size at gross examination. One patient had a 7 cm cortisol producing adrenal tumor, which turned out to be malignant (see below). Another patient had a left 8 cm pheochromocytoma. Both tumors could be removed by retroperitoneal endoscopic surgery. In both instances, the size of the adrenal tumors was underestimated on pre-operative imaging. Adrenal tumors as small as 0.1 cm were found in patients who had bilateral adrenalectomy for Cushing's disease.

The size of the incidentalomas varied from 2.5 to 6 cm. While surgery for incidentalomas is recommended only in those patients with adrenal tumors exceeding 4 cm in diameter, three incidentalomas of respectively 2.5, 3.0 and 3.5 cm were removed. The indication for adrenalectomy in these cases was the patient's concern about the nature of the enlarged adrenal. Two patients with Cushing's disease had only a unilateral endoscopic retroperitoneal adrenalectomy because of mild Cushing's disease after unsuccessful pituitary surgery or irradiation. Six patients had Cushing's syndrome due to ectopic ACTH production due to carcinoid tumors (n=3), neuro-endocrine pancreatic tumor (n=1) and unknown primary tumors (n=2). Unilateral adrenalectomy required less than 2 hours while bilateral adrenalectomy lasted 3.5 hours (figure 9). There were no significant differences in either operating time or blood loss between left and right adrenalectomy. Hospital stay was significantly longer after bilateral adrenalectomy of medical correction because of endocrine disbalance ($p = 0.013$).

	Unilateral Adrenalectomy	**Bilateral Adrenalectomy**	**Conversion**
Number	74	15	5
Operating Time (min)	114 (4.8)[1]	214 (25.9)[1]	183 (34.7)[1]
Blood Loss (ml)	65 (13.2)[1]	121 (39.6)[1]	75 (75)[1]
Hospital Stay (days)	2 (1.5-5.0)[2]	5 (4.8-7.5)[2]	12.5 (7.3-16.3)[2]
Complications	8	3	1
Mortality	-	1	-

Table 4. *Operative details and clinical courses. [1] Mean value (standard error), [2] Median value (P25 -P75 percentile)*

Any correlation between body mass index and either operating time, blood loss or hospital stay was not found.

Peritoneal tears occurred in one third of all patients, particularly during the first forty cases. Although peritoneal perforation reduced the working space to some extent, conversion was never necessary. In some cases, an additional instrument was introduced to provide retraction of the peritoneal sac.

Except for four patients, all patients had complete removal of the affected adrenal gland. Partial adrenalectomy was purposely performed in two patients with Conn's adenomas, in one patient with a 3 cm Cushing's adenoma and in one patient with an adrenal cyst. Agenesis of the contralateral kidney with suspected concomitant absence of the adrenal gland was the indication for partial adrenalectomy in one of these patients. This patient has been cured of disease, and does not require substitution of adrenocortical hormones. In the other patients, partial adrenalectomy was performed because the lesion was located at the periphery of the adrenal gland and the remaining gland was macroscopically normal.

Two patients had endoscopic retroperitoneal adrenalectomy during pregnancy. One patient had uneventful bilateral endoscopic adrenalectomy for MEN II A syndrome at 13 weeks gestation, and delivered a healthy baby after 40 weeks gestation. The other pregnant patient had a 6 cm pheochromocytoma diagnosed at 28 weeks gestation. At 35 weeks gestation, a healthy baby was delivered through caesarean section followed by endoscopic removal of the right-sided pheochromocytoma. As suggested by pre-operative Magnetic Resonance Imaging (MRI), this involved a paraganglioma located between the renal artery and vein necessitating lumbotomy.

Five endoscopic retroperitoneal adrenalectomies were converted (4.5 %). Bleeding was the cause of conversion in one patient with a left sided pheochromocytoma and in another patient with Cushing's syndrome due to excessive traction on the right adrenal vein. The conversions for bleeding occurred among the first 30 cases. Both patients with paragangliomas had their procedures converted to thoracolumbotomy since lumbotomy did not allow sufficient access. One paraganglioma was located between the aorta and the caval vein while the other was found in between the artery and vein of the right kidney. Both the location and the presence of multiple short venous branches into the caval and renal vein necessitated open surgery. The remaining conversion was for unexpected malignancy. In this patient with a 5 cm incidentaloma on the left side, several enlarged lymph nodes were encountered during adrenal dissection. Peroperative microscopy showed malignant tissue in the lymph nodes. The

endoscopic procedure was converted to lumbotomy to allow peri-aortic lymph node dissection.

Total morbidity was 11%. Hematoma (n=3) and urinary tract infection (n=3) were the most common complications. One hematoma was drained under ultrasonographic guidance for persisting pain in the operative field. Other complications included paralytic ileus after lumbotomy, depression and Candidemia. This patient with near terminal asthmatic disease precluding any open surgery had a hematoma after bilateral adrenalectomy for severe Cushing's syndrome due to ectopic ACTH production of an unknown primary tumor. The hematoma spread to the peritoneal cavity due to a laceration of the peritoneal sac during right adrenalectomy. The hematoma was infected by Candida, In spite of systemic fungicide treatment and surgical abdominal lavage, this patient died on the 20th postoperative day. This was the only case of postoperative mortality (0.9 %).

Pathology and follow-up

Microscopic examination of adrenal tissue revealed in one patient a van Slooten index greater than 8. This patient had a cortisol producing tumor with a diameter of 7 cm. Since capsular and vascular invasion were absent, adjuvant mitotane treatment was not given. Although abdominal computed tomography at 6 months postoperatively was normal, local recurrence and bone metastases were found 3 months later. Port site metastases were not present. The patient deceased fourteen months after adrenalectomy. In one patient with MEN II-B syndrome histological examination of a pheochromocytoma revealed capsular ingrowth, angioinvasive growth, necrosis and cysts. This patient was later on diagnosed with liver metastases and died two years after the adrenalectomy.

In another patient with a 5 cm incidentaloma of the left adrenal gland, adenocarcinoma was found in the adrenal and removed lymph nodes. It was unclear whether this tissue was adrenocortical cancer. At follow-up, enlarged lymph nodes in the retroperitoneum and mediastinum and a pulmonary lesion were found, suggesting that the incidentaloma was a metastasis of unknown primary adenocarcinoma.

Median follow-up was 14 months (2 – 68 months). All patients who had their Conn's adenomas removed were normokalemic without potassium preserving medication. Eighteen of these 26 patients (69 %) had a normal blood pressure without medication. Two of six patients with ectopic ACTH induced

hypercortisolism died from hepatic failure due to extensive metastases and perforated diverticulitis after respectively 14 and 11 months.

Open adrenalectomy

In 1994, the authors performed the first minimally invasive adrenal surgeries. During 1994, thirteen open adrenalectomies were performed for pheochromocytomas, bilateral disease and adrenal tumors greater than 6 cm in diameter. With growing experience, pheochromocytomas and bilateral adrenal disease were also approached endoscopically. However, adrenal tumors exceeding 6 cm in diameter were not considered for endoscopic retroperitoneal surgery.

Twenty-two patients had open adrenalectomies from 1995 through 1999. Eight of these patients had adrenocortical cancers with diameters varying from 8 to 20 cm. Five adrenal tumors, which were all greater than 7 cm in size, were suspected to be malignant but appeared benign at microscopic examination of the specimen. Three patients had sporadic pheochromocytomas with diameters of 7, 10 and 15 cm. The remaining six patients had a Cushing's adenoma (7 and 9 cm in diameter), adrenal metastasis of a hepatocellular cancer, adrenal metastasis of renal cancer, Castleman's disease and a 5 cm pheochromocytoma with a spontaneous hemorrhage.

DISCUSSION

Adoption of endoscopic techniques has greatly changed our approach to adrenal pathology in less than 6 years time. Currently, at the University hospital Rotterdam, only 1 out of 5 adrenal tumors is still removed by open surgery. In our opinion, indication for open surgery remains an adrenal tumor, which is suspected to be malignant. Radical resection of the adrenal tumor is of paramount importance in the surgical treatment of adrenal cancer. Considering that most adrenal cancers are large tumors, the retroperitoneal space does not provide sufficient space for safe removal of an adrenal cancer. The role of transperitoneal laparoscopic removal of adrenal cancers remains controversial. Since Gajraj and Young have demonstrated clearly that the risk of malignancy is 1 in 10,000 for adrenal tumors smaller than 6 cm, we have adopted 6 cm as the upper limit of adrenal tumors amenable to a retroperitoneal endoscopic approach [20]. However, primary adrenal cancers as small as 3 cm have been described [32]. Therefore, one cannot rely solely on tumor size to differentiate between benign and malignant adrenal tumors. Adrenal tumors greater than 6 cm in size can, in our opinion, be

safely approached minimally invasively when imaging studies have shown homogeneous density of the tumor, smooth surface and lack of invasion of surrounding tissues. For those tumors greater than 6 cm in size and devoid of malignant features, we advocate a transperitoneal approach with the patient in lateral decubitus position following the technique described by Gagner et al, since the retroperitoneal space is too small to conduce safe dissection of large tumors [16].

Recurrence of adrenal cancer occurred in one patient after endoscopic removal of a 7 cm corticosteroid producing adrenal tumor. It remains under debate whether the endoscopic technique attributed to cancer recurrence. Since the adrenal tumor had neither macroscopically nor microscopically been breeched, and the tumor was placed in a plastic bag for extraction, direct implantation of tumor cells in the operative field appeared unlikely. Three other cases of recurrence of adrenal cancer after laparoscopic adrenalectomy have been reported to our knowledge [14,24,50]. Hamoir et al. reported a patient with a 12 cm androgen producing right adrenal tumor, which had been removed through a subcostal laparotomy after 4 hours of troublesome laparoscopic dissection. Diffuse peritoneal adrenal cancer was found at follow-up. Relaparotomy was undertaken to excise all tumor deposits and install intraperitoneal chemotherapy, which was followed by intravenous chemotherapy [24]. Foxius et al. observed peritoneal carcinomatosis 6 months after laparoscopic removal of a 2.7 cm aldosteron producing lesion of the right adrenal gland. In spite of splenectomy and omentectomy followed by mitotane chemotherapy, the patient died 20 months after surgery [14]. Suzuki et al. reported a similar case of abdominal dissemination 19 months after laparoscopic adrenalectomy for a cortisol producing adrenal tumor [50]. To our knowledge, port site metastases of adrenal cancer have not been reported.

The advantages of retroperitoneal endoscopic adrenalectomy entail the limited need to retract liver, spleen or pancreas to expose the adrenal gland, and avoidance of the peritoneal cavity. Laparoscopic transperitoneal adrenalectomy with the patient in lateral decubitus position requires mobilization of the right lobe of the liver on the right side, and detachment of the spleen from the lateral abdominal wall on the left side. Both liver and spleen are retracted during transperitoneal adrenalectomy. Although bleeding from tears in the liver can usually be solved by compression, splenic injury necessitated splenectomy in two patients among 60 laparoscopic transperitoneal donornephrectomies, and 11 laparoscopic transperitoneal adrenalectomies at our institution.

A clear advantage of the retroperitoneal approach is avoidance of the peritoneal cavity, which is valuable in patients who have undergone previous abdominal surgery. The presence of an enlarged liver, which renders retraction difficult, in patients with right-sided adrenal tumors is another indication for the retroperitoneal approach. Whether less late bowel obstructions and chronic abdominal pain due to intraperitoneal adhesions occur after retroperitoneal adrenalectomy compared to transperitoneal adrenalectomy requires studies with longer follow-up.

The first reports on successful retroperitoneal endoscopic adrenalectomy appeared in 1995 [37,54]. Both Mercan and Walz recommended to place the patient in prone position. The advantage of the prone position is that bilateral adrenalectomy can be performed without turning and repositioning the patient. However, conversion to open surgery, particularly in case of profuse bleeding, is more complex in prone position than in lateral decubitus. In our experience, turning and redraping the patient does not require more than 10 minutes. After initial experience with balloon dissection, Walz et al. have modified their technique, and create the retroperitoneal space by blind digital dissection [54,55]. Although this method is cheaper than balloon dissection, we adhere to using a balloon because it provides rapid creation of upon the retroperitoneal space without anatomical distortion.

The anatomy of the retroperitoneal space has been considered to provide fewer landmarks than the intraperitoneal space. However, the lateroconal fascia, quadratus lumborum muscle and the kidney provide sufficient guidance to discover the adrenal gland. Removal of the fat surrounding the upper renal pole is essential to expose the adrenal gland. In our experience, peroperative ultrasonography has never been necessary to aid in localizing the adrenal gland. A disadvantage of endoscopic retroperitoneal adrenalectomy is the limited maneuvering space. Proper patient positioning, sufficient mobilisation of the peritoneal sac and avoidance of bulky 10 mm instruments provides are necessary to provide good visualisation of the operative field. In our series, no single endoscopic procedure required conversion for insufficient exposure.

Subtotal adrenalectomy has been advocated by Walz to preserve adrenal cortical tissue [55]. This is particularly of importance in patients with bilateral disease since supplementation of adrenal hormones can be avoided, and Addison's crises are potentially lethal. Although the majority of endocrine surgeons favours complete adrenalectomy, other endocrine disorders such as parathyroid adenomas and solitary adenomas can be treated successfully by removal of the lesion only.

Several studies comparing various endoscopic approaches to adrenal pathology have been performed. Fernandez-Cruz et al. performed the only randomized study in patients with hypercortisolism undergoing either transperitoneal or retroperitoneal endoscopic adrenalectomy[10]. Transperitoneal adrenalectomy was associated with increased hypercarbia and more profound hypertension. In another comparative study by Fernandez-Cruz et al. operating time, blood loss, postoperative pain and hospital stay were similar after either transperitoneal or retroperitoneal endoscopic adrenalectomy [11]. Duh et al. studied 23 transperitoneal laparoscopic adrenalectomies with the patient in lateral decubitus position and 14 posterior endoscopic adrenalectomies with the patient in prone position [7]. Operating time was in both groups approximately 3.5 hours while hospital stay was similar for both approaches. Baba et al. assessed the efficacy of 33 transperitoneal laparoscopic adrenalectomies with the patient in supine position versus 5 retroperitoneal endoscopic adrenalectomies in lateral decubitus position and 13 retroperitoneal endoscopic adrenalectomies in prone position [1]. Only three trocars were required for the retroperitoneal prone approach while at least four trocars were used for the other approaches. Operating time and blood loss were less for the retroperitoneal approaches. In one of our earlier studies, transperitoneal laparoscopic adrenalectomy with the patient in supine position was compared to retroperitoneal endoscopic adrenalectomy in lateral decubitus position [2]. Operating time, blood loss and hospital stay were significantly less employing the retroperitoneal approach. Therefore, retroperitoneal endoscopic adrenalectomy appears preferable to transperitoneal laparoscopic adrenalectomy with the patient in supine position. The operating time and blood loss in the present series is in the same range as those reported by Gagner et al. in a study of 100 consecutive transperitoneal laparoscopic adrenalectomies with the patient in lateral decubitus position [19]. However, all comparative studies involved consecutive series except for the randomized study of Fernandez Cruz et al. [10]. Therefore, the technique which was employed later in the experience of the authors would benefit from experience with techniques used initially.

Fair conclusions about the preferred endoscopic approach to adrenal pathology can only be drawn based on a prospective trial randomizing patients to either transperitoneal laparoscopic adrenalectomy or retroperitoneal endoscopic adrenalectomy while both procedure are performed by experienced surgical teams

Endoscopic retroperitoneal adrenalectomy appears safe and effective in patients with benign adrenal lesions less than 6 cm in diameter but requires expertise in adrenal surgery and thorough knowledge of retroperitoneal anatomy.

2.3 RETROPERITONEAL ENDOSCOPIC RESECTION OF PHEOCHROMOCYTOMAS

INTRODUCTION

Although at present the feasibility of both transperitoneal and retroperitoneal endoscopic adrenalectomy is well demonstrated, debate remains whether the retroperitoneal approach is justified in patients with pheochromocytomas [11,22,39]. The discussion on the safety of endoscopic surgery for pheochromocytomas focuses understandably on the aspects of the procedure that could lead to excess catecholamine secretion, with potentially detrimental hemodynamic consequences.

Traditionally early ligation of the adrenal vein has been propagated in surgery for pheochromocytomas to block catecholamine secretion from the tumor into the circulation with subsequent hemodynamic instability [23,29]. However, in retroperitoneal endoscopic adrenalectomy ligation of the vein occurs in a late phase of the procedure, suggesting potentially more hemodynamic variances throughout the procedure [3,53] . Another concern is whether carbonic dioxide (CO_2) insufflation in the confined retroperitoneal space causes catecholamine release with subsequent hypertension and cardiac arrhythmia [12,31,33]. Finally, surgical exploration of the aortic axis for extra-adrenal tumors and exploration of the controlateral adrenal gland are difficult or impossible in retroperitoneal surgery, which theoretically could leave secondary tumors or metastases undetected [38]. We retrospectively studied the results of all patients who underwent endoscopic retroperitoneal adrenalectomy for pheochromocytoma to evaluate feasibility and safety with regard to the hemodynamic response to surgery.

METHODS

The medical records of all patients who underwent adrenalectomy for a pheochromocytoma between June 1995 and August 1999 in the University Hospital Rotterdam were reviewed for clinical features, localization studies,

operative findings and outcome. Since the last patient in this series was included in August 1999 the number of patients is smaller than the number of patients with pheochromocytomas described in chapter 2.2. Preoperative hormonal investigation, including determination of plasma catecholamines (adrenaline, noradrenaline and dopamine) and urinary metanephrines or VMA excretion, was achieved in all patients. Because preoperative evaluation of some patients partly took place in referring hospitals, no standard imaging protocol was used. Ultrasonography (US), computerized tomography (CT) and ^{123}I-meta-iodobenzylguanidine (MIBG) scintigraphy, ^{111}In-octreotide (SMS) scintigraphy and magnetic resonance imaging (MRI) were alternately used to obtain information about tumor localization and appearance.

All patients received α-receptor blockade starting at least 10 days prior to surgery. Phenoxybenzamine was most commonly administered with increasing doses until patients reported symptoms of orthostatis. If tachycardia (heart rate more than 100 beats per minute for at least two minutes) occurred, patients received propanolol additionally. All patients were operated under general anaesthesia, with continuous monitoring of circulatory status through an arterial line and a pulmonary artery thermodilution catheter. Hemodynamic instability was defined as systolic blood pressure exceeding 180 mmHg for at least two minutes and heart rate exceeding 130 beats /minute for at least two minutes. Hypertensive episodes during the operation, were controlled with drip infusion of nitroglycerine or nitroprusside. Tachycardia during anesthesia was treated with intravenous short-acting β-adrenergic blockade (esmolol). To avoid circulatory collapse after removal of the pheochromocytoma, dosed infusion of catecholamines along with infusion of colloids and crystalloids was administered. Blood pressure changes during tumor manipulation as compared to preinduction values were recorded.

RESULTS

Age and sex

Between June 1995 and September 1999 a total of 17 patients underwent resection of a pheochromocytoma. Two patients underwent transabdominal resection of a pheochromocytoma larger than 7 cm in diameter and were excluded from this study. 15 Patients had retroperitoneal endoscopic surgery for 17 pheochromocytomas and 1 extra-adrenal tumor. The endoscopic group consisted of 11 women and 4 men with a mean age of 47.2 years (range 17-75), an average

body mass index (B.M.I.) of 22.1 (range 15.6-32.8). One of these patients was a woman at 13 weeks gestation.

Symptoms

The most prominent symptoms at presentation were hypertension, tachycardia, anorexia, nausea, weight loss, fatigue, severe headaches, flushing, sweating, tremor and dizziness. Two patients were asymptomatic at the time of presentation and their pheochromocytomas were discovered in connection with an associated condition. Bilateral adrenalectomy for pheochromocytoma was performed in one patient with Multiple Endocrine Neoplasia (MEN) II A syndrome, another patient with MEN II B syndrome and in one patient with von Recklinghausen's disease. Subtotal adrenalectomy was not possible in these three patients since grossly normal adrenal tissue was not present. One 19 year old female patient with MEN II B syndrome and another 17 year old patient with von Hippel Lindau's disease had unilateral adrenalectomy since MIBG scintigraphy did not show accumulation of the radiopharmacon in the contralateral adrenal gland. Furthermore, computed tomography showed in both patients a normal size of the contralateral adrenal gland, which was left in place. After 15 and 6 months follow-up, there was no sign of recurrence of disease in either of these patients. One extra-adrenal tumor (paraganglioma) was located between the caval vein and the aorta. Two patients had extra-adrenal. In this patient, the normal adrenal gland was removed in continuity with the paraganglioma.

Diagnostics

For preoperative detection of a pheochromocytoma US was used in 6 (40%), CT in 13 (87%), MIBG scanning in 15 (100%), SMS scanning in 5 (33%), and MRI in 3 (20%) patients respectively. Detection rates for the various imaging studies were: US 50%, CT 85%, ^{123}I -MIBG scan 80%, SMS scan 100% and MRI 100%.

Operative data and complications: The mean overall operative "skin to skin" time was 125 minutes (range 80-180): 140 minutes (range 90-180) for left adrenalectomy, 115 minutes (range 80-155) for right adrenalectomy. Mean estimated blood loss was 292 ml (range <50-800; median 100 ml). There was no mortality. Three complications (20%) occurred postoperatively. One patient developed a retroperitoneal haematoma, in the adrenal bed, requiring ultrasonographic drainage. Another patient was treated conservatively for a retroperitoneal hematoma after right adrenalectomy, but received transfusion of

two units of blood. The third patient complained of postoperative tachycardia and dizziness without apparent cause that prolonged the hospital stay to 28 days. Three peritoneal lacerations occurred during retroperitoneoscopy requiring introduction of an additional instrument to retract the peritoneal sac.
There was one conversion to open surgery (5.6 %). One thoracolumbotomy was performed in the patient with a paraganglioma located between the caval vein and the aorta that could not sufficiently be exposed endoscopically. The pregnant patient was a 30-year-old woman, who underwent surgery before her pregnancy for a medullary carcinoma of the thyroid gland. She got pregnant during further evaluation of a MEN II-A syndrome. She was without symptoms or hypertension. She was operated after 13 weeks gestation and had an uncomplicated pregnancy after endoscopic bilateral adrenal surgery.

Hemodynamics
Four patients demonstrated short hypertensive periods during the operation despite adrenergic receptor blockade (26 %). In these patients intervals with systolic blood pressure peaks between 180 and up to 210 mm Hg were observed during manipulation of the adrenal gland. However, all patients responded instantly on infusion of nitroglycerine and hypertensive episodes never exceeded 5 minutes. In all other patients the intraoperative systolic blood pressure ranged between 90 mm Hg and 170 mm Hg with a median of 140 mm Hg, while the intraoperative diastolic blood pressure ranged between 50 mm Hg and 115 mm Hg with a median of 70 mmHg. The overall median heart rate was 70 bpm (range 45 - 150) . Intraoperative tachycardia with heart rates between 100 and 150 bpm was observed in 5 patients (33%). These episodes were successfully controlled with infusion of esmolol or resolved spontaneously.

Pathology and follow-up
The mean diameter of the resected tumors was 3.7 cm (range 1.0 -7.0 cm): 2.6 cm (range 1.0 –7.0 cm) at the left side and 3.0 cm (range 2.5-4.0 cm) at the right side. Histological examination revealed capsular ingrowth, angioinvasive growth, necrosis and cysts in one of the pheochromocytomas of the patient with MEN II-B syndrome. This patient was later on diagnosed with liver metastases. In two other tumors capsular ingrowth and cysts were seen, but no other malignant characteristics were present.

Except for the patient with liver metastases, no recurrences were seen after a median follow-up of 24 months (range 1-51). All but one patient regained normotension with no antihypertensive medication, postoperatively. Median postoperative stay after endoscopic adrenalectomy was 5 days (range 3-28).

DISCUSSION

As was stated in chapter 2.2 adrenal tumors deserve endoscopic removal, since they are commonly small in size but require large incisions in conventional open surgery. Several reports have indicated that endoscopic treatment of adrenal disease leads to diminished postoperative discomfort en faster recovery compared to open surgery [5,16,19,34,37,51,53].

Although the feasibility and safety of retroperitoneal endoscopic treatment of benign 'non-secreting' adrenal tumors is well established, particular reluctance exist about the retroperitoneal approach to pheochromocytomas. Debate remains if the catecholamine secreting capacities of these tumors and subsequent danger of hemodynamic instability are unfavourably influenced by retroperitoneoscopic surgery. The current belief is that the adrenal vein should always be identified and controlled before further manipulation of the gland is undertaken, whereas in retroperitoneal adrenalectomy the vein is clipped and divided only in the final stage of the procedure [15,22,40].

Supposedly, the limited working space, lack of overview and possible unfavourable effects of CO_2 insufflation in the confined retroperitoneal space could lead to more extensive manipulation of the tumor and undesired release of catecholamines, leading to dangerous changes in blood pressure and heart rate. In the past, fatalities occurred after retroperitoneal insufflation of CO_2, when pneumography was the standard method for imaging pheochromocytomas while patients were not receiving α- and β-adrenergic blockade. However, this is nowadays an essential measure before procedures, that entail adrenal manipulation, are undertaken [48].

Several authors reported marked variability in hormonal and hemodynamic changes especially during the creation of pneumoperitoneum and during manipulation of the pathologic adrenal gland with hypertensive crises despite α-adrenergic blockade in 50 to 67% of the patients [15,33,38,40,46]. Fernandez-Cruz et al. already demonstrated that the plasma level of catecholamines was mostly influenced by manipulation of the tumor regardless of operative technique.

However, increase in catecholamine levels and hemodynamic instability was significantly higher during conventional adrenalectomy than during endoscopic surgery [13]. This observation illustrates the rationale of the minimal invasive approach, both transperitoneal and retroperitoneal, to a pheochromocytoma. Non-manipulative dissection and optimal magnification enable optimal resection of the adrenal gland with minimal tissue trauma. With regard to hemodynamic stability, surgical technique probably plays a far more important role than the timing of adrenal vein ligation. Retrospective analysis of the blood pressure data of a historic group of patients who underwent conventional adrenalectomy at our institution revealed episodes of hemodynamic instability after presumed ligation of the adrenal vein in a number of patients. Apparently, 'leakage' of catecholamines can occur. Indeed during dissection of a pheochromocytoma, sometimes other (smaller) venous side branches are encountered, possibly due to neovascularization that can occur in pheochromocytomas. The protecting effect of adequate preoperative adrenergic blockade seems to further reduce the need for early ligation of the adrenal vein.

In the presented series we observed hypertensive episodes only in four patients (26%) and tachycardia in five (33%), during manipulation of the adrenal gland but practically none during insufflation. Hemodynamic changes were successfully controlled in all patients within minutes and no adverse effects or morbidity was seen in these patients. These findings are in accordance with other studies, where hemodynamic changes during transabdominal laparoscopy were, relatively simple, controlled with additional α- and β-adrenergic blockade [15,38,39,40]. Other authors reported similar results in retroperitoneoscopic surgical treatment of patients with a pheochromocytoma [48,53]. The absorption of CO_2 in the circulation can lead to acidosis, which in its turn can stimulate the sympathic nervous system causing hypertension and tachycardia [12,13,31]. Other studies have demonstrated a tendency to acidosis during prolonged endoscopic procedures but show a comparable absorption rate of CO_2 during transperitoneal and retroperitoneal adrenalectomies [2,11,33]. Fernandez-Cruz et al. performed the only randomized study in patients with hypercortisolism undergoing either transperitoneal or retroperitoneal endoscopic adrenalectomy [10]. Transperitoneal adrenalectomy was associated with increased hypercarbia and more profound hypertension. In this study, CO_2 was used to maintain a retroperitoneal working space. Apart from standard anesthesiologic monitoring, no attempt was made to detect hypercapnia or respiratory acidosis. Also no plasma samples for catecholamine level were taken during the creation

and insufflation of the retroperitoneal space. However, unlike other reports, no distinct hypertensive response was observed during generation of pneumo-retroperitoneum in any of these patients [48].

Until recently it was considered mandatory that adrenalectomy was performed after visualization of both adrenal glands and inspection of possible extra-adrenal locations of pheochromocytomas [13,23]. This extensive inspection of the abdominal cavity requires either laparotomy or transabdominal laparoscopy with inspection of extra adrenal locations. However, modern preoperative imaging techniques are very successful in the detection of adrenal- and extra-adrenal abnormalities and the presence of synchronous tumors. Overall reported sensitivity rates for the various imaging techniques in the literature are 89% for CT, 98% for MRI and 81% for MIBG scanning, respectively [30,35,52]. MIBG scintigraphy combined with either CT- or MRI-imaging of the abdomen localizes multiple pheochromocytomas very precisely [41,47]. Already in 1993, at the brink of endoscopic adrenalectomy, the open extraperitoneal flank approach to pheochromocytomas was advocated [42]. Therefore, routine inspection of the abdomen appears to be of limited value [43].

Bilateral adrenalectomy, as in the transperitoneal approach in lateral decubitus position, requires repositioning of the patient on the other side halfway the procedure, but forms otherwise no impediment for retroperitoneoscopy. The prone position has the advantage of performing bilateral adrenalectomy without re-positioning the patient, but there is no experience with this at our institution.

The retroperitoneal approach has proven to be also feasible in pregnancy. A pheochromocytoma produces similar symptoms and signs in both pregnant and non-pregnant patients, but the diagnosis may be overlooked in pregnancy because of the rarity of the association and because the clinical feature often mimics that of pre-eclampsia. Harper et al reported on five cases of pheochromocytoma in pregnancy. It has been advised to achieve adrenergic blockade before surgery like in non-pregnant patients and to perform definitive removal of the pheochromocytoma preferably before 28 weeks gestation to ensure good fetal outcome [25]. To our knowledge the pregnant patient in this study represents the first reported case of bilateral endoscopic adrenalectomy for pheochromocytoma during pregnancy.

The most important drawback of the retroperitoneoscopic approach is the relatively limited working space that could prove to be a problem in case of larger adrenal tumors although retroperitoneoscopic removal of tumors up to 8 cm in diameter has been reported [37]. One of the tumors in the presented series had a

diameter of 7.0 cm and was successfully removed retroperitoneoscopically. Preoperative differentiation between benign and malignant pheochromocytomas is, most of the time, not possible. Limiting endoscopic adrenalectomy to pheochromocytomas less than 6 cm in diameter appears appropriate since radical endoscopic resection of such relatively small tumors is feasible [3]. We failed to diagnose liver metastases in a patient with bilateral pheochromocytoma and MEN II-B syndrome, although it is uncertain if these metastases would have been detected with transperitoneal endoscopy. Also, Von Hippel-Lindau's disease is commonly considered a relative contraindication for laparoscopic adrenalectomy being bilateral and ectopic localizations very common (between 50 and 80 %) [6]. All of these conditions challenge the efficacy of endoscopic surgery. However, we consider the benefits of a successful endoscopic removal of a pheochromocytoma of such great importance that we strongly support an endoscopic attempt in all situations and advise to consider the transperitoneal route in cases were inspection of the abdominal cavity is desired: in paragangliomas, when malignancy is suspected during preoperative workup and in tumors larger than 6-7 cm in diameter.

Other exclusion criteria for the retroperitoneoscopic approach to the adrenals could exist in a patient who underwent previous surgery or suffered a trauma in the area of the adrenal gland.

In conclusion, the advantages of the retroperitoneal approach to the adrenals in terms of limited blood loss, fast recovery and good comesis also seem to hold for the treatment of pheochromocytomas. In retroperitoneoscopic surgery for pheochromocytomas hemodynamic safety is not compromised in patients with sufficient preoperative α- and β-adrenergic blockade despite late ligation of the adrenal vein.

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Chapter 3

The Pancreas

Adapted from the original articles:

Laparoscopic detection and resection of insulinomas.
Berends FJ, Cuesta MA, Kazemier G, van Eijck CH, de Herder WW, van Muiswinkel JM, Bruining HA, Bonjer HJ
Surgery 2000 Sep;128(3):386-91.

Laparoscopic assisted cysto-gastrostomy for pancreatic pseudocysts.
Berends FJ, Yuan JZ, Craanen ME, Prevoo W, Cuesta MA
Submitted for publication

3.1 GENERAL INTRODUCTION

The advantages of minimally invasive techniques for diagnosis and treatment of intra-abdominal lesions has widened the scope of of laparoscopic surgery. Growing laparoscopic experience has allowed technically more complex procedures, such as pancreatic surgery. Laparoscopic staging of suspected malignant tumors of the pancreas with the use of diagnostic laparoscopic ultrasonography was routinely performed at many hospitals until. Laparoscopic pancreatectomy is done only by a few surgeons. The underlying cause is that pancreatic surgery is considered challenging even in open surgery and is associated with significant morbidity. Pancreatitis, pancreatic fistula and abscess formation are greatly feared complications following pancreatic surgery. Some conditions such as pancreatic cancer require an extreme resection to obtain resection margins which are free of malignancy. The complexity of such procedures and adequate evaluation of tumorous ingrowth in the surrounding tissue practically always requires a sufficient exposure through a laparotomy. However, some predominantly benign conditions such as insulinomas and pancreatic pseudocysts do not require a resection of part of the pancreas and, therefore, appear good cases for laparoscopy.

3.2 LAPAROSCOPIC DETECTION AND RESECTION OF INSULINOMAS

INTRODUCTION

The laparoscopic detection and surgery of islet cell tumors has been attempted since 1995. Although conventional intraoperative ultrasonography as a diagnostic tool for localization of islet cell tumors has been frequently reported in the literature [12,23,33,56,58], reports on laparoscopic ultrasonography and resection of insulinomas are scarce [11,22,42,50,52]. In this retrospective study laparoscopic experience with this relatively uncommon tumor is reported.

METHODS

Between February 1996 and February 1999, all consecutive patients with solitary insulinomas who were operated at the University Hospital Rotterdam and 'Vrije Universiteit' Medical Center in Amsterdam for organic hyperinsulinism were included in this study. Patient and operative characteristics were analyzed including age, gender, localization of tumor, preoperative diagnostic methods, operative procedure, operating time, blood loss, histopathological outcome, morbidity, hospital stay, and follow-up for recurrence of disease.

Hyperinsulinism was diagnosed based on clinical picture, determination of serum levels of glucose and insulin during prolonged fasting up to 72 hours, and determination of serum C-peptide. Factitious causes of hyperinsulinism were ruled out in all patients. Since several patients, who had been referred to our hospitals, were initially analyzed at other institutions, there was no standard preoperative imaging work-up. Preoperative imaging studies are shown in table 5.

	Tumor location	Diameter	Transabd US	CT	MRI	^{111}In-pente-treotide scanning	Lap US
1.	Tail	1.5 cm	-	No	-	No	Yes
2.	Tail	2.0 cm	No	No	-	Yes	Yes
3.	Tail	2.0 cm	No	Yes	-	No	Yes
4.	Body	1.4 cm	Yes	No	No	No	Yes
5.	Body	1.2 cm	-	No	Yes	-	Yes
6.	Body	1.5 cm	Yes	Yes	Yes	-	Yes
7.	Body	1.4 cm	Yes	Yes	-	-	Yes
8.	Head	1.2 cm	No	No	No	-	Yes
9.	Head	3.0 cm	No	-	-	No	Yes
10.	Head, uncinate proc.	1.3 cm	No	No	-	-	No
	Detection rate		38%	33%	50%	20%	90%

Table 5. *Success rate in Insulinoma detection, preoperative imaging techniques and laparoscopic ultrasonography. "Yes" or "No" indicate whether or not the diagnostic tool could correctly indicate tumor localization. "-" Means that this technique was not used to attempt to localize the tumor.*

Laparoscopic operative technique for insulinomas of the pancreas.

To inhibit pancreatic exocrine secretion, patients received three daily doses of 0.1 mg octreotide subcutaneous, starting the day before surgery until three days after operation [17,39]. The patient was placed in supine position on the operation table with the legs in stirrups to allow the operating surgeon to stand between the legs. A 30^{o} laparoscope was introduced at the umbilicus using an open technique. Three additional 12 mm trocars were placed in a diamond configuration, with the cranial trocar close to the xiphoid process to retract the stomach (figure 8).

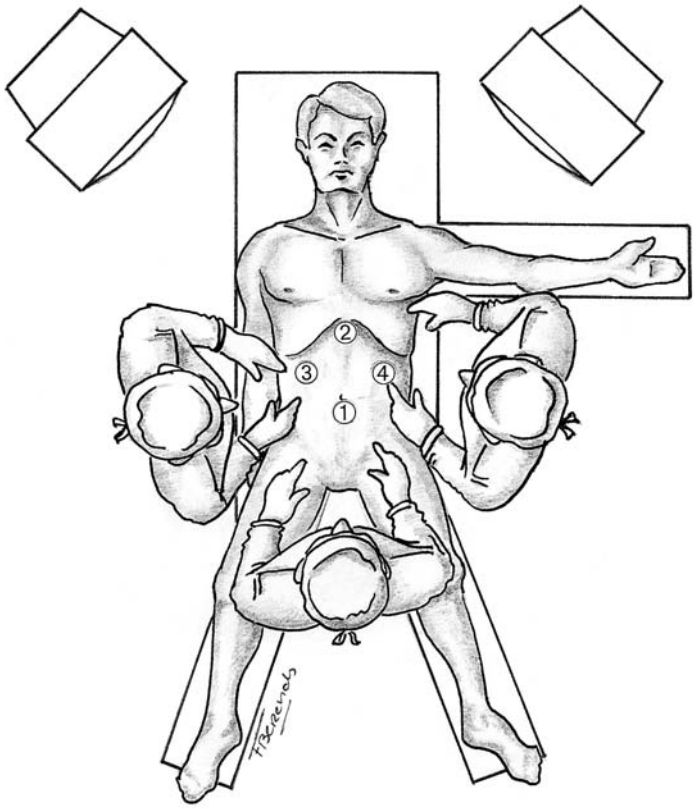

Figure 8. *Patient position and trocar placement for laparoscopic resection of an insulinoma.*

A window was created in the gastrocolic ligament by lifting the greater curvature of the stomach and using either electrocautery endoscissors or an ultrasonic device (Ultracision®, Ethicon, Sommersville, NJ, USA) to dissect the ligament. The head of the pancreas could be freed by careful dissection of the pancreatic head from the mesocolic and dorsal gastric attachments. The posterior aspect of the head could be evaluated after a laparoscopic Kocher maneuver, as earlier described by

Gagner et al. [22]. The body and tail were freed from the dorsal attachments of the stomach up to the splenic hilum allowing visualization of the body and tail of the pancreas. After freeing the whole pancreas a systematic ultrasonographic inspection of the head, body and tail was performed, using a laparoscopic 7.5 MHz probe 10 mm in diameter with a flexible tip (B&K, Gentofte, Denmark). Recognition of a typical hypoechoic lesion and its anatomic relation to important adjacent structures such as the pancreatic duct or the splenic and mesenteric vessels was best achieved in close co-operation with an experienced radiologist (figure 9).

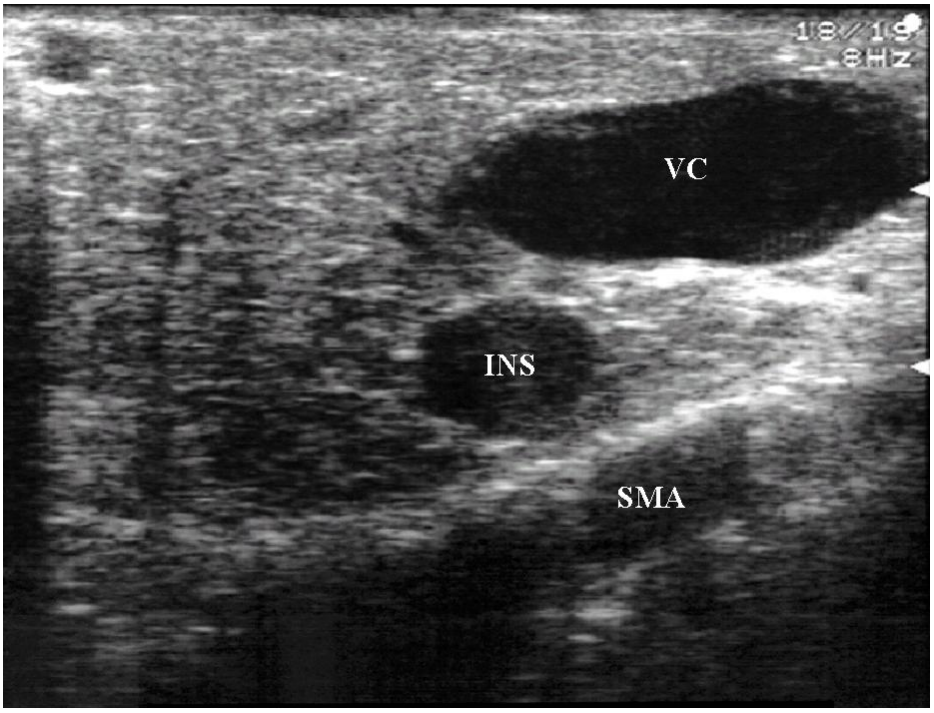

Figure 9. *Laparoscopic ultrasonography of the typical hypoechoic aspect of an insulinoma (INS) in the pancreatic head. Anatomic relation to important adjacent structures such as the superior mesenteric artery (SMA) and venous confluence (VC) is shown.*

Only after ultrasonographic confirmation of the location of the tumor the operating team decided whether or not laparoscopic removal would be attempted. Laparoscopic enucleation was performed using either electrocautery scissors or an ultrasonic device dissecting the tumor from the surrounding normal pancreatic tissue. In one patient, a tumor located in the pancreatic tail was extirpated by a pancreatic tail resection while preserving the spleen (figure 10). A 30-mm endoscopic linear stapler (EndoGIA®, US Surgical, Norwalk, CT, USA) was used

for transection of the tail. All specimens were extracted in an endoscopic plastic bag (Endocatch®, US Surgical, Norwalk, CT, USA) to avoid tumor spill or seeding. A silicone drain was left in the bed of the insulinoma. In some cases, fibrin glue was sprayed on the pancreatic lesion.

Results

Age and sex

Eight women and two men were operated upon for organic hyperinsulinism based on clinical findings and pre operative biochemical results. Mean patient age was 42 years (range 16 – 72).

Localization

Table 5 shows the success rates for detection of an insulinoma for the various imaging techniques. Overall success rate for preoperative localization of an insulinoma was 60% (6/11). Hepatic metastases were ruled out in all patients. Laparoscopic ultrasonography identified the tumor in nine out of 10 cases (90%).

Operative findings

In six cases, laparoscopic enucleation or laparoscopic tail resection (1) could be performed. In four patients, conversion to laparotomy was necessary. In 3 patients laparoscopic ultrasonography demonstrated an insulinoma at a site that was difficult or hazardous to be approached laparoscopically. Two of these tumors were located at the posterior aspect of the head of the pancreas, adjacent to the portal vein. The third case involved an insulinoma in the tail of the pancreas but in close proximity to the pancreatic duct. In these three patients, the insulinoma was enucleated through laparotomy. In a fourth patient laparoscopic ultrasonography suggested a possible tumor in the tail of the pancreas. Because of uncertainty about the ultrasonographic image, conversion to laparotomy was performed to confirm tumor location by palpation of the pancreas. By palpation and open, direct ultrasonography the tail of the pancreas proved to be normal, but an insulinoma was detected in the uncinate process and enucleated. Median operating time was 180 min (range 150 -210) including time needed for laparoscopic ultrasonography. Blood loss was less than 100 cc in all cases of laparoscopic removal and ranged from 250 to 650 cc in patients who had laparotomy.

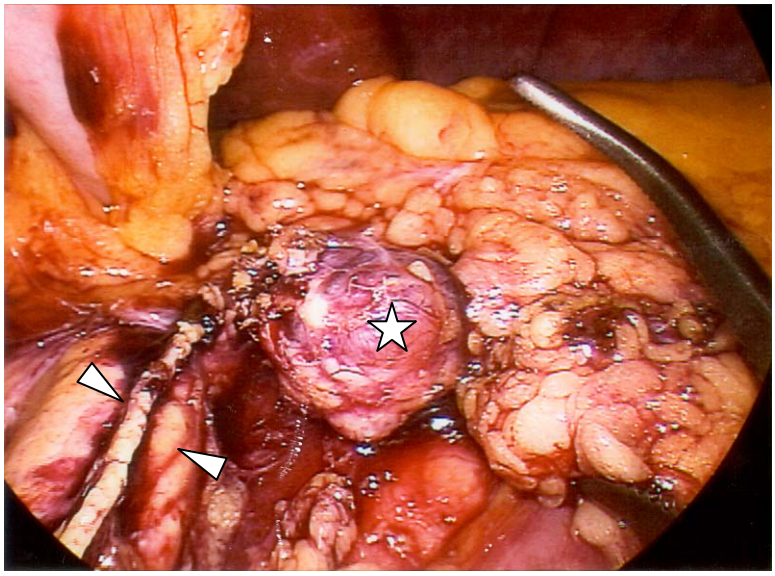

Figure 10. *Insulinoma located in the pancreatic tail. Arrows indicate staple lines. ✶ indicates the insulinoma.*

Complications

Five complications were observed, two after laparoscopy and three after open surgery. A pancreatic fistula complicated two laparoscopic enucleations. In one case, the patient could leave the hospital after 9 days with the drain in situ which was removed after three weeks. In the other case a pancreatic fistula was treated successfully with ultrasonographic drainage and ERCP with placement of a stent in the pancreatic duct. After open surgery, one patient developed a small fluid collection near the common bile duct associated with low-grade fever and pain after open enucleation of a tumor from the head of the pancreas. Both fever and pain resolved spontaneously within three days. The second complication after open surgery was a paralytic ileus in a patient, which resolved with conservative therapy. Finally, one patient developed a paralytic ileus that did not resolve with conservative treatment. A reoperation was performed after ten days but no abnormalities were found. After this reoperation the patient required prolonged intubation because of pneumonia. Median hospital stay was 7 days (range 3-21).

Pathology and follow-up

Mean tumor diameter was 1.7 cm (range 1.2 - 3.0). All insulinomas were benign and resections were considered complete. In one case microscopy of the specimen showed lymphoid tissue surrounding a small insulinoma. This tumor was

enucleated from the upper margin of the corpus of the pancreas. The presence of lymphoid tissue suggested a metastasis of a (malignant) insulinoma in a lymph node. However, no other localization of an insulinoma could be detected. A fasting test performed six months postoperatively was normal and this patient is free of symptoms 12 months after surgery.

At a median follow up of 18 months after surgery (range 3-36) all patients were normoglycemic.

DISCUSSION

More than 90 % of insulinomas are benign, intrapancreatic and solitary [14,28,47]. These characteristics render insulinomas suitable for a minimally invasive surgery. However, until recently only a few authors have reported case reports on laparoscopic resection of pancreatic tumors [11,50,52]. Gagner described the feasibility of laparoscopic resection of islet cell tumors in a retrospective series of twelve patients [22].

Tumors located in the corpus or tail of the pancreas can be resected safely and with relative ease when they are not localized near the pancreatic duct or the portal venous confluence. Tumors in the head or uncinate process are more difficult to approach laparoscopically. We failed to detect one insulinoma in the uncinate process with laparoscopic ultrasonography and had to convert to open enucleation. Two insulinomas in the head of the pancreas were correctly identified with laparoscopic ultrasonography but could not be resected laparoscopically because of their dorsal position and proximity to the portal vein.

The necessity of performing preoperative imaging techniques in patients with organic hyperinsulinism, remains under debate. There are conflicting claims as to the relative accuracy of the various localization techniques and many of these investigations are difficult to justify because of their high cost, degree of invasiveness or lack of precise anatomic information that is obtained [24]. Detection rates of transabdominal ultrasonography (US) and computerized tomography (CT) were lower than 50-60% [7,34,56]. Other imaging studies proved recently more successful. Magnetic resonance imaging (MRI) identified 45-95% of insulinomas [9,37]. Endoscopic ultrasonography appears even more sensitive, with preoperative detection rates varying from 86-93% [44,60]. The accuracy of ^{111}In-pentetreotide scintigraphy is between 20-70% [9,29,32,55]. Invasive techniques such as percutaneous transhepatic venous sampling for insulin (PTVS) was successful in 70-95% [7,24,36]. Arterial stimulation and venous sampling for insulin (ASVS) could

identify insulinomas 75-80% [24]. However, several authors state that the success rate of detection of intraoperative ultrasonography, particularly when combined with palpation of the pancreas region, cannot be surpassed by any preoperative localization technique (90 - 100%) [33,34,35,40,57]. Preoperative imaging appears to be of limited benefit when an operative procedure is combined with intraoperative ultrasonography. The presence of hepatic metastases can generally be excluded using US, CT or MRI. When an insulinoma cannot be discovered intra-operatively, venous sampling and rapid insulin assay can indicate the part of the pancreas most likely harboring the insulinoma. In this study, only 9 of 26 preoperative imaging studies could identify an insulinoma (35%). Preoperative imaging, therefor, seems an unnecessary burden to the patient and is not cost effective.

However, in the evaluation of detection rates, one must consider the relatively small groups. Nine patients underwent CT scanning preoperatively. An additional detection of an insulinoma in one patient therefore would have altered the detection rate by 11%, illustrating the relativity of presented percentages in small series. Moreover, since preoperative workup was sometimes carried out in a referring hospital, diagnostic results are possibly not fully comparable. We think this may add to the relatively low detection rated obtained by CT in this series.

Concern could exist about the lack of tactile senses during laparoscopic surgery for insulinoma, which eliminates palpating the pancreas. Therefor, detection of an insulinoma during laparoscopic surgery is solely dependent on ultrasonography. The detection rate of 90% in our series is encouraging and suggests that palpation of the pancreas can omitted. Insulinomas are often small tumors at time of detection: sixty-six percent of insulinomas are less than 1.5 cm in size and forty percent are less than 1.0 cm. In our series tumor size ranged from 1.2 - 3.0 cm. Although greater tumor are expected to be imaged with more ease, operative imaging techniques failed to localize a tumor with a diameter of 3.0 cm in our study, whereas tumors of 1.2 and 1.4 cm were successfully detected.

Although in none of the patients malignancy was found, in one patient microscopic examination of a tumor resected from the upper margin of the pancreas showed an insulinoma surrounded by lymphoid tissue. Several reports exist on lymph nodes containing neuroendocrine tissue in absence of a primary tumor. Theories regarding the pathogenesis of these cases include lymphatic metastases from an occult or regressed primary tumor and embryonic admixture of nearby lymphoid and epithelial elements during morphogenesis [15,31,41].

Finally, we like to emphasize that a median postoperative stay of 7 days may seem long in the US, but is considered relatively short in Europe where national healthcare does not equally pressure patients and doctors towards shorter hospital admissions.

Minimal invasive treatment can be beneficial to the patient, and laparoscopic failure does not impede open localization or treatment. Laparoscopic failure can be caused by inexperience, technical problems, occult tumors or absence of tumor as in nesidioblastosis and islet cell hyperplasia. These circumstances require conversion to laparotomy in order to perform contact ultrasonography, exploration and palpation and sometimes venous sampling to identify the affected part of the pancreas.

Laparoscopic ultrasonography followed by laparoscopic removal of the insulinoma in patients with clinically manifest hyperinsulinism is a feasible and safe technique with low morbidity and fast postoperative recovery. Preoperative localization studies seem to be of limited value.

3.3 LAPAROSCOPIC ASSISTED CYSTO-GASTROSTOMY FOR PANCREATIC PSEUDOCYSTS.

INTRODUCTION

A pseudocyst of the pancreas occurs frequently after acute or chronic pancreatitis and can be responsible for debilitating abdominal pain. Among more conservative techniques such as percutaneous and endoscopic drainage, surgical cysto-gastrostomy has proven to be successful in 80-90% with low recurrence rates [4,27,43,53]. However, classic surgical drainage requires a large laparotomy to approach the pancreas. Recent developments in laparoscopic solid organ surgery have demonstrated several advantages of a minimal invasive approach compared to conventional surgery, with respect to postoperative pain, convalescence, hospital stay and cosmesis [16,18,38]. Although laparoscopic pancreatic surgery is performed for various indications, it is considered difficult and is done by specialized laparoscopic surgeons only. As a consequence, large series on laparoscopic cysto-gastrostomy are absent. Objective of this retrospective study was to evaluate feasibility and outcome of laparoscopic assisted marsupialization of a pseudocyst of the pancreas in 6 patients.

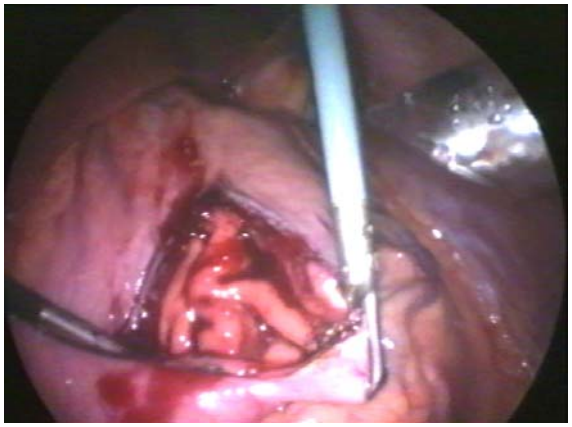

Figure 11. *Gastrotomy*

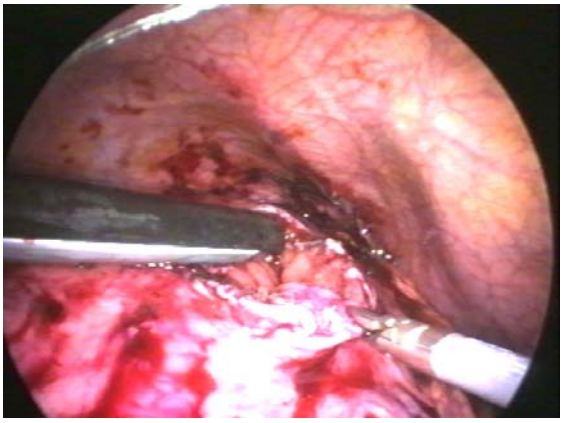

Figure 12. *Ultrasonographic localization of the pseudocyst.*

Figure 13. *Transgastric puncturing of the pseudocyst.*

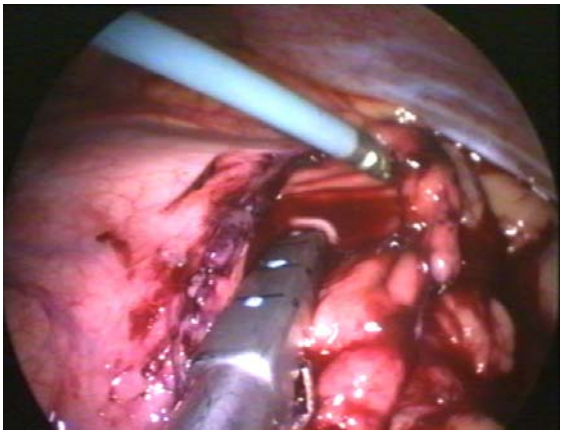

Figure 14. *Opening of the dorsal gastric wall (endostapler).*

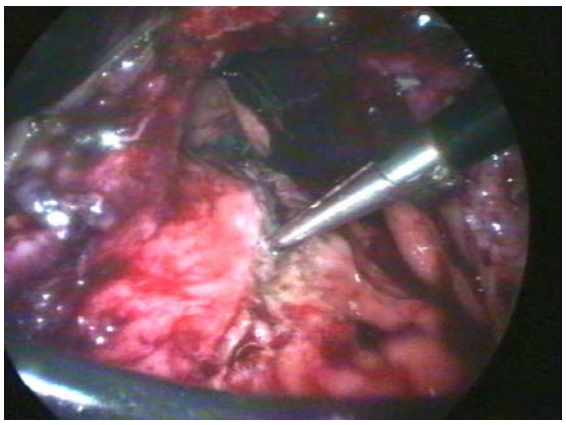

Figure 15. *Opening of the dorsal gastric wall (electrocautery).*

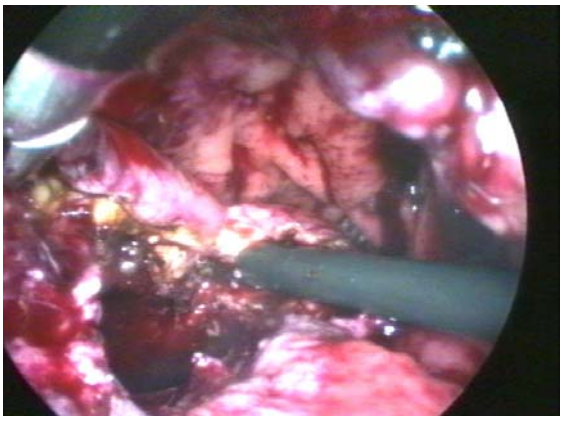

Figure16. *The window in the dorsal gastric wall to the pseudocyst.*

METHODS

Between December 1994 and December 2000, seven patients (3 women, 4 men) had surgery for a suspected pseudocyst of the pancreas at the surgical department of a large teaching hospital. In one patient with a symptomatic cyst, initially attributed to a previous abdominal trauma, laparoscopic inspection suggested adherence of the wall of the cyst to the transverse mesocolon and the upper pole of the left kidney. Because malignancy could not be ruled out, a laparotomy and radical resection of the cyst, and of the pancreatic tail along with the spleen, left kidney and a segment of the transverse colon were performed. Histopathology revealed a cystadenoma. This patient was excluded from this series. All other patients appeared to have a pancreatic pseudocyst, at least 6 cm in diameter, with duration of symptoms exceeding six weeks. Upper abdominal pain was the prominent symptom in all patients. Two patients complained of upper digestive passage problems related to meals. All patients had a history of pancreatitis. Etiology of pancreatitis was alcohol abuse in five patients and hypertriglyceridemia in one patient. Two of these patients had developed a pseudocyst after an episode of acute pancreatitis.

Standard preoperative screening included ultrasonography to exclude cholecystolithiasis and computerized tomography of the abdomen for proper diagnosis and localization of the pseudocyst. Magnetic resonance cholangio pancreaticography was performed in 2 patients. Transduodenal endoscopic ultrasonography was performed in one patient only. In two patients previous percutaneous drainage of the pseudocyst was performed but was unsuccessful. None of the patients underwent a previous laparotomy.

Surgical technique

All patients underwent bowel lavage on the day before surgery. Patients were operated under general endotracheal anesthesia. Standard antibiotic prophylaxis was administered preoperatively. The patients were positioned supine with the legs in stirrups, allowing the operating surgeon to stand between the legs. CO_2-pneumoperitoneum was achieved using a Verres needle. Five 10mm trocars were placed in a diamond shape configuration. A small opening in the gastrocolic ligament was created, using electrocautery or a harmonic scalpel (Ultracision®, Ethicon, Summerville, NJ, USA), and fixation of the cyst to the posterior gastric wall was confirmed. A radiologist performed laparoscopic ultrasonography (LUS) in all patients, in order to localize the cyst and confirm its adherence to the

stomach. The drainage procedure consisted of a cysto-gastrostomy or a cysto-jejunostomy through a Roux-Y construction, depending on localization of the cyst and fixation of the cyst to the stomach.

Laparoscopic cysto-gastrostomy is the laparoscopic version of the classical open procedure. The anterior wall of the stomach was opened longitudinally, using electrocautery, ultrasonic scissors or an endoscopic stapler (EndoGIA 30 ®, US Surgical, Norwalk, CT, USA), which more expensive but helps to prevent tedious bleeding from the gastric wall (figure 11). LUS was used to reconfirm the position of the cyst nearest to the posterior wall of the stomach (figure 12). A puncture through to posterior wall into the cyst, showing an aspirate of the typical grayish fluid marked the place for perforation of the posterior wall (figure 13). The cyst fluid was routinely sent for culture and cytological examination. The dorsal gastric wall was then opened either by electrocautery (figure 14), with ultrasonic scissors or using an endoscopic stapler (figure 15). The perforation was enlarged to a diameter of at least 4-5 cm. An effort was made to resect part of the cyst-wall to ensure an adequate opening for drainage and to obtain a specimen for histopathological examination (figure 16). The perforation margins were closely inspected for bleeding, but the gastric wall was not routinely sutured to the wall of cyst. Occasional oozing from the perforation margins was stopped with a hand suture. The anterior wall of the stomach was closed through a small (5-7 cm) left subcostal incision or (in one patient) through a continuous laparoscopic suture.

Laparoscopically assisted cysto-jejunostomy is procedure of choice when a pseudocyst is located more caudal than the stomach or when fixation of the cyst to the dorsal stomach is absent. The proximal jejunum was transected 15 cm past Treitz ligament, using an endoscopic stapler. The distal leg of the jejunum was pulled through a retrocolic route near to the cyst. Through a small left subcostal incision a hand sewn side-to-side cysto-jejunostomy was performed. Open re-anastomosing the Roux-Y limb to the proximal jejunum completed the procedure.

RESULTS

Six patients (2 women, 4 men) were laparoscopically treated for a symptomatic pseudocyst of the pancreas. The mean age was 51 years (range 31-63). Conversion to laparotomy was necessary in one out of six patients (17%). In this patient the cyst was located on the posterior wall of the corpus of the stomach

After opening the anterior wall and puncturing of the cyst, a perforation was made through the posterior wall in an attempt to reach the cyst. However, accidentally

the dorsal perforation reached into the free abdominal cavity. A small laparotomy was needed to close the gap sufficiently.

In four patients a small left subcostal incision was used to close the (sometimes thickened) anterior wall of the stomach safely. One Roux-Y cysto-jejunostomy was needed in a patient because the pseudocyst was not attached to the posterior wall of the stomach. One patient with an apparently normal gastric wall had a fully laparoscopic cysto-gastrostomy. Success rate for laparoscopic assisted marsupialization is therefore 5/6 (83%).

The mean operative time was 163 min (110 – 225 min). Operative blood loss was less than 150 cc in all patients. No mortality was seen in this series. The median postoperative admission time was 7 days (4 - 15 days). A prolonged admission of 15 days was observed in one patient because of gastric retention which resolved spontaneously. One patient was readmitted two weeks after cysto-gastrostomy with hematemesis. Gastroscopic evaluation demonstrated a blood clot at the site of the stapled cysto-gastrostomy but no active bleeding. This patient was treated conservatively but received three units of blood. No recurrent bleeding occurred thereafter. All cultures of pancreatic fluid were free of microorganisms. Histopathological examination confirmed the diagnosis of pseudocyst of the pancreas in all patients. No malignancies were present.

All patients were free of symptoms at time of discharge. Postoperative US was performed within the first postoperative month in all patients. Only in the patient with hyperglyceridaemia, US depicted the presence of a small residual cyst. In the following months she developed several other small cysts in the pancreas. After a mean follow-up of 30 months (3- 73 months) this is the only patient with moderate abdominal complaints. All the other patients are free of symptoms.

DISCUSSION

Pancreatic pseudocysts are a serious consequence of pancreatitis for both patient and physician, because they are associated with abdominal pain, tendency to chronicity, and risk of complications. However, approximately 50% of the pseudocysts resolve spontaneously within 6 weeks after an episode of pancreatitis. Of the remaining cysts, a large number is small and asymptomatic without a tendency to grow [8,25,43,59].

Larger pseudocysts are more likely to give rise to mechanical complaints and, when the diameter surpasses 6 cm, are associated with a higher complication rate up to 41% [8]. Although larger asymptomatic cysts can be managed conservatively,

the increased risk of complications (infection, hemorrhage, rupture and obstruction) has brought many to treat cysts larger than 6 cm in diameter invasively [5,27].

Invasive modalities for treatment of symptomatic pancreas pseudocysts include percutaneous drainage, transendoscopic drainage and surgical marsupialization. Which procedure is most beneficial to the patient depends on a number of factors, including the general condition of the patient, size, number and location of the cyst, presence or absence of communication with the pancreatic duct and possible signs of infection of the cyst [46,49]. Although percutaneous drainage is a relatively simple way to treat a pseudocyst, the success rate is subject of debate. Failure of percutaneous drainage is often associated with an underlying stricture or occlusion of the pancreatic duct [1]. Failed nonoperative drainage is associated with a protracted illness and carries a risk of increased morbidity after operative intervention compared to direct operative internal drainage [45]. Although some authors have reported a low failure rate of percutaneous drainage of 16 %, more recent studies demonstrate failure rates of more than 50% [26,27,43] and even a mortality rate of 16 % [27]. Therefore, it is suggested that percutaneous drainage should be reserved only for critically ill patients, who cannot tolerate anesthesia, in case of acute very large immature pseudocysts (>15cm) and in infected pseudocysts [20,30]. Contraindications for percutaneous drainage include intracystic hemorrhage and presence of (pancreatic) ascites [43].

Transendoscopic drainage appears to be a valid alternative to surgical drainage in mature pseudocyst of the pancreatic head and body. It is minimally invasive, not expensive, but requires experience. It appears especially suitable for solitary pseudocysts in direct proximity of the gastric or duodenal wall (visible bulge in the gastro-intestinal lumen). Failures are associated with thick walled pseudocysts (> 1 cm) and with acute necrotizing pancreatitis. Although longer-term outcome data are limited, a reported success rate of 62% is promising [4].

Recent developments in laparoscopic solid organ surgery have brought the minimal invasive approach to the pancreas within reach. Reports on laparoscopic treatment of insulinomas of the pancreas, formal tail resections and even laparoscopic Whipple procedures demonstrate the feasibility of laparoscopic pancreatic surgery [2,6,13,21,27,54]. However, most of these procedures are considered suitable exclusively for experienced laparoscopic surgeons. Hence, reports on laparoscopic pancreatic surgery, including pseudocyst drainage, are limited to case reports and larger series are absent [3,10,19,48]. The surgical approach to the

pancreas traditionally required large incisions with subsequent morbidity. Unlike many other surgical procedures, pseudocyst drainage does not require extirpation of a specimen or organ and a minimally invasive approach seems therefore very suitable.

This study has shown that laparoscopic pseudocyst treatment is indeed feasible, but requires advanced laparoscopic equipment (LUS) and skills. Correct localization of the cyst before drainage is crucial for successful marsupialization. In one patient, we incorrectly perforated the posterior wall of the stomach. Optimal trocar positioning and sufficient exposure of the posterior wall of the stomach, combined with adequate LUS can prevent wrongful perforation. Successful marsupialization without leakage is only possible if the cyst wall is firmly attached to the dorsal gastric wall. This cannot be regarded as a certainty in every patient. The transabdominal laparoscopic approach allows for opening of the lesser sac and inspection of the pseudocyst and its relation to the gastric wall.

An alternative minimal approach to a pseudocyst is the transgastric route, where trocars are inserted directly through the anterior wall of the stomach. Visualization inside the stomach can be achieved using either a laparoscope or a gastroscope. This approach has the advantage that it does not require a large opening of the anterior gastric wall. We tried this approach several times successfully during transgastric resection of gastric and duodenal polyps but found it difficult to maintain a sufficient working space, as CO_2 tends to leak away through the esophagus and the pylorus. However, others report this approach to be a valuated alternative to transabdominal laparoscopic surgery [51,53].

In this study the anterior gastric wall closure was performed through a small aiding subcostal incision to ensure adequate sealing. From a minimal invasive viewpoint fully endoscopic suturing of the anterior gastric wall may be an even better alternative but it requires more laparoscopic skill and is more time consuming. An endoscopic stapling device can also be used for closure of the anterior gastric wall, but is more expensive. A minilaparotomy of 4-5 cm is well tolerated and did not add to morbidity in this series.

Laparoscopic assisted drainage of pancreatic pseudocyst is a safe, well-tolerated procedure and is associated with low morbidity and good outcome. It appears the method of choice in the surgical treatment of pseudocysts of the pancreas.

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Chapter 4

The Spleen

Adapted from the original articles:

Hematological long-term results of laparoscopic splenectomy for patients with idiopathic thrombocytopenic purpura.
Berends FJ, Schep N, Cuesta MA, Bonjer HJ, Kappers-Klunne MC, Huijgens P, Kazemier G
Submitted for publication.

Laparoscopic splenectomy for ITP, long term results and the relation with splenosis and accessory spleens.
Schep NWL, Berends FJ, Bonjer HJ, Valkema R, Kappers Klunne MC, Kazemier G Submitted for publication.

Laparoscopische splenectomie voor hematologische aandoeningen.
Den Hoed PT, Van Wessem KJP, Berends FJ, Kappers-Klune MC, Kazemier G, Bonjer HJ
Nederlands Tijdschrift voor Geneeskunde 1999;143:1222-5.

4.1 HEMATOLOGICAL LONG-TERM RESULTS OF LAPAROSCOPIC SPLENECTOMY FOR PATIENTS WITH IDIOPATHIC THROMBOCYTOPENIC PURPURA.

INTRODUCTION

Since the first laparoscopic splenectomy by Delaitre in 1991, several case controlled studies have demonstrated the surgical advantages of the laparoscopic approach to the spleen [1-5] . Laparoscopic splenectomy (LS) appears, when compared to open splenectomy (OS), associated with less postoperative pain, lower morbidity, shorter hospitalization and better cosmesis. Splenectomy is an excellent treatment option for patients with prednisone refractory Idiopathic Thrombocytic Purpura (ITP). However, in a number of patients splenectomy does not lead to an adequate response. In other patients, after initial response, a relapse occurs after some time. A relapse is associated the presence of accessory spleens and with splenosis. It has been postulated that the laparoscopic approach to the spleen is less accurate in detecting accessory spleens and one could imagine that instrumental manipulation of the spleen during laparoscopy could more easily lead to splenosis. Both factors might contribute to less favorable hematological results after LS than after OS in ITP patients.
The purpose of this study was to compare the operative outcome and the hematological results on the longer term of a series of LS with a historic series of OS for the treatment of ITP.

METHODS

Study design

A retrospective review of medical records was done of 50 consecutive patients who underwent LS for ITP at either the university hospital Rotterdam or the university hospital of the 'Vrije Universiteit' of Amsterdam from March 1992 through July 1999. Patient characteristics, outcome of surgery and hematological results were compared to a historical group of patients who underwent conventional splenectomy for ITP from January 1985 through July 1996.
The criteria for diagnosis of ITP were: (1) isolated thrombocytopenia with absence of splenomegaly and a. (2) normal or increased number of bone marrow

megakaryocytes. (3) No apparent cause for thrombocytopenia (i.e., sepsis, diffuse intravascular coagulation, systemic lupus erytematosis, lymphocytic leukemia, Hodgkin's disease) or evidence of a known cause for platelet sequestration (i.e., prosthetic heart valve, aortic graft, vascular tumor).

Indications for splenectomy were: (1) Patients who were refractory to corticosteroids or with a contraindication to corticosteroid therapy and a spontaneous platelet count of 30.000 /μl or less. No age limits were set. As hematological outcome was one of the key questions in the study and a majority of relapses can be observed within two postoperative years, a minimum follow up of 20 months was considered mandatory for inclusion.

Response to splenectomy was defined in the following manner (6):

(1) Complete remission (CR): An increase in platelet count to normal values of > 120,000 /μl; maintained for at least 1 month after discontinuation of corticosteroid therapy, documented by serial platelet counts. Every thrombocytopenic event during follow-up with a platelet count lower than 120,000 /μl was classified as a relapse. These patients were from that time classified as partial responders even when platelet count regained normal values thereafter.

(2) Partial response (PR): a rise of platelet count to at least 50,000 /μl but lower than 120,000 /μl, or alternatively a normal platelet count sustainable only with corticosteroids or other drugs. Relapse after initial complete remission was also defined as a partial response.

(3) No response (NR) or refractory disease: absence of a rise of platelet count, or a rise that never exceeded 50,000 /μl, or an initial rise above 50,000 /μl but return to values lower than 50,000 /μl within the fourth postoperative week.

Preoperative work-up.

All patients were vaccinated against S*treptococci pneumoniae* preoperatively. At least 4 weeks prior to therapy, corticosteroid therapy or immune globulin were given depending on platelet count. Patients received peroperative platelet transfusion after ligation of the splenic vessels when the platelet count was below 50, 000 /μl. No antibiotics were used. Almost all patients underwent preoperative ultrasonography to determine the size of the spleen.

Operative technique. LS was initially performed with the patient in 'supine position' (11 patients). Since 1996 patients were operated using the lateral flank approach, with the patient in a lateral decubitus position with the left side up: the so-called 'hanging spleen method' [7]. After establishing a pneumoperitoneum using either a Verres needle or an open technique, access to the peritoneal cavity was obtained through four trocars placed in the left subcostal and flank region. After meticulous inspection of the greater omentum and splenic hilum for the presence of accessory spleens, the splenocolic ligament was divided. The lateral peritoneal deflection was divided cranially, to the level of the splenophrenic ligament and the short gastric vessels. The short vessels were ligated using titanium clips or, in more recent years, by ultrasonic dissection device (Ultracision®, Ethicon, Summerville, NJ, USA). The splenic hilar vessels were cut with an endoscopic stapling instrument (Endogia®, Surgical corporation, Norwalk, USA) or separately ligated with clips and cut with scissors. After complete dissection of the spleen, it was placed in a plastic retrieval bag, which was introduced through the most lateral port. The retraction bag was delivered after slightly widening the trocar incision, to allow blunt morcellation of the spleen and piecemeal extraction. Part of the extracted spleen was sent for histological examination to confirm the diagnosis and to exclude other diseases. After closing of the extraction wound pneumoperitoneum was re-established to confirm hemostasis. A wound drain was left behind sporadically. Preoperative embolization of the splenic artery was not used in this study. Open splenectomy was performed through an upper-midline or left subcostal incision.

Analysis

All data were analyzed using SPSS software (SPSS Inc., Chicago, ILL, USA). The parameters described were analyzed using the Mann-Whitney U test for nonparametric, unpaired data sets and the Student's two-sample t-test for variables that followed a Gaussian distribution. Fisher's exact test was used for 2x2 contingency tables.

RESULTS

The demographic characteristics and operative results of the two groups are shown in table 9. Operative time was significantly longer in the LS group ($p < 0.001$). No significant difference was noted in operative blood loss.

	Open Splenectomy n =31	Lap Splenectomy n =50	P-value
Male (%) : Female (%)	16 (51.6) : 15 (48.4)	15 (30.0) : 35 (70.0)	
Mean Age (yrs) (range)	36.0 (16 – 70)	42.4 (18 – 70)	NS
Mean BMI (range)	25.6 (19.8 – 30.9)	25.3 (18.8 – 34.3)	NS
Mean splenic ∅ on US (cm) (range)	11,4 (8 – 15)	11,9 (8 – 14)	NS
Mean operative time (min) (range)	103 (60 – 170)	159 (90 – 240)	P< 0.001
Mean operative blood loss (ml)	725 (100 – 2300)	615 (<50 – 1800)	N.S.
Mean hospital stay (days)(range)	8.9 (5 – 27)	5.5 (1 – 18)	P< 0.001
Complications (%)	8 (26.0)	7 (14.0)	P < 0.001
Mortality	0	0	N.S.

Table 9. *Patient characteristics and operative outcome. NS = Not significant.*

Postoperative complications were significantly more frequent in the OS group (p < 0.001). Complications are depicted in table 10.
In both groups relaparotomy had to be performed for postoperative hemorrhage. Two patients in the LS group developed a pancreatic fistula at the site of the wound drain after conversion to OS because of a bleeding in the splenic hilum. Both fistulas resolved spontaneously within 6 postoperative weeks.

Open Splenectomy n =31	Lap Splenectomy n =50
4 wound infections	2 wound infections
2 postoperative hemorrhages	1 postoperative hemorrhage
1 wound dehiscence	2 pancreatic fistula
1 pneumonia	1 pneumonia
	1 pulmonary thrombosis

Table 10. *Postoperative complications*

The two wound infections in the LS group also arose after conversion to open splenectomy because of uncontrollable bleeding. In total 11 (22%) conversions to OS were performed, more than half of which (55%) occurred in the first 10 laparoscopic procedures. In the first laparoscopic splenectomies patients were

positioned supine on the operating table. In this patient subgroup (n = 11) there were 7 (64 %) conversions, while the conversion rate in the ‘ lateral decubitus group’ was 4/39 (10 %). In the interpretation of these conversion rates one must consider a superimposed effect of the patient position on the learning curve. Hospital stay was significantly longer after OS ($p < 0.001$).

Hematological outcome

Follow up after OS was understandably longer than after LS, which is the standard operation in both participating institutions since 1994. Mean follow-up after OS was 84,9 months, with a median of 66 months (range 24 -180). After LS the mean follow-up was 40,7 months, with a median of 35 months (range 20-106).

Rates for complete remission, partial remission and failure were not significantly different after LS compared to OS (table 11).

	Lap Splenectomy n=50 (%)	Open Splenectomy n=31 (%)	P-Value
Complete Remission	32 (64.0)	20 (64.5)	NS
Partial Remission	11 (22.0)	8 (25.8)	NS
Failure	7 (14.0)	3 (9.7)	NS

Table 11. *Hematological outcome. NS = Not significant*

The group of partial remissions consisted of patients with partial remission of ITP after initial splenectomy and relapse of disease after initial complete remission. Relapse after splenectomy (both LS and OS) occurred in 14 out of 19 patients (73.7%) with PR within two years, in 81.8 % within two years after LS and in 62.5% after OS. Median time of relapse after splenectomy is 9 months for the whole group (range 2 – 96), 6 months after LS (range 2 - 41) and 18.5 months after OS (range 2 – 96). Time till relapse did not significantly differ between groups ($p = 0.057$). Accessory spleens were detected in 4/31 (12.9%) patients during OS and in 6/51 (12.0 %) during LS. In the OS group a Technetium 99 sulfur-colloid scan or Heat Damaged Red Blood Cell scintigraphy was obtained in 6/11 (54.5 %) patients with deterioration after PR or relapse after initial CR. In two patients (33.3 %) an accessory spleen was detected for which reoperation was performed. One of these procedures was done for a relapse 48 months after OS. Through a laparoscopic approach an AS with a diameter of 7cm was removed. This patient

regained complete remission with a total FU of 13 years. In the other patient with a failure after OS four small AS were removed through a subcostal approach. However, platelet counts in this patient never exceeded 50.000/ μL. In the LS group scintigraphy was obtained in 6 patients with PR and 2 with NR (44 %). In only 1 patient residual splenic tissue was detected (12,5%). This patient however spontaneously regained a normal platelet count and will remain under observation.

DISCUSSION

Splenectomy represents a valid treatment for adults with ITP who prove to be corticosteroid refractory and remains the most effective therapy for long-term remission. Although no randomized trials are available, the laparoscopic approach appears to be the method of choice for removal of the spleen, because compared to open splenectomy, it is associated with less morbidity and faster convalescence [2-5]. Operative data of the present series seem to confirm these advantages. Initial hematological response to splenectomy is usually very good. Platelet counts return to normal values within days to several weeks and many authors can therefore report satisfying results and high complete remission percentages of 80-90% in the first months after LS [8 -11]. However, as the interval from the time of splenectomy increases, the success rate will progressively decrease [12]. Several mechanisms can be held responsible for a relapse after complete remission, a partial response or a failure after splenectomy. Not only does splenectomy remove the potential site of destruction of damaged platelets, it also removes the most important site for platelet antibody production. Antiplatelet antibody titers however, often do not decrease[13,14]. Furthermore, other reticuloendothelial organs such as the liver and bone marrow remain capable of destroying highly sensitized antibody-coated platelets, thus giving rise to relapse or failure. Finally, the presence of residual splenic tissue after splenectomy can grow and lead to 'secondary ITP'. The two major causes for residual splenic reticuloendothelial activity after splenectomy are 'splenosis' and missed accessory spleens (AS).

Splenosis can theoretically occur when the splenic capsule is breached and splenic tissue cells are disseminated throughout the abdominal cavity where they implant and grow. Splenic auto transplantation can occur anywhere in the abdominal cavity also extraperitoneally when traumatic disruption of the retroperitoneum occurs. The most commonly reported sites are the serosal surfaces of gut, mesentery and diaphragm. However, some authors have reported a preferential localization in the left upper quadrant [17-19]. Splenosis has been

reported in patients both after elective hematological operations and after operations for splenic trauma. Incidence of splenosis is significantly higher after splenectomy for trauma, ranging between 44 and 76%, than after hematological operations (16-30%) [15,16]. It is suggested that the laparoscopic approach to the spleen could add to the risk of intraperitoneal seeding of splenic cells. Several studies demonstrated persistence of splenic tissue in up to 50% of patients after LS for hematological indications [15,20,21]. Splenic capsule disruption with sharp laparoscopic instruments, spillage from the retrieval bag during morcellation and piecemeal extraction and possible trocar site implantation are mentioned as potential risk factors.

Accessory spleens, which are erroneously left in place, may take over splenic function after splenectomy. AS can be localized throughout the abdominal cavity but are mainly found in the left upper quadrant, the splenic hilum, the paracolic gutter, near the tail of the pancreas and in the lesser sac. As preoperative imaging techniques such as CT scan and heat-denaturated red blood cell scintigraphy have limited value in detecting AS, adequate detection of AS mainly depends on meticulous inspection of the abdominal cavity during operation [5,15,21,22,23]. Rates for AS detection during LS and OS vary significantly in the literature. There is a continuous debate if laparoscopy is equally efficient in detecting AS as the conventional approach. Some authors argue that the absence of tactile response and technical restrictions during laparoscopy could lead to a lower AS detection and higher rate of incomplete remissions on the long term [15,21,22]. Other authors however, have reported equal or greater incidence of AS identification with laparoscopy [3, 4,9,10]. Katkhouda compared detection rates for AS in a series of articles on LS with OS and found a mean rate of 15% AS (range 6-39%) for LS and 16% AS (range 5-28%) for OS[8]. The operative detection rates in the presented study for OS and LS of 12% and 13% respectively are in accordance with these results.

As relapses after initial CR are reported till as many as 25 years after splenectomy [24-26], only time will clarify the question whether or not laparoscopy leads to less optimal hematological results. Mazzucconi and co-workers demonstrated in a cohort of 94 patients with autoimmune thrombocytopenic purpura followed for a long period of time (median 84 months) that the median time of the first relapse after splenectomy was 19 months and that the majority of relapses (81%) occurred within 48 months after splenectomy [27]. Stasi and others however, showed a relatively constant rate of relapses during the first 5 years after splenectomy, with

a 65% probability of remaining in complete remission at 72 months [6]. In the presented series 73% of all relapses (both LS and OS) were seen within two postoperative years.

Author	Year	N =	Treatment	Acc. Spleens %	Complete Remission %	Follow –up in months
DiFino [29]	1980	37	OS	4	49	37 (median)
Akwari [30]	1987	100	OS	18	71	10 (mean)
Chirletti [31]	1992	70	OS	16	90	21 (mean)
Stasi [6]	1995	63	OS	-	65	92 (median)
Watson [4]	1997	47 13	OS LS	9 15	83 93	60 (median) 14 (median)
Katkhouda [8]	1998	67	LS	18	78	38 (mean)
Lozano [28]	1998	27 22	OS LS	11 9	70 68	35 (median) 14 (median)
Mazzucconi[27]	1999	81	OS	-	72	84 (median)
Marassi [32]	1999	14	LS	21	93	19 (median)
Trias [33]	2000	18 48	OS LS	6 11	78 84	63 (median) 30 (median)
Szold [10]	2000	60	LS	14	84	16 (mean)
Berends	2001	31 50	OS LS	13 12	65 64	66 (median) 35 (median)

Table 12. *Hematological response in open and laparoscopic treatment of ITP. N = Number of patients with ITP; OS = Open Splenectomy; LS = Laparoscopic Splenectomy.*

Only few authors have tried to compare hematological results after LS with a historic group of OS (table 12.) However, most series lack sufficient follow-up especially in the LS group [4,28]. From the available published data more than 50% of the patients monitored for up to 20 years continued to have a response after splenectomy [12,24].

In summary, laparoscopic experience in solid organ surgery has evolved to a level that laparoscopic splenectomy for ITP is safe, with low morbidity and fast convalescence. Hematological results after laparoscopic splenectomy for ITP are comparable to those after open splenectomy both on the short and on the long-term. However, vigilant follow-up after LS for ITP should be advocated.

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Chapter 5

The Kidney

Adapted from the original articles:

Laparoscopische donornefrectomie bij familieniertransplantaties; gunstige eerste ervaringen.
IJzermans JNM, Berends FJ, Van Riemsdijk IC, Weimar W, Bonjer HJ
Nederlands Tijdschrift voor Geneeskunde. 1999;143:942-5.

Technical considerations and pitfalls in laparoscopic live donornephrectomy.
Berends FJ, den Hoed T, Weimar W, G Kazemier, Bonjer HJ, IJzermans JNM
Surgical Endoscopy. 2002 Jun;16(6):893-8.

TECHNICAL CONSIDERATIONS AND PITFALLS IN LAPAROSCOPIC LIVE DONORNEPHRECTOMY

INTRODUCTION

The superior histocompatibility matching of living related donor organs, short cold ischemic time and the possibility to schedule a transplantation procedure, thus shortening the waiting period, offers great advantages of living (un)related donor kidney transplantation compared to cadaveric transplantations. Despite these advantages the annual rates of living donor procedures in Western Europe and the US represent respectively only 11% and 26% of all kidney transplants [7,2]. Living donor transplantation poses unique ethical dilemmas since it challenges the basis of the Hippocratic principle: “primum nihil nocere” (first do no harm) since the removal of an organ from a healthy individual puts the donor’s health at risk. Conventional lumbotomy, which is the common approach for donor nephrectomy, requires a large incision to enable adequate access to the kidney. Postoperative pain, pulmonary atelectases or infection, wound infections, hospital stay and return to normal activity are all correlated to the length of the operation wound. However, recent progress in laparoscopic solid organ removal such as laparoscopic splenectomy and endoscopic adrenalectomy has greatly diminished disability and discomfort associated with abdominal and retroperitoneal surgery [4,5,10].

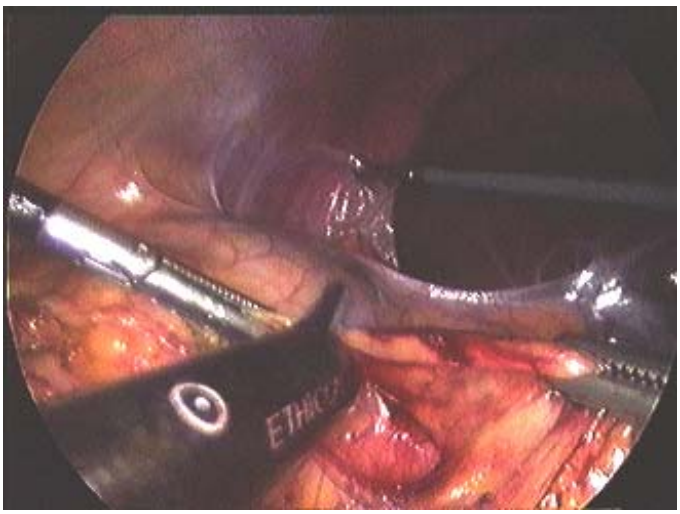

Figure 17. *Mobilization of the hepatic flexure. An Endobabcock clamp fixated to the lateral abdominal wall retracts the right liver lobe.*

Similar advantages can be expected for laparoscopic kidney removal. Indeed, early reports on laparoscopic donor nephrectomy are promising, showing decreased discomfort and faster donor recovery [11,24,28]. However, kidney transplantation, unlike other solid organ removal procedures, requires the extraction of a kidney in optimal condition, to ensure transplant function and survival.

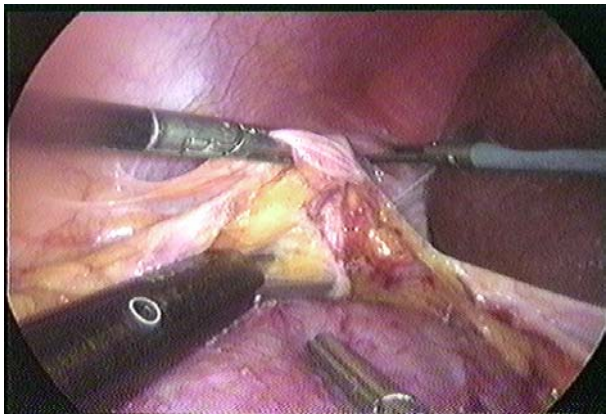

Figure 18. *Opening of the renal fascia and division of the renal fat using the ultrasonic dissection device.*

Laparoscopic donor nephrectomy may be less traumatic for donors, but little is known about the impact of laparoscopic manipulation on graft function, pressure pneumoperitoneum and possible longer warm ischemia times. We prospectively studied the results of laparoscopic donor nephrectomy in 57 patients and their recipients and compared them with a matched control group of conventional living related kidney transplants.

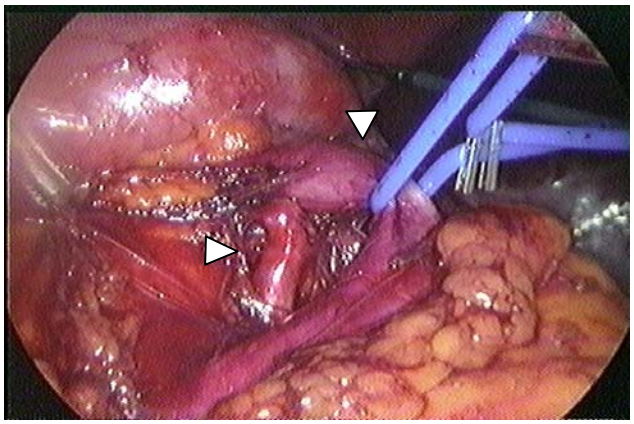

Figure 19. *The renal vessels. The smaller renal artery is seen caudally of the vein (left arrow). The renal vein contributes to the caval vein. A vessel loop surrounds the vein.*

METHODS

Between December 1997 and January 2000 living related donor nephrectomy was performed in 63 patients at our institution. Candidates for donor nephrectomy underwent standard preoperative screening including renography, Seldinger angiography and in case of suspicion of more than one artery, selective renal artery angiography. Percutaneous ultrasonography was performed to exclude the presence of kidney deformities. Preoperative diagnostics determined the site of kidney explantation. In case of normal anatomy and normal function of both kidneys, we favored right donor nephrectomy. Five patients were excluded for a laparoscopic procedure: two patients because of morbid obesity, two patients because the renal arteries were more than 5 cm apart on both sides and once because of the unavailability of a fully equipped laparoscopic team.

Laparoscopic donor nephrectomy (LapNx) was performed under general endotracheal anesthesia. The patient was placed in lateral decubitus position and the operating table was flexed maximally to expose the space between the costal margin and the iliac crest. Orogastric suction and bladder catheterization were used routinely, but no antibiotics were administered. A 30^{o} videoendoscope was introduced though a small midline incision just caudally of the umbilicus using an open technique. At the end of the procedure this incision was lengthened to 5-6 cm to enable extraction of the kidney.

A 12 mm Hg CO_2-pneumoperitoneum was created and four additional trocars were inserted. One 10 mm trocar port was placed at the lateral margin of the rectal muscle, equidistant from the umbilicus and the superior iliac spine. The second 10 mm trocar was placed laterally between the costal margin and the iliac crest. The two 5 mm ports were inserted in the midline between the xyphoid process and the umbilicus. The uppermost of these two was used to insert a small endobabcock clamp to retract the right lobe of the liver (right nephrectomy) or spleen (left nephrectomy). Fixing this babcock clamp to the lateral abdominal wall saved one hand. The operating procedure for right nephrectomy consisted of: Mobilization of the right hemicolon using an ultrasonic device (Ultracision®, Ethicon, Sommersville, NJ), opening of the renal fascia and division of the renal fat (figures 17,18). The vein was dissected up to its entrance in the caval vein and encircled with a rubber vessel-loop to enable gentle traction and, later on, correct positioning of the stapling device (figure 19).

The absence of venous branches of the right renal vein facilitated dissection compared to the left side. Special attention was paid to occasional lumbar veins at the confluence of the renal- and caval vein. Particularly in case of multiple renal arteries or a central bifurcation of renal arteries (behind the caval vein), arterial dissection was facilitated by rotating the kidney medially enabling dorsal view and access to the hilar structures. The procedure on the left side was similar, starting with the mobilization of the left hemicolon and the spleen. The left renal vein was freed up to it's crossing with the aorta. Tributaries such as the adrenal- and spermatic- or ovarian vein were ligated with titanium clips. The ureter was identified easiest by lifting the lower pole of the kidney followed by caudal dissection. However, later on in the study, when the risk of ureteral stenosis in the recipient became clear, the technique was altered and the ureter was identified at the crossing with the iliac artery and dissected cranially. Special care was taken to leave as much peri-ureteral tissue in place to avoid ischemic problems after implantation (figure 20).

The ureter was ligated only at the end of the procedure to avoid rotation of the kidney around its vascular pedicle. After administering heparin systemically, ureter, artery and vein were divided using a laparoscopic stapler (EndoGIA 30 ®, US Surgical, Norwalk, CT, USA). A plastic extraction bag (Endocatch®, US Surgical, Norwalk, CT, USA) was used to extract the kidney through the infraumbilical incision (figure 21).
Immediately after extraction, hemostasis was restored by protamin sulfate. The kidney was perfused with Eurocollins at 4^{o} C and stored on ice (4^{o} C) awaiting implantation. After closure of the infraumbilical fascia, pneumoperitoneum was restored for final inspection of the abdominal cavity. In case of diffuse bleeding a drain was left behind. Wounds were infiltrated with marcain 1% solution to contribute to postoperative analgesia and were closed intracutaneously for improved cosmesis. When conversion was necessary, a lumbotomy was used to remove the kidney. Data are expressed as a group mean with the standard deviation. Statistical analysis of groups comparison was done using the Mann-Whitney test and the Student's t-test for independent samples.

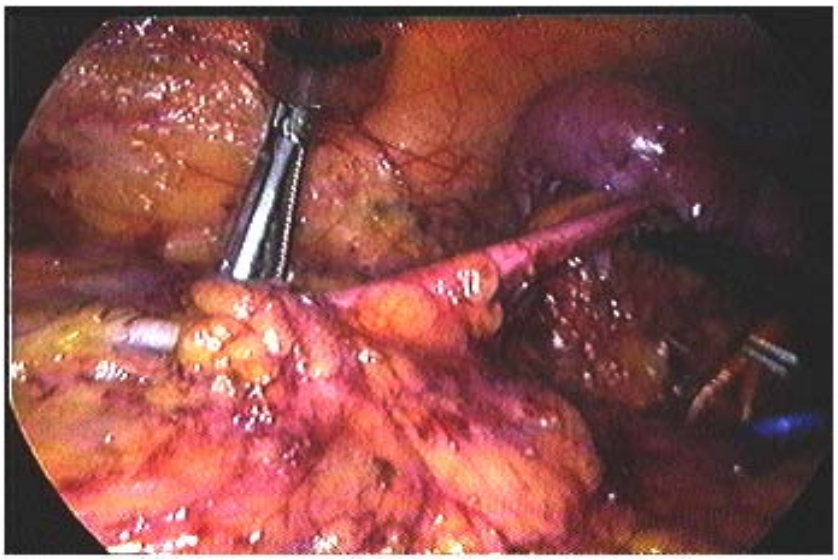

Figure 20. *Ureteral dissection*

RESULTS

Between December 1997 and January 2000, laparoscopic live donor nephrectomy (LapNx) was attempted in 57 patients and successfully completed in 54 patients (94.7 %). Patient characteristics and operative results were compared to a historic control group of 27 patients that underwent standard flank live donor nephrectomy (OpenNx) between September 1996 and December 1997.

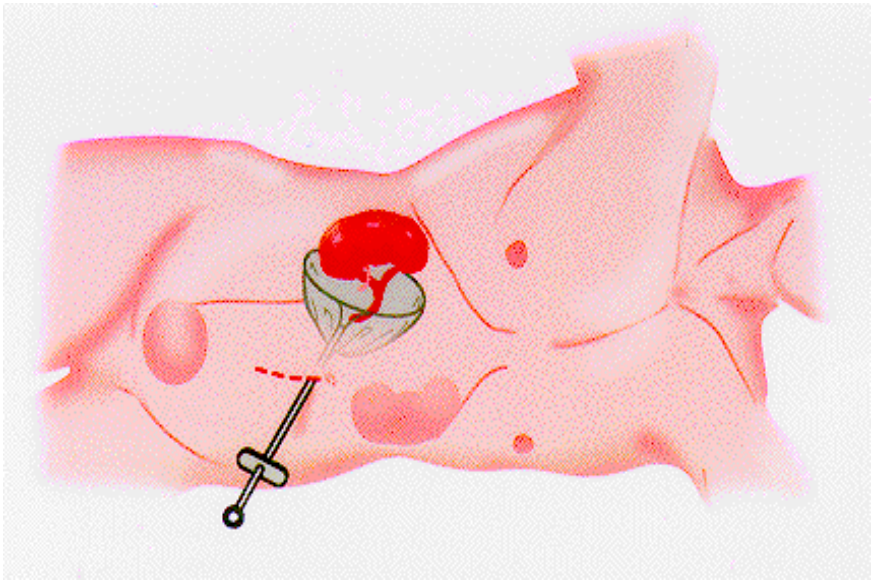

Figure 21. *A plastic bag is used to extract the kidney through a small infra umbilical incision.*

	Lap Nx (N=57)	Open Nx (N=27)	P value
Male	30 (53 %)	13 (48 %)	NS
Female	27 (47 %)	14 (52 %)	NS
Age (years) (range)	44.7 (22 – 74)	46.3 (22 – 66)	NS
Weight (kg) (range)	72 (52 – 94)	76 (44 –103)	NS
Side: Left	22 (38 %)	9 (33 %)	NS
Right	35 (61 %)	18 (67 %)	NS
Multiple artery/ vein	9/ 8	3/ 3	NS
Mean operative time (min) (range)	240 (130 – 430)	145 (100 – 330)	P < 0.001
Mean blood loss (ml)	298	316	NS
Warm ischemia (min) (range)	7.78 (4-17)	4.8 (2-12)	P < 0.001
Postoperative pain > 2 days	12 (21%)	13 (45%)	P < 0.001
Mean length of stay (days) (range)	3.9 (2-10)	6.0 (3-9)	P < 0.001

Table 13. *Patient characteristics and operative results*

Clinical characteristics and operative data are listed in table 13. In the LapNx group, conversion to flank laparotomy was performed in three patients (5.2 %). All conversions were performed in the first half of the study. In one patient a hemorrhage occurred from a hilar sidebranche of the right renal vein requiring lumbotomy. In a second patient a bleeding arose from a small lumbar vein during an attempt to encircle the right renal vein. In the third patient an instrumental laceration of the splenic capsule occurred during left nephrectomy requiring lumbotomy and subsequent splenectomy. One other small lesion of the splenic capsule occurred in the LapNx group, which could be treated laparoscopically. Further complications in the laparoscopic group consisted of one postoperative hemorrhage, probably in the renal bed, requiring two units of blood without operation. One patient was reoperated for a bleeding from the minilaparotomy wound that turned out to be a vessel in the wound margin. Four patients in the LapNx group developed a ureter stenosis requiring reoperation (7.0 %). Complications of laparoscopic and open nephrectomy are listed in table 14.

Graft survival in the laparoscopic group was 100% with a median follow-up of 13 months (range 2-27). We observed delayed function up to 48 hours in two grafts (3.5 %) after uneventful laparoscopic harvest. Warm ischemia times in these two cases were 5 and 8 minutes respectively.

LapNx 8 (14.0 %)	OpenNx 8 (29.6 %)
Hemorrhage, conservative treatment	Hematoma
Hemorrhage from minilap wound, reoperation	Urinary tract infection
Subcutaneous emphysema	Infected epidural catheter
Fever	Exanthema after epidural anesthesia
Ureter stenosis (4x)	Ureter stenosis (2x)
	Incisional hernia (2x)

Table 14. *Postoperative complications*

No additional dialysis was required in these patients. All other grafts functioned immediately during, or directly after transplantation. Warm ischemia times were significantly longer ($P < 0.001$) in the LapNx group. (8 min, range 3 - 17 min versus 5 min, range 3 - 12 min). In two patients in the LapNx group we encountered technical difficulties during the extraction phase due to stapler failure and a torn extraction bag leading to prolonged warm ischemia times of 12 and 17 minutes respectively. However, both recipients had immediate transplant function and an uneventful recovery. Currently, all recipients of a laparoscopic harvested kidney have functioning transplants and are off dialysis. The mean operative time in the LapNx group was significantly longer ($P < 0.001$) than for OpenNx (240 $\pm$ 60 min, versus 145 $\pm$ 50 min). Table 15 demonstrates the effect of growing experience with the laparoscopic procedure in time. Mean operative times for right and left LapNx (218 and 275 min) demonstrate an advantage for the right side. It should be noted however, that the percentage of right LapNx is somewhat greater in the second half of the learning curve (57 %).

The number of patients complaining of pain longer than two postoperative days, requiring more analgesics than paracetamol or continued epidural anesthesia was significantly higher ($P < 0.001$) in the OpenNx group.
The majority of the laparoscopically operated patients resumed normal diet and mobilized on the first postoperative day. This rapid recovery led to a significantly shorter ($P < 0.001$) mean postoperative hospital stay than after OpenNx (3.9 days (range 2 – 10), versus 6.0 days (range 3 – 9)).

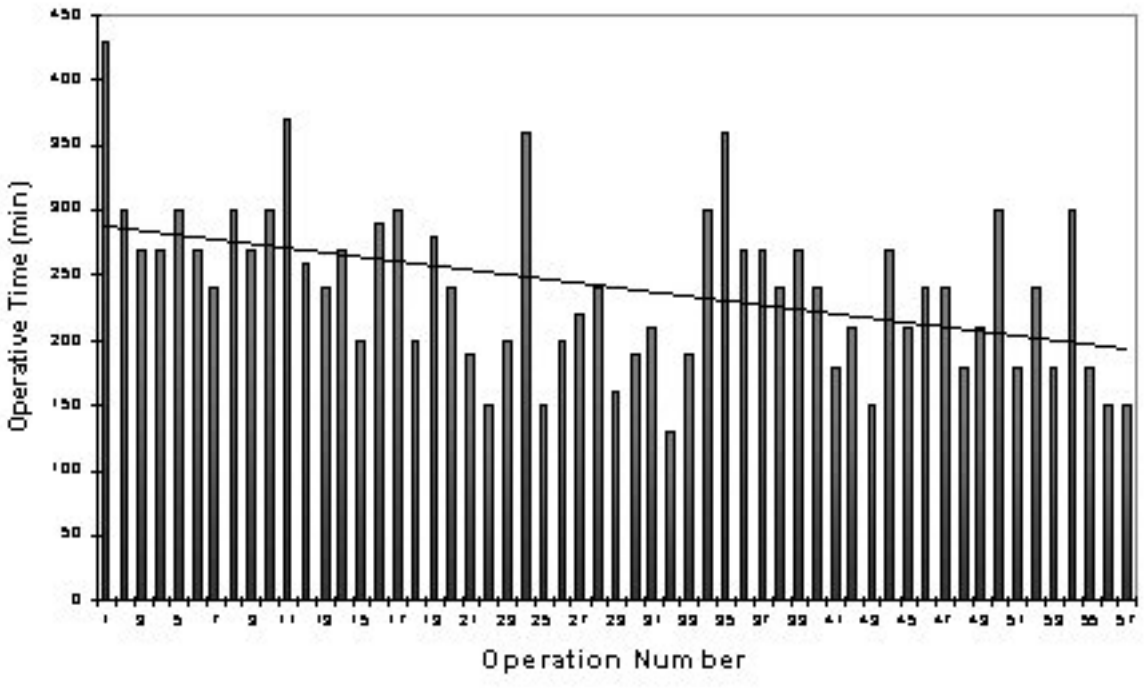

Table 15. *Coherence between operative time of laparoscopic donor nephrectomy and increased experience with the procedure. The drawn line represents the regression line.*

DISCUSSION

In the past, controversy existed regarding the use of living donors because of the risk of mortality, potential morbidity and the unknown long-term sequelae to the donor [1,31]. In 1984 Hardy even commented, "that the use of living donors is no longer morally justified" [13].

The mortality rate associated with donor nephrectomy can be considered low. A survey among all members of the American Society of Transplant surgeons estimated the risk of mortality after living donation to be 0.03% [19]. Several authors report no mortality at all in large series [17,29].

Long-term considerations of unilateral nephrectomy revolve around the question whether or not donors have an increased risk on proteinuria and hypertension. Although 30-40% of donors present mild proteinuria, there is no tendency to increase in time and there is no evidence of long-term detrimental sequelae. A meta-analysis of 48 studies on long term risk for donors concluded that "changes of developing end-stage renal disease as a result of successful organ donation appear to be remote" [15].

However, there is still a considerable incidence of short-term complications associated with “open” flank nephrectomy. Complications vary in the different studies between 15 and 47%, although the risk of short term more serious complications is considered to be lower (2-7%) [3,6,30]. However, most of these studies do not evaluate late complications including incisional hernia, chronic incisional pain, abdominal wall ”bulging” as a result of local muscle paralysis and bowel obstruction due to intra-abdominal adhesions, so that the real morbidity after lumbotomy may be underestimated.

The increasing success of minimal invasive techniques in the past few years has made endoscopic surgery the method of choice in several surgical procedures, including laparoscopic adrenalectomy and laparoscopic splenectomy for benign disease [4,5,10]. Earlier reports on laparoscopic removal of a kidney for benign disease invariably show significant decrease in complications, analgesic consumption, hospital stay and convalescence compared to transperitoneal or flank nephrectomy [16,22].

The same favorable results can be expected for living kidney donors. After initial reports proved feasibility [24,28], now the first matched control studies are available [9,25]. The findings in the presented study are in accordance with these results. Laparoscopic donor nephrectomy appears to be feasible in a selected patient population without technical restrictions. Operative time of LapNx is considerably prolonged compared to conventional nephrectomy. The laparoscopic dissection of the kidney requires considerable laparoscopic skills and experience. More than in open surgery the co-operation between the operative surgeons determines progress and speed of the procedure. However, operative times merely depict an indication of the level of complexity and extend of a procedure. More important than operative times, should be the patient and transplant outcome. In our study, longer operative time did not disadvantageously influence the speed of patient recovery or transplant function. In the LapNx group there was a significant decrease in postoperative pain and demand of analgesics and shorter length of stay. Perioperative blood loss and complication rates were comparable in both groups.

Nevertheless, LapNx may significantly reduce donor discomfort and hospital stay, as yet little is known about the long-term transplant survival after LapNx. Although transplant survival depends on many factors, a great portion of the success of living kidney donation compared to cadaveric transplants involves the comparatively short ischemic times [29]. Unlike reported warm ischemic times from

2-7 min in Lap Nx in other studies [9,25] we observed a relatively long mean ischemic time of 8 min. (range 3-17 min.). After division of the renal artery it apparently takes more time to: ligate the renal vein, insert the retraction bag, place the specimen in the bag, remove the kidney through an infra-umbilical incision and connect it to the perfusion device for preservation, than in OpenNx. Insertion of the extraction bag before ligation of the renal vessels could shorten warm ischaemia times but proves to be difficult because of impaired view and loss of pneumoperitoneum. However, despite longer ischemia times we observed only two recipients who demonstrated delayed graft function, and overall there was no transplant failure.

Other factors related to a laparoscopic procedure can influence graft function. Prolonged increased intra-abdominal pressure is known to cause oliguria and anuria probably due to changes in renal hemodynamics [12]. Experimental studies have demonstrated a decrease in GFR due to elevated intra abdominal pressure during pneumoperitoneum. An intra-abdominal pressure above 12mm Hg can affect splanchnic blood flow[18]. Unfavorable body position along with the more extensive manipulation of the kidney during laparoscopy may add to a decrease in intra-operative kidney perfusion [8]. First reports on longer-term recipient renal function indicate no difference between LapNx and OpenNx [21]. However, only time will learn if prolonged warm ischemia after laparoscopic harvest will influence transplant survival in the long run.

Another concern was the incidence of 4 (7.0%) ureteral complications in recipients after LapNx during the first year of our study. Ureter stenosis can be presumed to be an ischemic event and must primarily be imputed to compromising the ureter vascular supply during harvesting, although surgical technique of the ureterovesical anastomosis may add to the problem. In the literature urological complications after conventional renal transplantation (i.e. leakage, stenosis and reflux) vary in the different series between 1 –30 % [20,27]. Recent studies on ureteral complications after LapNx report a rate of 7.6 % [21,23]. The tissue surrounding the ureter is only loosely connected to it and blunt dissection will easily barren the ureter and damage its vascular supply.

A ureter stenosis usually takes up to three months to develop and therefore some time elapsed before the extent of this problem became clear. Now we use extra care in ureteral dissection. Sufficient length and viability can be improved by identifying the ureter at the crossing with the iliac artery and then to dissect it proximally leaving a safe amount of peri-ureteral tissue in place. An endoscopic

stapling device can be helpful in this procedure. We have observed no more ureteral complications after modification of the laparoscopic technique.

The preferred side for nephrectomy remains a matter of debate. Most authors seem to have a preference for left LapNx because of greater vascular length facilitating graft reimplantation [9,26]. Especially the threat of a (too) short renal vein and the presence of the overlying liver is supposedly a disadvantage. We disagree with this point of view. The right liver lobe is easily retracted by insertion of a small endobabcock clamp that can be fixated to the lateral abdominal wall. The renal vein should be dissected up to its entrance into the caval vein where it can be ligated. Although use of a stapling device results in loss of approximately 1 cm of vascular length, remaining vein length is usually about 2.5 cm. Depending on individual experience this usually forms no problem in the recipient operation. In our series we performed 36 right LapNx and have not encountered any problems with venous anastomosis nor did we need any saphenous vein interpositions. We find that the right hemicolon is somewhat easier mobilized than the left side, where the attachments to the spleen may hamper dissection of the colonic flexure. Moreover, on the left side both the adrenal vein and the spermatic or ovarian vein drain into the renal vein, whereas on the right side these veins directly drain into with the caval vein. In fact, the slightly more caudal position of the right kidney, the venous anatomy and the absence of the vulnerable spleen have led to a preference for right LapNx at our institution.

The discussion on the preferred approach to the kidney resembles that of the endoscopic treatment of adrenal tumors. From a theoretical point of view the retroperitoneoscopic approach to the kidney could offer some advantages over the transperitoneal route. However, retroperitoneoscopic adrenalectomy is usually performed with tumors smaller than 6-8 cm in diameter and no ligation of great vessels is required. Still, feasibility of retroperitoneoscopic live donor nephrectomy has already been demonstrated and could prove advantageous in the future [14].

Laparoscopic live donor nephrectomy is technically feasible and can be performed safely. It offers the kidney donor a considerable decrease in postoperative discomfort and allows for faster recovery and shorter hospital stay.

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Chapter 6

The Liver

Adapted from the original article:

Technical considerations in laparoscopic liver surgery. A solid organ easily forgotten?
Berends FJ, Meijer S, Prevoo W, Bonjer HJ, Cuesta MA
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TECHNICAL CONSIDERATIONS IN LAPAROSCOPIC LIVER SURGERY. A SOLID ORGAN EASILY FORGOTTEN?

INTRODUCTION

Laparoscopic surgery for solid organs such as the spleen, the adrenals and the kidney has gained wide acceptance, but experience with minimal invasive surgery for hepatic disease is limited. Liver surgery in general is considered to be technically difficult and tedious even if performed conventionally and is in many centres left to specialized surgeons. The technical complexity of liver surgery, risk of life threatening bleeding and fear of gas embolism have withheld many to embark on laparoscopic liver surgery. However, a number of hepatic lesions does not require large and complex resections but can be treated with relatively simple surgical interventions. The objective of this study is to assess the feasibility of laparoscopic surgery for hepatic lesions and to report the results of our experience in liver surgery by laparoscopy.

Figure 22. *Large hemangioma of segment III*

Figure 23. *Wedge resection of segment III*

METHODS

The clinical characteristics, operative procedures and postoperative outcome of all patients who had laparoscopic liver surgery at our institution between June 1993 and April 2000 were reviewed. The most frequent benign lesions of the liver include cysts and hemangioma, liver cell adenoma and focal nodular hyperplasia (FNH). Patients may undergo hepatic resection because of mechanical complaints

Figure 24. *Large cyst of segment II/III.*

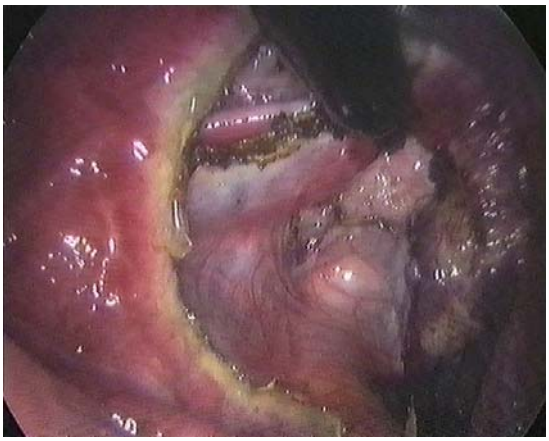

Figure 25. *Aspect of the liver after unroofing of the cyst.*

or a preoperative diagnosis of malignancy or uncertainty in diagnosis despite an extensive work-up.
Patients with benign lesions of all sizes or solitary metastases with a diameter of 3 cm or less were candidates for a laparoscopic approach. Tumors had to be located at segments II, III or IV-a or at the liver margin. Patient characteristics, diseases and treatment are shown in table 16 and illustrated in figures 22-29.

Besides routine workup, all patients underwent preoperative imaging of the liver by use of ultrasonography and computerized tomography. Patients with non-cystic disease underwent mechanical bowel preparation on the day before surgery.
Patients were operated under general anesthesia with endotracheal intubation.

Figure 26. *Focal nodular hyperplasia segment II/III.*

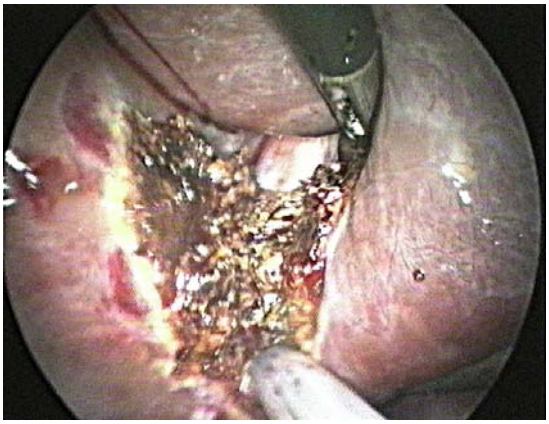

Figure 27. *Dissecting the liver parenchyma*

Lesion	Sex	Age	Complaints	Diagnosis	Treatment
Cystous	F	37	Mechanical	Cyst segm II/III	Unroofing
	F	71	Mechanical	Cyst segm VI/VII	Unroofing, conversion
	M	53	Fever, pain	Recurrent abscess segm V after nephrectomy	Unroofing and drainage
Solid benign	M	67	Mechanical	Hemangioma Ø 15cm, segm III	Wedge resection
	F	62	Suspected malignancy	Hemangioma Ø 4cm, segm II	Wedge resection
	F	41	Suspected malignancy	FNH Ø 2,5 cm, segm IV	Wedge resection
	F	34	Suspected large adenoma	FNH Ø 7cm, segm II/III	Segm II/III resection
Solid malignant	F	43	No complaints	Metastasis breast carcinoma, segm III	Wedge resection
	M	67	No complaints	Metastasis Grawitz tumor, segm VI/VII	Wedge resection, conversion
	F	63	No complaints	Metastasis colon carcinoma, segm II/III	Segm II/III resection

***Table 16**. Patients, diagnosis and treatment.*

All patients received an arterial and central venous catheter for peri-operative monitoring of arterial blood pressure and central venous pressure and to provide a large calibre access to the circulation in case of rapid bleeding. Single dose of cefuroxim and metronidazole was routinely administered preoperatively.

Operative technique: Patients were placed in supine position with the legs in stirrups, allowing the operating surgeon to stand between the patients' legs. After establishment of CO_2 pneumoperitoneum, using a Verres needle, four or five trocars were introduced, generally in a diamond shaped configuration, although the particular location of the lesion may call for an adjusted approach. Particularly tumors located in segments VI and VII may be approached with an additional trocar on the right. It is advisable to use an angled (at least 30^o) scope, especially for lesions located in the dorsal segments. In all cases, a radiologist performed laparoscopic ultrasonography (LUS) to establish local anatomical proportions and resectability (7.5 MHz laparoscopic rigid transducer, B-K medical, Gentofte,

Denmark). At first, the liver was mobilized by taking down the ligaments of the liver. Gaining control of the vascular structures in the hepatic ligament (Pringle manoeuvre) can be a safety precaution in large resections but is usually not necessary in smaller resections. After visualization of the affected liver segments aided by LUS, the planned resection is demarcated on the liver surface by diathermy. Parenchymatous dissection was carried out by meticulous 'step-by-step' crushing of the tissue with an endoscopic clamp followed by split division of the tissue. A 10-mm ultrasonic dissection device (Ultracision ®, Ethicon, Sommerville, NJ, USA) is the routine instrument for parenchymatous division. Small intraparenchymatous vessels up to 3-mm are easily coagulated and transsected with this device. The larger calibre vessels and biliary pedicle can be ligated with titanium clips and transsected with scissors or with a linear endo-stapler (Endogia ®, Ethicon, Somerville, NJ, USA). After meticulous hemostasis, specimen retrieval was performed through a transumbilical longitudinal or infraumbilical transverse mini laparotomy, up to the surgeon's preference, using a plastic retrieval bag. A low vacuum silicone drain was left behind in all cases. In case of conversion to laparotomy an upper abdominal transverse incision was used.

RESULTS

Between June 1993 and April 2000, 8 females and 2 males underwent laparoscopic treatment of the liver for various conditions. Mean age was 54 years (34 - 71). Mean operative time including LUS measured 180 min (80 – 240). Peroperative blood loss ranged from 200 – 450 cc. There was no mortality. In two patients conversion to laparotomy was necessary. In one patient with a metastasis of a Grawitz carcinoma in segment VI /VII, for which segmentectomy was attempted, tedious bleeding and a very dorsal position of the tumor were the reasons for conversion. In another patient with multiple cysts for which laparoscopic unroofing was performed, there was persistent bleeding from the cysts edges that could not sufficiently be controlled laparoscopically. None of the patients had postoperative complications. Microscopic examination of the specimen demonstrated radical resection margins in all patients with solid lesions. Mean hospital stay was 6 days (range 4 – 11). Median Follow up was 42 months (13 – 80). All resections for mechanical complaints were successful. No recurrences were seen so far. Out of three patients with metastases, one is disease free 13 months after resection of a colorectal metastasis.

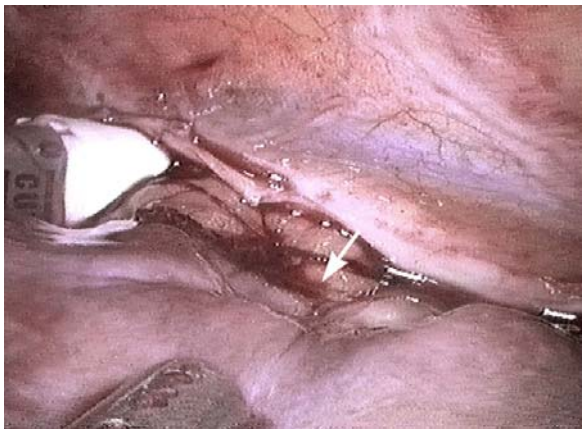

Figure 28. *Metastasis in segment II (arrow)*

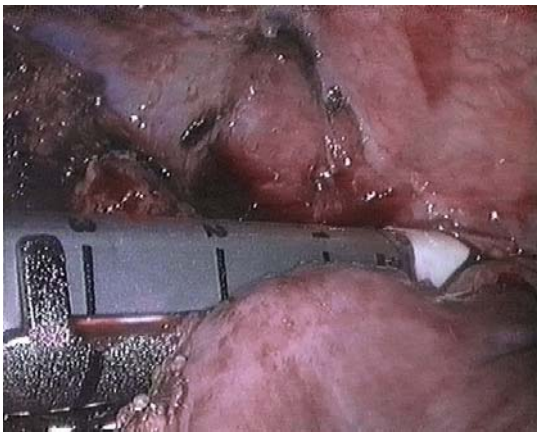

Fig 29. *The left hepatic vein is transsected with the stapler close to the caval vein.*

The patient with a liver metastasis two years after primary treatment of a mamma carcinoma had a disease free postoperative period of one year. She had a recurrence of disease in bones and brain and died two years after her liver surgery. The patient with a metastasis of a Grawitz carcinoma had a recurrence in the greater omentum for which resection was performed one year after his liver surgery. He is disease free since then, with a follow up of 4 years.

DISCUSSION

The benefits of minimal invasive surgery compared to conventional open surgery, have sufficiently been demonstrated for a large number of surgical interventions. Most spectacular improvements in postoperative pain, convalescence and hospital stay however, are reported for endoscopic surgery for solid organs such as the adrenals, the spleen, and the kidney [9,14,21]. Recent literature has shown a rapidly growing number of studies on laparoscopic solid organ surgery, illustrating the increasing penetration of minimal invasive techniques in this particular field. However, this development does not hold for laparoscopic liver surgery.

Except for laparoscopic diagnosis and staging of hepato-biliairy malignancy and minimal invasive ablative treatment of liver metastases in patients with incurable disease by means of radio frequency-, laser- or cryo-surgical techniques, laparoscopic liver surgery is not widely performed [4,5,7,10,25]. Laparoscopic applications in liver surgery have been demonstrated from the early nineties starting mainly with the laparoscopic treatment of cysts and, in time of solid

tumors, but reports are mostly casuistic and generally scarce [4,11,15,16,17,19]. To date, only a few authors can report their experience with larger, multi-segmental resections and hemi-hepatectomies [12,13,23,29]. Clearly, this kind of laparoscopic procedures are time consuming and complex and most suitable for the daring and experienced few. However, a lot of liver lesions are benign in nature and limited in size, so that a small resection or drainage suffices for curation. These lesions appear to be very suitable for a minimal invasive approach. From a theoretical point of view mainly size and location of a lesion should determine feasibility of a laparoscopic resection. Why then is the laparoscopic approach to the liver often considered unpractical or unfeasible?

Liver surgery differs from most other solid organ surgery because it requires a resection of a part of the organ, instead of a whole organ removal. This necessitates dissection of the parenchyma requiring specialized instruments (Jet-Cutter, Cusa, Ultracision, Argon coagulator) [1,24]. No liver resection can be performed without some blood loss and no liver surgeon can disregard the psychological burden of a potential massive hemorrhage. In case of bleeding, laparoscopy could be considered to slow down and hamper adequate response. However, in practice, larger hepatic vessels are individually isolated before division and can usually be controlled, adequately. Serious bleeding is rare in limited resections and can be treated by laparoscopic compression of the bleeding site, followed by laparoscopic ligation or conversion to laparotomy.

CO_2-gas emboli can occur during large resections as is demonstrated in animal experiments [26] and is indeed reported in patients during laparoscopic cholecystectomy and liver resections [8,20,28]. Due to the suction mechanism caused by a high velocity flow, the so-called 'Venturi- effect', air, CO_2 or argon gas is sucked into the liver veins or arteries. High-pressure pneumoperitoneum or use of an argon coagulator may add to this risk. Therefore, several authors advocate a low-pressure pneumoperitoneum or 'gasless' environment during the actual parenchymatous resection phase, using an abdominal wall-lifting device [27,29]. The risk of CO_2-embolism is not to be disregarded, however it is questionable if it plays a significant role in limited resections.

The success of the laparoscopic approach is largely dependent on the exact location of the lesion and its proximity to the larger (vascular) structures of the liver. The absence of tactile responses during laparoscopy must be compensated by direct visualization and laparoscopic ultrasonography. Especially in case of malignancy, local anatomical proportions and oncological resection margins must

be thoroughly evaluated before actual resection is undertaken. Furthermore, evidence in literature, underlines the additional role for LUS in the detection of previously undetected metastases, narrowing the selection of candidates for actual resection [6,22]. We find laparoscopic ultrasonography mandatory before laparoscopic liver resections for both malignant and benign lesions.

As postoperative morbidity is strongly correlated to the length of the surgical incision patients benefit from small incisions. However, liver resections for non-cystic conditions entail some kind of extraction of the resected specimen. Theoretically, the size of the extraction site can be limited when the specimen is crushed in the extraction bag before actual extraction as is commonly done in laparoscopic splenectomy for hematological disease. For benign lesions no real need exists for 'intact' extraction. In case of malignancy, intact extraction for the purpose of pathological examination and determination of radicallity of the resection is often desired. The exact location of the exteriorization is not really important. A transumbilical incision is well tolerated and offers good cosmetic results, because it mostly disappears in the navelpit when the scarring tissue retracts in time. However, best cosmetic results are achieved with a Pfannenstiel incision.

Revolutionary techniques have entered the field of general surgery. Virtual reality imaging of liver disease, computer guided surgery and tele surgery are rapidly evolving techniques that hold a promise for future liver surgery and are easily made compatible with a laparoscopic approach [18]. New instruments, such as the Ligasure® (Tyco international Inc, Exeter, NH, US) that literally seals of blood vessels (diminishing the chance of gas embolism?) may further bring laparoscopic liver surgery within reach. The limited comparative data in literature show that the laparoscopic approach to liver lesions may represent safe and effective treatment in selected patients 15,23. The results from the presented small series do not permit comparison to open liver surgery because of diversity of indications and operations. However, the absence of postoperative complications and relatively short hospital stay is encouraging.

We feel that the benefits of minimal invasive surgery, as demonstrated for so many other conditions now, also holds for laparoscopic liver surgery. Laparoscopic treatment should be considered in selected patients with benign and malignant lesions in the left liver lobe or frontal segments of the liver.

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Chapter 7

Discussion

DISCUSSION

In 1990 nobody would have suspected that nowadays, less than 13 years later, a considerable part of all surgical procedures would be performed endoscopically. In the Netherlands last year, approximately 80% of all cholecystectomies were performed laparoscopically[1]. Groin hernia repair and appendectomy are, with a percentage of around 10%, somewhat falling behind, although percentages for these procedures are many times higher in other European countries and in the US. Laparoscopic colon surgery for benign disease is accepted increasingly and the same goes for laparoscopic treatment of reflux disease and laparoscopic bariatric surgery. Solid organ surgery does not represent a large group within the total of surgical procedures, but is interesting from an endoscopic point of view, because of the potential advantages compared to conventional surgery.

However, in close assessment of these advantages, a number of questions arise. First of all: are the supposed advantages of laparoscopic surgery in comparison to open surgery fact or fiction? Or in other words: what scientific backup exists to support these claims.
For years the surgical practice was largely based on traditional dogmas that were not solemnly based on science, but on tradition, hand-down customs and self-confidence. However, in the past few years there has been a justly aim at so called ‘evidence based medicine’, with the double blind randomised trial as a gold standard for scientific testing. Other scientific assays, among which the case controlled study, leaves more room for study ‘bias’ and are therefore considered as less reliable. It is to be expected that a new technique such as endoscopic surgery, that has gained a worldwide support in such a short period of time, would have been scientifically tested and approved before its worldwide implementation. This however, appears not to be the case. In the world literature randomised trials comparing endoscopic surgery with conventional techniques are scarce. Even with a worldwide-accepted surgical procedure as the laparoscopic cholecystectomy it took several years to produce the first randomised trials [2-7]. Later on some others trials followed hesitantly, describing the beneficial effects of laparoscopic appendectomy, groin hernia repair and surgery for reflux disease [8-17]. Randomised trial to compare endoscopic surgery for Irritable bowel disease are pending and two large international studies after the endoscopic treatment of colorectal

malignancies are still running and results are expected only in the next few years [18-21].

In solid organ surgery randomised studies are practically absent. This may be expected for the surgical rarities such as laparoscopic pancreas or liver surgery. However, Laparoscopic splenectomy and endoscopic adrenalectomy are widely accepted procedures and are even considered standard techniques. This also hold for endoscopic live donor nephrectomy, a procedure that can rejoice in growing international support in spite of, for the present, lacking randomised proof of the advantages. Nevertheless, these endoscopic procedures are undeniably popular, which is furnishing food for thought.

Obviously the benefits of endoscopic surgery have persuaded many surgeons to embrace them despite the absence of elaborate randomised support. On the other hand numerous case controlled studies exist on many of these procedures to emphasize the advantages of laparoscopy. When in the beginning of the nineties laparoscopic cholecystectomy tumultuous conquered the surgical world, the spectacular diminution in postoperative pain and hospital stay was such an improvement compared to the old situation, that randomised studies did not come forth till much later. Many surgeons felt after their early experience with laparoscopic surgery that they would prejudice their patients if they withheld them the obvious advantages. The laparoscopic solid organ surgery struggles with the same dilemma. Apparently, many surgeons find their experience with endoscopic solid organ surgery so much better than their conventional experience that few care for a randomised comparison for the sole purpose of scientific up righteousness. And that's not surprising. Because, despite the differences between procedures, target organs, locations of incision and extend of intra-abdominal trauma, the final comparison roughly boils down to the key question: Does a ten or twenty times larger incision hurt more or less than a small one? In my opinion that is the main reason why some endoscopic procedures will always be performed unrandomised.

Another often heard question is who must perform endoscopic procedures. The words 'laparoscopic surgery' suggest a subspecialty within the broader scale of general surgery, comparable with, for example vascular surgery or traumatology. In that context a 'laparoscopic surgeon' would be logical result. However, endoscopic surgery is merely a term for the performance of well-known surgical procedures, with the aid of endoscopic equipment. That endoscopic surgery

requires specialized and extensive training is certain, the same way as it is required for any procedure in general medicine. A number of the chapters in this thesis describe operations that could be classified as 'advanced laparoscopy'. However, residents and surgeons can well perform laparoscopic splenectomy and endoscopic adrenalectomy with no more than basic laparoscopic skills. These and other endoscopic procedures are in fact part of the normal surgical training program in a number of training hospitals in the Netherlands. The question who should perform endoscopic adrenalectomy is therefore determined by two factors: Sufficient knowledge of adrenal surgery and sufficient endoscopic experience. In that sense the question parallels the discussion about the more complex surgery of oesophagus, liver, pancreas and colon. Studies have demonstrated that mortality and complication rate of (high-risk) conventional procedures are lower in high volume hospital [22-24]. But in practice the question who must perform laparoscopy will proof to be superfluous. Nowadays al surgical residents are trained in basic laparoscopic skills. No surgeon, who finished his or her training in the last five years, is unable to perform a laparoscopic cholecystectomy. Many of them will proof to be capable to perform more advanced laparoscopic procedures.

The future of endoscopic surgery is hard to predict. After a turbulent beginning the technique now finds itself in calmer waters. There is a persistent group of enthusiastic physicians that strongly believes in its benefits and keeps on refining and propagating its techniques. A un going stream of scientific papers in general surgical literature and specialized journals add to the mounting evidence of pros and cons. Some large randomised trials await their unravelling. First results concerning endoscopic versus conventional treatment of colon cancer seems to indicate a benefit in disease free survival in the laparoscopic group [20,21]. If the larger international randomised trials should confirm these findings, this could clearly revolutionize conventional treatment methods. Other running randomised trials in the Netherlands include: donor nephrectomy (EUR), incisional hernia repair (EUR), IBD treatment (AMC), perforated peptic ulcer treatment (MCRZ, St Clara) and obesity surgery (Rijnstate ZH).
Several surgical disciplines in the Netherlands, among which urologists, gynaecologists, surgeons and neurosurgeons have combined forces in an endoscopic association (Nederlandse Vereniging voor Endoscopische Chirurgie) to strive for a joint approach of endoscopic problems and to exchange experiences.

Starting 2003 an endoscopic skills station will start in Rotterdam that aims to train and educate physicians in endoscopic techniques. From patient interest groups, through the media and on the internet the call for minimally invasive techniques is getting louder every day.

Finally there is a strong lobby for endoscopic surgery from certain commercial companies. Presently, many of the limitations of endoscopic surgery can be minimized with better equipment. Using instruments with more degrees of motion and hinge-joint properties improve the limited range of motions in endoscopic surgery. Some of the commercially available operative robots provide these features. Such progress definitely enlightens more difficult endoscopic tasks, such as sewing and knot tying. Stereoscopic vision in endoscopic surgery already exists but is not commonly used. It could, however, mean a large step forward compared to the two dimensional projection that is now the standard. Improved staplers, better dissection instruments and other technical renewal will further facilitate the endoscopic technique. Some firms propagate the so called ‘Endosuite”concept: which is an operating theatre especially designed for endoscopic surgery. In this set up, apart from ergonomic positioning of endoscopic monitors and equipment a lot of emphasis is put on digital recording of procedures for the purpose of documentation and education.

In conclusion, the technique of endoscopic surgery seems here to stay. Only the future can tell if the same can be said of conventional surgery.

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Chapter 8

Summary/ Samenvatting

SUMMARY

The operative procedure through a number of small abdominal incisions is called a ‘laparoscopy’. Laparoscopy refers to the endoscopic inspection of the peritoneal cavity. The term ‘endoscopy’ or ‘endoscopic surgery’ is an overall term for inspection of a hollow organ or cavity through a rigid tube. A laparoscopic procedure holds a lot of potential advantages over conventional ‘open’ surgery. The avoidance of large incisions often leads to diminished postoperative pain and less wound related complications. Patient convalescence is faster and hospital stay is often reduced. Moreover, the cosmetic results are often better than after open surgery. It is therefore no surprise that the laparoscopic approach has become the standard operation for a number of indications. Apart from laparoscopic cholecystectomy, endoscopic groin hernia repair and laparoscopic appendectomy are considered valued surgical alternatives. However, the overall number of indications for laparoscopic surgical treatment remains limited. Unfortunately so! Several organs appear to be very suitable for a laparoscopic approach and treatment. This thesis describes the endoscopic surgery of the, so-called ‘solid abdominal organs’. Unlike for example the stomach, the gallbladder ore the intestines, these organs do not have a central lumen or cavity. The solid abdominal organs are: the adrenal glands, the pancreas, the spleen, the kidneys and the liver.

CHAPTER 1: INTRODUCTION

In this chapter the definitions and endoscopic terminology are explained. The history of endoscopic surgery is enlightened. The rationale of the surgical approach of solid abdominal organs is discussed.

CHAPTER 2: THE ADRENAL GLAND

The adrenals are located in the retroperitoneal space on the cranial side of the kidneys. Although, the adrenal gland itself is a small organ, its position in the retroperitoneal space traditional required a large incision to ensure adequate exposure. The endoscopic approach makes such incisions superfluous and is therefore very suitable for adrenal surgery. In the past different approaches to the adrenal gland have been used. On the one hand the transperitoneal approach, on the other hand the retroperitoneal approach, directly into the retroperitoneal space.

In endoscopic adrenal surgery both approaches are feasible. Although worldwide the transperitoneal route is applied the most, the retroperitoneal route has the theoretical advantage of leading directly into the retroperitoneal space, thus avoiding interference of intra abdominal organs. In a series of 111 endoscopic retroperitoneal adrenalectomies in 95 patients the feasibility op the operation, safety and operative results were studied. 79 Unilateral and 16 bilateral adrenalectomies were performed for various afflictions of the adrenal glands. Endoscopic retroperitoneal adrenalectomy proved to be feasible with acceptable operative times and low blood loss. The percentage of (mostly minor) complications was 11%. Conversion to open adrenalectomy was necessary in only 4.5% of patients. Most patients were discharged from the hospital on the 2nd postoperative day after unilateral adrenalectomy. Endoscopic retroperitoneal adrenalectomy is the method of choice for benign tumors of the adrenal gland which are smaller than 6 cm in diameter.

A distinct group of adrenal tumors, the pheochromocytomas, is notorious because of their capacity to produce substances that influence hart rate and blood pressure. Dangerous variations in heart rate and blood pressure can occur during an operation, when the tumor is manipulated and vasoactive hormones are released into the circulation. For that reason it is standard policy to administer vasoactive hormone blocking medication to patients with a pheochromocytoma, preoperatively. Many surgeons state that it is mandatory to ligate the efferent adrenal veins as early as possible during adrenalectomy, in order to avoid release of vasoactive hormones into the circulation. During endoscopic retroperitoneal adrenalectomy, the adrenal vein is identified and ligated only at the end of the operation. In a series of 18 endoscopic retroperitoneal adrenalectomies for pheochromocytomas, no significant changes in heart rate or blood pressure occurred. The presence of a pheochromocytoma is therefore no impediment for endoscopic retroperitoneal adrenalectomy.

CHAPTER 3: THE PANCREAS

The pancreas is a digestive organ, which on the one hand produces digestive enzymes that are excreted into the intestine and on the other hand produces substances responsible for regulation of the blood glucose levels, such as insulin. The pancreas is situated in the dorsal portion of the abdomen behind the stomach and the transverse colon and is for that reason sometimes hard to reach even in

open surgery. An insulinoma is mostly a small, solitary, benign tumor. It produces excessive amounts of insulin, which can cause a drop in blood glucose levels leading to fainting or even cerebral damage. The main problem in the surgical treatment of an insulinoma is the fact that it cannot always be located with preoperative imaging techniques. Therefore, adequate detection of an insulinoma often depends on palpation of the pancreas during exploratory surgery, sometimes combined with intraoperative ultrasonography. In laparoscopic surgery for insulinomas tactile response is lacking, which could be a problem in adequate detection. Alternatively laparoscopic ultrasonography can aid localization of the insulinoma. In a series of 10 consecutive patients with a clinically manifest insulinoma of the pancreas, the tumor could be detected with laparoscopic ultrasonography in 90% of patients. In 60% laparoscopic resection of the insulinoma was feasible. The blood loss during laparoscopic resection of an insulinoma is low and there are few complications.

Another affliction of the pancreas suitable for laparoscopic surgery is a 'pseudocyst'. A pseudocyst is a cavity adjacent to the pancreas filled with pancreatic enzymes. It arises after a period of acute or chronic pancreatitis. A pseudocyst is situated behind the stomach and can give rise to persistent pain and/or obstructive complaints. One of the therapeutic modalities consists of anastomosing the pseudocyst to a hollow organ, such as the stomach or the small intestine. Because this procedure does not entail removal of an organ, an abdominal incision is unnecessary. Out of a series of 6 patients laparoscopic treatment of a pseudocyst proved to be successful in 5 patients (83%). Postoperatively, 5 out of 6 patients were free of symptoms.

CHAPTER 4: THE SPLEEN

The spleen is very suitable for laparoscopic removal, because it is relatively easily accessible and can after intra abdominal morcellation be extracted in small pieces, so that no large incision is necessary. Several studies have demonstrated the advantages of laparoscopic splenectomy over open splenectomy with regard to postoperative pain and convalescence.

Splenectomy is sometimes indicated in patients with various hematological diseases, among which ITP (Idiopathic Thrombopenic Purpurae). This disease causes rapid annihilation of platelets by the spleen, leading to an increased tendency to haemorrhaging or even spontaneous bleeding. After splenectomy, there is often a spectacular increase in platelet count. However, as time elapses

the platelet count relapses to preoperative values. Two factors can contribute to this phenomenon: the presence of accessory spleens or breaking of the splenic capsule during surgery and subsequent seeding of splenic tissue. Some authors have stated that laparoscopic splenectomy increases the chance of residual splenic tissue and therewith the chance of relapse of the disease. Because the technique of laparoscopic splenectomy is relatively young, data on longer-term hematological results were non-existent. In a study of 50 patients who underwent laparoscopic splenectomy the haematological results after a mean follow-up of more than 3 years, were compared to a historic group of patients who underwent open splenectomy. The number of relapses of ITP was comparable in both study groups, but after laparoscopic splenectomy there were less complications and a shorter hospital stay. Laparoscopic experience in solid organ surgery has evolved to a level that laparoscopic splenectomy for ITP is safe, with low morbidity and fast convalescence. Hematological results after laparoscopic splenectomy for ITP are comparable to those after open splenectomy both on the short and on the long-term.

CHAPTER 5: THE KIDNEY

Living related kidney transplantation provides the best graft survival result for patients with kidney failure. The concept of removal of a healthy organ in optimal condition from a healthy individual is unique in general surgery. Kidney donation is for the donor not without risk of shorter term and longer-term morbidity. Traditionally nephrectomy requires a considerable incision, which is associated with pain and risk of complications. The promise of reduced discomfort and a reduced complication rate is especially in this patient group very appealing. Laparoscopic live donor nephrectomy was attempted in 57 patients and successfully completed in 54 patients (94.7 %). Patient characteristics and operative results were compared to a historic control group of 27 patients that underwent standard flank live donor nephrectomy between September 1996 and December 1997. Although especially at the beginning of the laparoscopic procedure operative time was considerably longer, complication rate was significantly lower than after open nephrectomy. Furthermore, patients used fewer analgesics after laparoscopy and were sooner discharged from the hospital. Warm ischemia time was significantly longer during the laparoscopic procedure. However, longer warm ischemic times were not translated into delayed graft function. At the end of the study all grafts were functioning well. Right laparoscopic

nephrectomy seems easier and somewhat faster than left nephrectomy. Laparoscopic live donor nephrectomy is technically feasible and can be performed safely. It offers the kidney donor a considerable decrease in postoperative discomfort and allows for faster recovery and shorter hospital stay.

CHAPTER 6: THE LIVER

Liver surgery in general is considered to be technically difficult and tedious even if performed conventionally and is in many centres left to specialized surgeons. The technical complexity of liver surgery, risk of life threatening bleeding and fear of gas embolism have withheld many to embark on laparoscopic liver surgery. However, a number of hepatic lesions do not require large and complex resections but can be treated with relatively simple surgical interventions. In chapter 6, 10 patients and indications for laparoscopic liver surgery are discussed and the technique of laparoscopic liver surgery is demonstrated. Operations consisted of unroofing for abscesses and cysts and wedge resections and segmentectomies for solid tumors. Peroperative blood loss ranged from 200 – 450 cc. There was no mortality. In two patients conversion to laparotomy was necessary. Laparoscopic ultrasonography seems mandatory before laparoscopic liver resections for both malignant and benign lesions. The benefits of minimal invasive surgery, as demonstrated for so many other conditions now, also hold for laparoscopic liver surgery. Laparoscopic treatment should be considered in selected patients with benign and malignant lesions in the left liver lobe or frontal segments of the liver.

SAMENVATTING

Het opereren van patiënten via kleine sneetjes in de buik wordt een laparoscopische operatie of ook wel een ‘kijkoperatie’ genoemd. De term ‘laparoscopie’ betreft kijkoperaties in de buikholte, dwz binnen het buikvlies. Omdat er ook kijkoperaties buiten de buikholte bestaan, wordt vaak de term ‘endoscopie’ gebruikt, die een verzamelnaam is voor alle kijkoperaties binnen en buiten de buikholte. Een endoscopische operatie kan belangrijke voordelen hebben voor de patiënt. Het achterwege laten van een grote snede in de buik leidt veelal tot minder pijn en minder wondcomplicaties. Patiënten zijn vaak sneller uit bed, sneller uit het ziekenhuis en sneller weer aan het werk. Bovendien is het cosmetisch resultaat na endoscopie vaak fraaier dan na een ‘open’ operatie. Het is dan ook niet verwonderlijk dat voor een aantal operaties, zoals bijvoorbeeld het verwijderen van een galblaas, de kijkoperatie de voorkeursmethode is geworden. Andere ingrepen zoals liesbreukchirurgie of laparoscopische verwijdering van een blinde darm worden regelmatig uitgevoerd door laparoscopisch geïnteresseerde chirurgen. Toch blijft het totaal aantal laparoscopisch uitgevoerde operaties, ondanks de potentiële voordelen, beperkt. En dat is jammer. Een aantal organen in de buik blijken uitermate geschikt om door middel van een endoscopische operatie benaderd of verwijderd te worden. Dit proefschrift behandeld de endoscopische chirurgie van de zogenaamde ‘solide buikorganen’. Dat wil zeggen: buikorganen zonder holte, zoals de galblaas, maag of darm. Tot de solide buikorganen worden gerekend: de bijnieren, de alvleesklier, de milt, de nieren en de lever.

HOOFDSTUK 1: INTRODUCTIE

In dit hoofdstuk worden de definities van de verschillende endoscopische termen weergegeven. De geschiedenis van het endoscopisch opereren wordt chronologisch behandeld. De rationale van de endoscopische benadering van de solide organen wordt besproken.

HOOFDSTUK 2: DE BIJNIER

De bijnieren bevinden zich aan de bovenzijde van de nieren in de ruimte achter het buikvlies: de zogenaamde retroperitoneale ruimte. De bijnier is een klein orgaan dat evenwel vanwege zijn ligging achterin de buik in het verleden vaak een

grote incisie behoefde voor een adequaat exposé van het operatiegebied. Endoscopisch opereren maakt een dergelijke grote snede overbodig en om die reden leent de bijnier zich bij uitstek voor een endoscopische verwijdering. Van oudsher zijn er verschillende operatieve routes om de bijnier te benaderen toegepast. Enerzijds is er de toegang vanaf de voorzijde door de buikholte, de transperitoneale benadering, anderzijds is er de toegang vanaf de achterzijde direct in de retroperitoneale ruimte, de retroperitoneale benadering. Ook bij endoscopische bijnierchirurgie zijn beide benaderingen mogelijk. Hoewel wereldwijd de transperitoneale benadering het meeste wordt toegepast, zijn er op theoretische gronden voordelen verbonden aan de retroperitoneale route. Immers deze benadering leidt direct via de bedoelde ruimte, zonder hinder van andere (buik)organen, naar de bijnier. In een serie van 111 retroperitoneale endoscopische bijnieroperaties in 95 patienten werd gekeken naar de uitvoerbaarheid van de operatie, de veiligheid en de operatieresultaten.
Er werden 79 unilaterale en 16 bilaterale adrenalectomieën uitgevoerd voor uiteenlopende bijnieraandoeningen. Retroperitoneale endoscopische bijnier extirpatie bleek goed uitvoerbaar met een gemiddelde operatietijd van 114 minuten voor enkelzijdige bijnierverwijdering. Het mediane bloedverlies was met 65 ml laag, en de het percentage (meest kleine) complicaties bedroeg 11%. Conversie naar open bijnierextirpatie was nodig bij slechts 4,5 % van de patienten. De meeste patiënten konden 2 dagen na een enkelzijdige bijnierverwijdering uit het ziekenhuis worden ontslagen. Endoscopische retroperitoneale chirurgie is de methode van keus voor benigne bijnier tumoren, die kleiner zijn dan 6 cm.

Een bepaalde groep van bijniertumoren de zogenaamde pheochromocytomen is berucht vanwege hun vermogen stoffen te produceren die de hartslag en bloeddruk sterk kunnen beïnvloeden. Gevaarlijke wisselingen in de hartslag en bloeddruk kunnen tijdens de operatie optreden als de tumor gemanipuleerd wordt en deze bijnierhormonen in de bloedbaan worden uitgestoten. Om die reden krijgen patiënten met een pheochromocytoom altijd voor de operatie medicijnen die de werking van de bijnierhormonen blokkeren. Door veel chirurgen wordt gesteld dat daarnaast zo vroeg mogelijk in de operatie de afvoerende bloedvaten van de bijnier moeten worden afgebonden om uitstoot van bijnierhormonen te voorkomen. Bij de endoscopische retroperitoneale operatie worden deze vaten pas aan het einde van de ingreep gezien en verbonden. Uit bestudering van een serie van 18 retroperitoneale endoscopische bijnier verwijderingen voor een

pheochromocytoom. blijken nauwelijks veranderingen in hartslag en bloeddruk op te treden tijdens de operatie. De aanwezigheid van een pheochromocytoom is dan ook geen beletsel voor een retroperitoneale endoscopische benadering.

HOOFDSTUK 3: DE ALVLEESKLIER

De alvleesklier of pancreas is een spijsverteringsorgaan dat verantwoordelijk is enerzijds voor afgifte van verteringsenzymen aan de darm en anderzijds van stoffen verantwoordelijk voor regulatie van de bloedsuikerspiegel, zoals bijvoorbeeld insuline. De alvleesklier is diep in de bovenbuik gelegen achter de maag en het dwarse deel van de dikke darm en om die reden zelfs in open chirurgie soms moeilijk bereikbaar. Het insulinoom is een meestal op één plaats in de pancreas gelokaliseerde, veelal goedaardig gezwel van geringe afmetingen. Het insulinoom produceert een overmatige hoeveelheid insuline en kan zo aanleiding zijn tot te lage bloedsuiker waarden hetgeen leidt tot flauwvallen of zelfs hersenschade. Het voornaamste probleem bij de chirurgische behandeling van insulinomen is dat ze met afbeeldend onderzoek voorafgaand aan een operatie, niet altijd te vinden zijn. Voor adequate detectie werd daarom traditioneel in belangrijke mate vertrouwd op manueel onderzoek van de pancreas veelal gecombineerd met een echografisch onderzoek tijdens de operatie. In theorie is laparoscopie de aangewezen manier om een insulinoom te behandelen omdat het meestal een kleine, goedaardige afwijking betreft, die via een klein sneetje verwijderd zou kunnen worden . Bij laparoscopische behandeling ontbreekt echter de tactiele respons hetgeen een probleem zou kunnen zijn voor de detectie. Als alternatief kan laparoscopische echografie worden vervaardigd om het insulinoom te vinden. Uit onderzoek van een serie van 10 opeenvolgende patiënten met een insulinoom van de pancreas bleek het insulinoom in 90% van de gevallen goed te vinden te zijn met een laparoscopische echografie. In 60% van de gevallen bleek laparoscopische verwijdering van de afwijking goed uitvoerbaar. Het bloedverlies bij laparoscopische verwijdering van een insulinoom was laag en er waren weinig complicaties.

Een tweede afwijking van de pancreas, die zich in opzet leent voor laparoscopische behandeling is de ‘pseudocyste’. Een pseudocyste is een met pancreasenzymen gevulde holte buiten de pancreas, die ontstaat als complicatie op een acute of chronische ontsteking van de pancreas. Een pseudocyste is vaak gelegen achter de maag en kan aanleiding zijn voor hardnekkige pijn en/of passageklachten. Behandeling bestaat meestal uit het chirurgisch verbinden van

de holte met een ander hol orgaan, zoals de maag of de darm, zodat een permanente drainage mogelijk is. Omdat voor deze ingreep geen orgaan verwijderd hoeft te worden kan ook hier een incisie achterwege blijven. In een serie van zes patiënten bleek laparoscopische behandeling van de pseudocyste in 5 gevallen succesvol (83%). Van 6 patiënten waren er 5 klachtenvrij na de operatie.

HOOFDSTUK 4: DE MILT

De milt is een orgaan dat zich bij uitstek leent voor laparoscopische verwijdering, omdat het orgaan goed benaderbaar is in de buik en bovendien in vermalen toestand in kleine delen uit de buik kan worden gezogen zonder dat een aparte incisie nodig is. Meerdere studies hebben de voordelen van laparoscopische verwijdering van de milt boven open behandeling aangetoond. Miltverwijdering wordt onder andere verricht bij patiënten met hematologische aandoeningen, zoals de ziekte Idiopathische Trombocytopenische Purpurae (ITP), waarbij de bloedplaatjes in versnelde mate door de milt worden afgebroken, hetgeen aanleiding is voor een verhoogde bloedingsneiging of zelfs spontane bloedingen. Na het verwijderen van de milt stijgt meestal het aantal bloedplaatjes spectaculair. Bij een aantal patiënten wordt echter na verloop van jaren een terugval gezien. Twee oorzaken kunnen hieraan bijdragen: Het achterlaten van kleine bijmilten of beschadiging van de milt tijdens verwijdering, waardoor cellen uit de milt achterblijven die tot nieuw miltweefsel kunnen uitgroeien. In sommige studies is beweerd dat de laparoscopische miltverwijdering een verhoogde kans geeft miltweefsel achter te laten en daarmee de kans of recidivering van de ziekte kan vergroten. Omdat de techniek van laparoscopische miltverwijdering nog relatief jong, is ontbraken echter de gegevens om het hematologisch resultaat na laparoscopie op de lange termijn te toetsen. Wij vergeleken het hematologisch succes van 50 laparoscopisch geopereerde patiënten met een gemiddelde follow-up van ruim 3 jaar met een historische groep van 31 open geopereerde patiënten. Het aantal recidieven van ITP blijkt in beide groepen vergelijkbaar, maar de laparoscopische miltverwijdering heeft belangrijke voordelen voor wat betreft postoperatieve complicaties en opnameduur.

HOOFDSTUK 5: DE NIER

Bij patiënten die in aanmerking komen voor een niertransplantatie blijkt de transplantatie van een nier van een levend familielid de beste resultaten te geven.

Hiertoe is het noodzakelijk dat een gezonde nier verwijderd wordt bij overigens gezonde donor. Traditioneel was voor de verwijdering van een nier een forse incisie nodig, hetgeen gepaard gaat met postoperatieve pijn en kans op complicaties. Laparoscopische nierverwijdering ten behoeve van donatie werd geprobeerd bij 57 patiënten en succesvol gecompleteerd bij 54 patiënten (94,7%). Patiëntengegevens enoperatieresultaten werden vergeleken met een historische groep van 27 patiënten, die een open nierverwijdering ten behoeve van transplantatie hadden ondergaan in de jaren ervoor. Laparoscopische verwijdering bleek niet alleen goed uitvoerbaar, maar gaf minder postoperatieve complicaties, minder pijn en een leidde tot een kortere opnameduur. De warme ischaemie tijd, is de tijd dat de transplantatienier zonder bloed is maar nog niet gekoeld wordt. Deze warme ischaemietijd was in de laparoscopie groep aanzienlijk langer. Dit vertaalde zich echter niet in verminderde functie van de transplantatienieren. Aan het eind van de studie functioneerden alle transplantaten naar behoren. Het uitnemen van een nier van de rechter kant van de patiënt Lijkt eenvoudiger en sneller. Laparoscopische nierverwijdering ten behoeve van transplantatie is goed uitvoerbaar en is veilig voor donor en ontvanger. Het biedt de nierdonor een aanzienlijke afname in postoperatief ongemak en leidt tot een sneller herstel en kortere ziekenhuis opname.

HOOFDSTUK 6: DE LEVER

Chirurgische behandeling van leveraandoeningen wordt in de algemene heelkunde veelal als complex ervaren en meestal overgelaten aan gespecialiseerde chirurgen. De lever is erg bloedrijk en verwijderen van een deel van de lever heeft daarom ook de potentie van levensbedreigende bloedingen. Mede om die reden is de laparoscopische behandeling van leveraandoeningen zeldzaam. Toch is er een aantal aandoeningen dat zich goed leent voor laparoscopische verwijdering. In hoofdstuk 6 wordt een tiental patiënten en indicaties voor laparoscopische leverchirurgie besproken en de techniek gedemonstreerd. Operaties bestonden uit verwijderen van het dak van cystes of abcessen, ofwel wigresecties en segmentresecties voor solide tumoren. Het peroperatieve bloedverlies was 200 –450 cc. Geen van de patiënten overleed. In twee patiënten was conversie naar een open operatie noodzakelijk. Laparoscopische echografie blijkt noodzakelijk voorafgaand aan een resectie van zowel goedaardige als kwaadaardige afwijkingen. De voordelen van de minimaal invasieve chirurgie, die voor zoveel andere aandoeningen al zijn aangetoond,

lijken ook te gelden voor laparoscopische leverchirurgie. Bij geselecteerde patiënten met goedaardige of kwaadaardige afwijkingen in de linker leverkwab of frontale segmenten moet laparoscopische behandeling overwogen worden.

Chapter 9
Publications

LIST OF PUBLICATIONS INCLUDED IN THE PRESENT THESIS
(NUMBERS IN BOLD REFER TO CHAPTERS)

2. Berends FJ, Bruining HA, De Herder WW, Bonjer HJ. Endoscopic retroperitoneal adrenalectomy. Acta Chir Austriaca 1999;31:200-2.

2. Bonjer HJ, Sorm V, Berends FJ, Kazemier G, Steyerberg EW, de Herder WW, Bruining HA. Endoscopic retroperitoneal adrenalectomy: lessons learned from 111 consecutive cases. Ann Surg. 2000 Dec;232(6):796-803.

2. Berends FJ, Kazemier G, de Herder WW, Bruining HA, Bonjer HJ. Safe endoscopic retroperitoneal resection of phaeochromocytomas. World J Surg 2002 May;26(5):527-31.

3. Berends FJ, Cuesta MA, Kazemier G, van Eijck CH, de Herder WW, van Muiswinkel JM, Bruining HA, Bonjer HJ. Laparoscopic detection and resection of insulinomas. Surgery. 2000 Sep;128(3):386-91.

3. Berends FJ, Yuan JZ, Craanen ME, Prevoo W, Cuesta MA. Laparoscopic assisted cysto-gastrostomy for pancreatic pseudocysts. Submitted

4. Berends FJ, Schep N, Cuesta MA, Bonjer HJ, Kappers-Klunne MC, Huijgens P, Kazemier G. Hematological long-term results of laparoscopic splenectomy for patients with idiopathic thrombocytopenic purpura. Submitted.

4. Schep NWL, Berends FJ, Bonjer HJ, Valkema R, Kappers Klunne MC, Kazemier G.Laparoscopic splenectomy for ITP, long term results and the re;ation with splenosis and accessory spleens. Submitted.

4. Den Hoed PT, Van Wessem KJP, Berends FJ, Kappers-Klune MC, Kazemier G, Bonjer HJ. Laparoscopische splenectomie voor hematologische aandoeningen. Ned Tijschr Geneeskd 1999;143:1222-5.

5. IJzermans JNM, Berends FJ, Van Riemsdijk IC, Weimar W, Bonjer HJ. Laparoscopische donornefrectomie bij familieniertransplantaties; gunstige eerste ervaringen. Ned Tijdschr Geneeskd. 1999;143:942-5.

5. Berends FJ, den Hoed T, Weimar W, G Kazemier, Bonjer HJ, IJzermans JNM. Technical considerations and pitfalls in laparoscopic live donornephrectomy. Surg Endosc. 2002 Jun;16(6):893-8.

6. Berends FJ, Meijer S, Prevoo W, Bonjer HJ, Cuesta MA. Technical considerations in laparoscopic liver surgery. A solid organ easily forgotten? Surg Endosc 2001 Aug;15(8):794-8

Chapter 10
Curriculum vitae

Frederik Jan Berends werd op 6 januari 1964 geboren te Naarden als derde in een gezin van vier kinderen. Nadat hij in 1982 het VWO diploma behaalde aan het Goois Lyceum in Bussum, startte hij met de studie geneeskunde aan de Rijks Universiteit Utrecht. Tijdens de co-assistentschappen voorafgaand aan het behalen van zijn artsexamen in 1990 werd het hem duidelijk dat hij zich wilde specialiseren tot chirurg. Eerst werkte hij twee jaar als niet- opleidingsassistent in het Diaconessenhuis in Utrecht (opleider: Dr. P. Leguit) en aansluitend nog een jaar in het St. Franciscus Gasthuis in Rotterdam (opleider: Dr. J.C.J. Wereldsma). In 1993 kon hij beginnen met de eerste 3 jaren van zijn opleiding in het St. Clara ziekenhuis in Rotterdam (opleider: Dr. T.I. Yo). In die tijd werd zijn interesse gewekt voor een relatief nieuwe techniek binnen de algemene heelkunde: de endoscopische chirurgie. Tijdens de 3 vervolgjaren in het Academisch ziekenhuis Rotterdam 'Dijkzigt' (opleiders: Prof. Dr. H.A. Bruining, later Prof. dr. HJ Bonjer) groeide zijn belangstelling voor de gastro-intestinale chirurgie, hetgeen zich goed laat combineren met endoscopisch opereren. Daar werd onder leiding van Prof. dr. H.J. Bonjer de basis gelegd voor wat later dit proefschrift zou worden. Na het voltooien van de specialisatie in 1999 deed hij zijn chirurgische vervolgopleiding Gastro-intestinale chirurgie in het 'Vrije Universiteit' Medisch Centrum (opleider Prof. dr. H.J.Th.M. Haarman). Onder leiding van Prof. dr. M.A.Cuesta leerde hij de de fijne kneepjes van zowel de maag-darmchirurgie als van de laparoscopie. De gecombineerde ervaringen Dijkzigt en VU leverden uiteindelijk het materiaal voor de publicaties in dit boek. Vanaf september 2001 werkt hij als algemeen chirurg in het Rijnstate ziekenhuis te Arnhem, een plek waar hij nog vele jaren hoopt te blijven. Hij woont met zijn geliefde Jetske in Oosterbeek. Binnenkort verwachten zij hun eerste kind.

Chapter 11
Dankwoord

Het dankwoord van een proefschrift is in het wetenschappelijk totaal van het boekwerk van ondergeschikt belang. En toch is dat juist één van de meest gelezen onderdelen. En terecht! Niemand die ooit een proefschrift schreef deed dat geheel alleen. Al was het alleen maar dat anderen de ideeën, het commentaar, de gelegenheid of de ondersteuning leverden. Of zelfs slechts de vriendelijke belangstelling naar het vorderen van de wetenschappelijke pennevrucht. Van sommigen is de bijdrage aanzienlijk geweest, van anderen minder, maar vrijwel ieder van u, die dit boek in handen houdt en het dankwoord heeft opengeslagen is voor mij een meer of minder goede bekende en heeft enige rol gespeeld in mijn leven en daarmee tot het tot stand komen van dit boek. Daarvoor mijn dank!

Enkelen verdienen een speciaal woord van dank:

Johan Lange behoorde in Nederland tot de pioniers op laparoscopisch gebied. Hij was het, toen ik in 1993 mijn opleiding tot chirurg startte in het St Clara ziekenhuis, die mijn belangstelling voor de laparoscopie wekte. Zijn kundigheid , enthousiasme en creativiteit zetten mij op het spoor van wat later tot dit boek zou uitgroeien. Nog steeds geniet ik, bij congressen, van zijn eigenzinnige voordrachten, zijn spitsvondigheid en zijn gezelschap.

Jaap Bonjer wist later mijn enthousiasme voor de endoscopie nog aan te wakkeren en werd uiteindelijk mijn promotor. Ik had het niet beter kunnen treffen. Als eerste hoogleraar in de minimale chirurgie in Nederland is hij niet alleen een onovertroffen ‘expert in the field’, hij is ook een niet af te remmen ideeën machine, revisiteur en stimulans en bovenal een goede vriend. Zijn inspanningen op het gebied van de endoscopie hebben niet alleen bijgedragen aan het tot stand komen van deze promotie, maar zijn een stuwende kracht in de implementatie en

promotie van de techniek in ons land. Ik hoop nog lang, ook na deze promotie, met hem samen te kunnen werken.

Miguel Cuesta is de tweede hoogleraar minimaal invasieve chirurgie in Nederland en ook tweede promotor. Wat ik van hem geleerd heb gaat verder dan dit boek. Hij is een opleider, zoals die vrijwel niet te vinden zijn: een begenadigd operateur, een filosoof, een wandelende encyclopedie, een mensenkenner en daarnaast één van de aardigste mensen die ik ken. Van hem leerde ik niet alleen de fijne kneepjes van het vak, maar ook over relaties, eten, verre reizen en wetenschap, kortom over het leven zelf. Naast coach, inspirator en voorbeeld werd hij vooral ook één van mijn beste vrienden.

Geert Kazemier was mijn maatje gedurende vrijwel mijn hele opleiding en is dat nog steeds. Jarenlang praatten en dachten wij in en buiten het ziekenhuis over het vak en andere zaken. Hij was al die tijd mijn vaste sparring partner in discussies over de chirurgie als geheel en de endoscopie in het bijzonder. Verder wijdde hij mij in in de geneugten van lekker eten, drank, sigaren en snelle auto's. Hij zette mij er toe aan, altijd het onderste uit de kan te halen en nooit genoegen te nemen met 'second best'. Zijn intelligentie, rappe tong, creativiteit en vriendschap maken dat ik mij geen betere paranimf kan wensen.

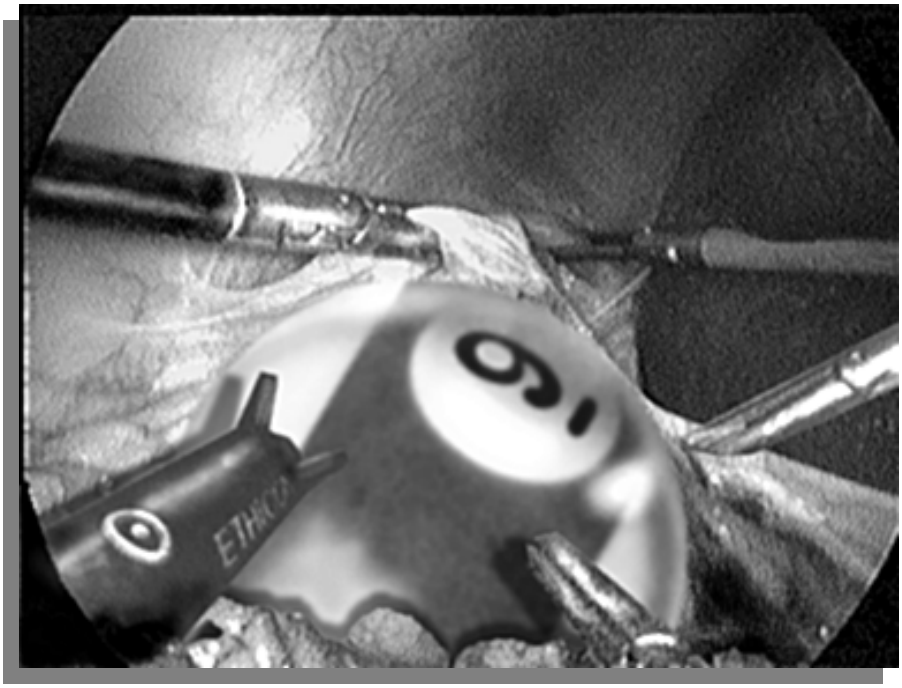
Evert van Santbrink is mijn jaarclubgenoot en beste vriend door de jaren heen. Al vanaf het begin van de studie hebben wij samen veel gedeeld. Dat hij later, ook in Rotterdam, opgeleid werd tot gynaecoloog heeft onze band alleen maar versterkt.
Ik vind in hem altijd een luisterend oor. Hij is een positief mens en ik weet altijd op hem te kunnen rekenen. Naast onze vriendschap delen we een gezamenlijke belangstelling voor de endoscopie ik prijs me gelukkig dat hij mijn andere paranimf wil zijn.

Mijn maten in het Rijnstate ziekenhuis dank ik voor hun vertrouwen in mij en mijn completeren van dit proefschrift. Dagelijks geniet ik van hun kennis, ervaring, hulp en vriendschap. Het is een groot goed te mogen werken in zo'n inspirerende omgeving en met zoveel plezier.

Mijn ouders zijn de liefste van de wereld. Ik dank ze voor hun levenslange liefde, steun en vertrouwen. Wat een feest dat ze deze promotie in goede gezondheid

mogen meemaken. Mijn verdere familie, schoonfamilie, jaarclubgenoten en vrienden, dank voor jullie getoonde begrip als ik weer eens te weinig tijd voor jullie had.

Mijn allerliefste Jetske, Je hebt fysiek aan dit proefschrift bijgedragen door me te helpen met literatuuronderzoek, revisies en lay-out. Met je onvoorwaardelijke steun, je werklust, je intelligentie en je liefde ben je een onuitputtelijke inspiratiebron. Met jou een baby te krijgen is het mooiste wat me kan overkomen. Wat is het fijn zoveel van iemand te houden.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