Colocolpopoiesis

The use of sigmoid colon

in the treatment of conditions associated with

absence of the vagina

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Colocolpopoiëse - Het gebruik van sigmoid bij de behandeling van ziektebeelden die gepaard gaan met een afwezige vagina

Proefschrift

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Ingrid Freundt

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Ie ne suis masle ny femelle
Et sy ie suis bien en ceruelle
Lequel des deux ie doibs choisir
Mais qu'importe à qui on ressanble
Il vault mieux les auoir ensemble
On en reçoit double plaisir.

Uit Thomas Artus "Les Hermaphrodites" (Paris 1605)
(Bayerische Staatsbibliotheek München)

TABLE OF CONTENTS

INTRODUCTION

Objectives and outline
of this thesis

The creation of a coitally functional vagina is an important part of sexual rehabilitation in patients with congenital or acquired absence of the vagina, and in male-to-female transsexuals. Various conservative and surgical techniques have been developed to construct an artificial vagina. Most of the operative techniques were based on the dissection of a cavity between the bladder and the rectum with subsequent grafting of various materials onto the walls of the tunnel. Nowadays, the most popular methods involve the lining of a surgically created rectovesical space with skin grafts. The major drawback is the stenosing tendency of the newly created channel. Life-long dilatations are required to assure its patency.

The search for methods to construct a permanently patent neovagina has prompted surgeons to use various parts of the intestine to line the rectovesical cavity. It is assumed that an intestinal neovagina retains its immediate postoperative dimensions even without regularly performed dilatations, but the operative techniques are difficult and in the past, fatalities were reported.

Sigmoid segments with intact mesenterial blood supply have been used for colpopoiesis since 1914 [1]. In 1975 it was stated that long-term anatomic and functional results were superior to that of other techniques [2]. Since 1983, a modified colocolpopoiesis technique is applied at the University Hospital Rotterdam Dijkzigt to treat conditions associated with absence of the vagina. Until 1991, 45 patients underwent this operation. Data from these patients are presented in this manuscript.

The objectives of the present study were to determine the short-term and long-term outcome after colpopoiesis from the sigmoid colon, to evaluate the histopathologic and microbiologic features of the isolated sigmoid conduit, and to discuss the complications of sigmoid vaginoplasty. This thesis comprises the following sections:

11

1. An introduction to the conditions associated with a missing vagina, divided into three categories: the congenital vaginal malformations, the acquired or secondary loss of the vagina, and male-to-female transsexualism (chapter 1).

2. A historic review of the different conservative and surgical methods to create a neovagina, distinguishing between non-intestinal (chapter 2) and intestinal techniques for vaginoplasty (chapter 3).

3. A description of the modified colocolpopoiesis technique applied at the University Hospital Rotterdam Dijkzigt, with retrospective data on postoperative complications and short-term outcome in a series of 40 patients who underwent this operation between 1983 and 1988 (chapter 4).

4. An evaluation of the long-term psychosexual and psychosocial performance of 19 patients with a sigmoid neovagina, realized with a questionnaire, a structured interview, and standardized gynecologic examination (chapter 5).

5. A histopathologic examination of biopsy specimens from 13 patients with a sigmoid neovagina, to investigate the occurrence of diversion colitis in these isolated sigmoid segments (chapter 6).

6. A study of the bacterial microbiota of 15 sigmoid neovaginas (chapter 7).

7. Case reports on rare complications of sigmoid vaginoplasty. Three cases of prolapse of the sigmoid neovagina that were corrected by various surgical procedures, are presented (chapter 8). In one patient, postoperative peritonitis with subsequent intraabdominal abscess formation due to anastomotic leakage, is described (chapter 9).

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CHAPTER 1

Conditions associated with absence of the vagina

1.1. The syndrome of Mayer-Rokitansky-Küster

The conditions associated with a missing vagina may be divided into three categories: the congenital vaginal malformation, the acquired, secondary loss of the vagina, and male-to-female transsexualism. The most common form of congenital vaginal aplasia or dysplasia is associated with a rudimentary uterus and generally known as the syndrome of Mayer-Rokitansky-Küster [1]. The incidence of vaginal dysgenesis is still unknown. Different authors reported largely varying estimates: one case in every 1418 gynecologic admissions [2], once in every 4000 [3] to 20000 female admissions [4], or once in 5000 [5] to 80000 female births [6].

1.1.1. History

In 1829, the German Mayer published a series of uterine malformations observed during post mortem examinations. Amongst others, he described one case of a 53-year-old woman with a vaginal blind pouch measuring one and a half inches. The appearance of the external genitalia was unconspicuous except for a dilated urethral orifice. The ovaries and tubes were normal, but the uterus consisted of two rudimentary plum-shaped structures united by a fibrous strand of tissue. Mayer thought this entity to be a particular form of uterus bicornis without uterine cavity and called it "uterus bipartitus" [7]. Similar post mortem findings were described in another case, in 1838, by the Austrian Rokitansky, who maintained Mayer's classification of uterine malformations (Figure 1)[8]. In the 19th century, bilateral ovariectomy was frequently performed to "treat" patients with a rudimentary uterus and vagina [9-11]. In many patients a dilated urethral orifice was described, probably resulting from repeated attempts at intercourse (Figure 2)[10]. A review of the literature, with a detailed description of 45 cases of vaginal dysgenesis, was presented by the German Küster in 1910, who suspected the "uterus bipartitus solidus rudi-

mentarius cum vagina solida" to be a developmental disorder resulting from non-fusion or incomplete cavitation of the Müllerian ducts. Also, the frequent association with renal anomalies was noted [12]. At the recommendation of the Swiss Hauser and Schreiner, the congenital absence of the vagina with concomitant rudimentary uterus has been named the
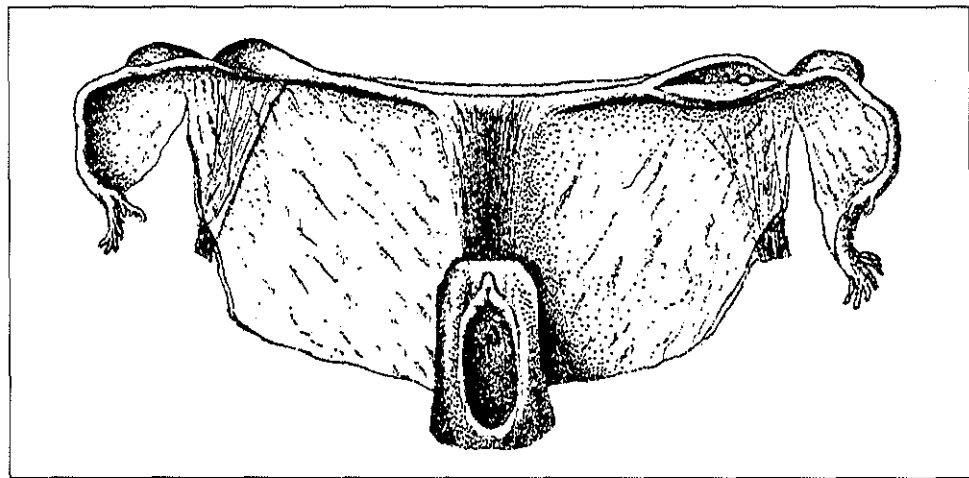
Figure 1: Uterus bipartitus solidus rudimentarius cum vagina solida (Rokitansky 1838) [8]

"syndrome of Mayer-Rokitansky-Küster" [1]. Certain authors in the anglosaxon literature may also refer to the "syndrome of Mayer-Rokitansky-Küster-Hauser" [13] or the "syndrome of Rokitansky-Küster-Hauser" [14-15]. Interestingly, the first doctoral thesis on this subject was published in 1781 [16]. In the past, controversy existed about whether or not an artificial vagina should be created in patients without procreative capacity[1] [17-20].

1.1.2. Clinical features of the syndrome

In late adolescence, the initial complaint is usually primary amenorrhea or impaired coital function, or both [21]. At physical examination, general body habitus and hair distribution, breast development and external genitalia are normal for a female [22]. In general, the vagina consists merely of a shallow dimple and a rudimentary uterus is palpated at rectal examination, although occasionally there is complete absence of uterine remnants

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[1] *"Meine Herren, Ehen werden geschlossen, um Kinder zu zeugen, und für das Eheglück, das sich auf einer künstlichen Vagina aufbaut, gebe ich keinen Pfifferling." (Dencks 1932)* [17]

or even an anatomically normal uterus [13]. The ovarian function is undisturbed, but the ovaries may be located rather high up in the pelvis [1,23]. In only one third of the patients normal tubes are found [23]. Extragenital congenital anomalies are not uncommon.

1.1.3. Extragenital congenital anomalies

Abnormalities of the urinary tract. Various studies indicated that renal malformations, consisting mainly of either agenesis of one kidney or ectopia of one or both kidneys, occurred in 15 to 51 % of the patients [2,3,13,23-27]. Rarely, a duplicated collecting system or bladder exostrophy may be found [25]. One author reviewed 520 cases of the syndrome of Mayer-Rokitansky-Küster and concluded that renal abnormalities are found in approximately one third of the patients [13].

Skeletal deformities. The overall incidence of skeletal malformations in a review of 524 cases was 12%, involving mainly the spine. Deformities, fusions and asymmetry of the vertebrae were common findings. Rib and limb abnormalities may also be observed [13]. In a recent retrospective study of chest X-ray films and intravenous pyelograms, skeletal defects were demonstrable in 28% of 167 patients [2].
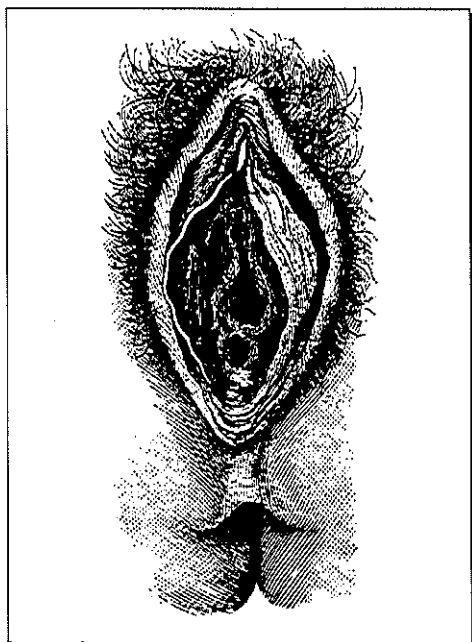
Figure 2: Dilated urethral orifice in vaginal aplasia (Kleinwächter 1881) [10]
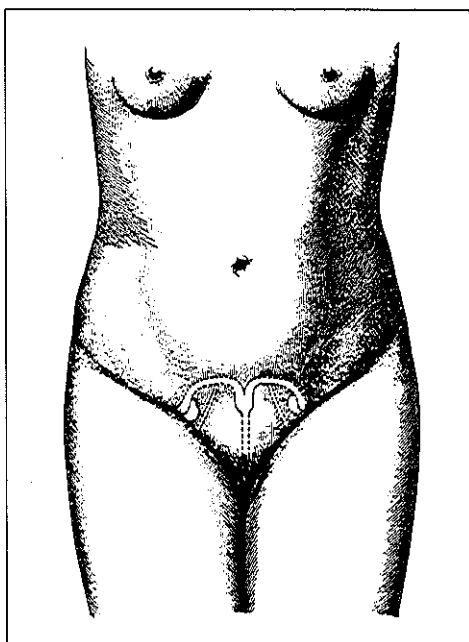
Figure 3: Vaginal aplasia and rudimentary uterus (Zweifel 1888) [70]

Other malformations. A variety of other congenital abnormalities have been described in patients with the syndrome of Mayer-Rokitansky-Küster, involving the hand (e.g., syndactyly or absence of digits), the heart (e.g., aortic coarctation or tetralogy of Fallot) and the ear (e.g., deformities of auricle or deafness). Also, inguinal or femoral hernias, cleft palate and imperforate anus have been reported [2,13,25]. However, it is difficult to assess whether these defects are specific for the Mayer-Rokitansky-Küster syndrome [13].

1.1.4. Guidelines to diagnosis

The Mayer-Rokitansky-Küster syndrome is diagnosed mainly on the basis of the patient's history and the clinical findings [28]. Additional investigations may include ultrasound to assess the ovaries and uterine remnants, and laparoscopy if the patient indicates cyclic abdominal pains suggesting the presence of endometrial or myometrial tissue [22,29]. Karyotyping reveals a female 46,XX chromosomal pattern and plasma hormonal levels are normal [25,30], but according to some authors these investigations needn't be performed if there's no doubt about the diagnosis [22]. An intravenous pyelogram is indicated prior to pelvic surgery to reveal eventual urologic malformations. Skeletal survey evaluation may be helpful in the assessment of visible or symptomatic skeletal deformities [22].

1.1.5. Uncommon findings in the Mayer-Rokitansky-Küster syndrome

Ovarian and uterine pathology. In the presence of ovarian tissue, pathology of the ovaries may occur. Incidental reports mentioned the occurrence of ovarian cancer [31], teratocarcinoma [32], granulosa cell tumor [33], dermoid cysts [34], and polycystic ovaries [1,23] in patients with the syndrome of Mayer-Rokitansky-Küster. Endometriosis has been reported [13,35-38], as well as fibromyoma of the rudimentary uterus [39].

Pregnancy. The occurrence of vaginal dysgenesis with a functional uterus, a partial Mayer-Rokitansky-Küster syndrome, is extremely rare, occurring in 1:100,000 women [40], or in 2.4 to 8% of the patients with Müllerian abnormalities. These patients present in early adolescence with haematometra [2,13,22,23]. Vaginoplasty may be performed to relieve obstructive symptoms if the uterus is to be conserved [41], although considerable morbidity and even mortality have been associated with this intervention [42]. In successfully treated cases, a number of pregnancies were reported [43], terminated either by cesarean section [23,44-50], or by vaginal delivery [51-57]. Pregnancy was also reported in one case of vaginal dysgenesis without an artificial vagina. Conception had occurred via a perforated gastrointestinal tract. At term, a live male infant was delivered by caesarean section [58].

1.2. Other congenital vaginal malformations

1.2.1. Female Pseudohermaphroditism

Increased levels of circulating androgens will induce a varying degree of masculinization of the external genitals, suppression of ovarian function and malformations of the vagina in a chromosomally normal female fetus [59,60]. Fetal androgenization may be brought about by administration of androgenic substances or progesterone during pregnancy [61-64]. In congenital virilizing adrenal hyperplasia (CVAH) the synthesis of cortisol is interrupted by a hereditary enzyme deficiency of 21-alpha-hydroxylase or 11-beta-hydroxylase, or other enzymes [65]. The child may be born with ambiguous genitals, with a hypertrophied clitoris and fused labia [64]. In most instances the birth-defective genitals do lead to a diagnosis in the neonatal period and the child is reared as a girl. Long-term substitution with cortisol arrests virilization and allows further morphological development to be feminine [66]. Surgical feminization, clitoroplasty, and vaginoplasty, may be required later in life [64]. Despite good and early hormonal control, fertility is probably reduced to some extent, although a number of successfull pregnancies have been reported [67].

Figure 4: "Hermaphrodite" (1582) [149]

17

1.2.2. Male Pseudohermaphroditism

A chromosomally normal male fetus with a 46,XY pattern who is subjected to a testoste-
rone deficiency in utero will be born with external genitals which are incompletely mascu-
linized. Testosterone deficiency may either be absolute, as a consequence of inborn errors
of biosynthesis or incompetent Leydig cells, or relative due to inability of the end-organ
to utilize androgenic hormones [65]. The latter, which is called "complete androgen-in-
sensitivity syndrome" or testicular feminization, is probably transmitted as an X-linked
recessive syndrome. Affected patients are born with unconspicuous female genitalia and
bilateral testes which are usually located intraabdominally. Sometimes the testes may be
palpated in the inguinal canal or in the labia. If not, these patients are reared as girls [66].
Male pseudohermaphroditism is usually detected at puberty, when patients may present
with primary amenorrhea despite normal breast development. Associated findings may
include sparse or absent pubic and axillary hair [67], a vagina consis-
ting of a shallow dimple or blind pouch, and absence of the uterus and cervix [66].

Although change of assigned sex at puberty, without emotional distur-
bance, has been described incidental-
ly [68], therapy in most instances is focused on reinforcement of the fe-
male gender identity which has been assigned at birth, and the surgical creation of an adequate vagina may thus be justified [65-66]. Extirpation of non-scrotal testes is advised be-
cause of increased incidence of ma-
lignant degeneration [69]. Without knowledge of the condition, two ca-
ses of male pseudohermaphroditism were reported in 1888; both patients were described as females with ab-
sent pubic and axillary hair, a rudi-
mentary vagina without uterus and bilateral inguinal hernias. The intra-
abdominal testes were mistaken for ovaries [70].

Figure 5: "Hermaphrodite" (1617) [150]

1.2.3. True Hermaphroditism

Defined as the simultaneous, histologically confirmed, presence of ovarian and testicular tissue within one person, true hermaphroditism is an intriguing form of intersex, and extremely rare [65]. In the majority a vagina and uterus are present, although they may be rudimentary. The external genitalia may either be male or female, but in most instances varying degrees of sexual ambiguity are seen [67]. According to van Niekerk, 58% of affected individuals have a 46,XX karyotype, in 11% a 46,XY karyotype is found and the remaining 31% have various forms of XX/XY mosaicism or chimerism [71]. True hermaphroditism may result from an autosomal mutant gene, a Y-chromosome translocation or sex chromosome mosaicism [65]. Parents and patients should be told about the birth defect [72]. Sex of rearing depends in most cases on the functional capability of the internal genitalia and the aspect of the external genitalia, after which inappropriate organs may be removed or surgically refashionned [67]. Longitudinal outcome with regard to gender identity and gender transposition has been studied in true hermaphrodites assigned to either sex [73-76].
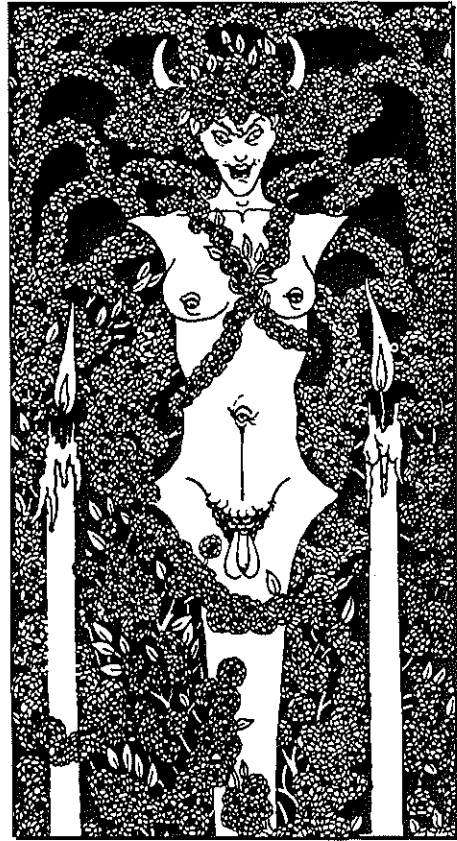
Figure 6: "Hermaphrodite" (1907) [151]

1.3. Acquired, secondary loss of the vagina

In the past, secondary total obliteration of the vagina frequently resulted from extensive birth trauma [77-79]. Nowadays, partial or total loss of the vagina is most commonly encountered after radical pelvic surgery or radiation therapy for malignancies of the genitals or other pelvic organs. A vaginal reconstruction may be performed to preserve coital function [80-84]. Secondary stenosis of the vagina was also reported after burns, infections (e.g. diphtheria, scarlet fever, smallpox), and extensive mechanical, caustic or chemical trauma [40,85-94].

1.4. Male-to-female transsexualism

1.4.1. History

One of the earliest references to gender transposition [95] in the medical literature was published in 1870 by the German Westphal who described the case of an effeminated male who assumed a female gender role in public [96]. Seven years later, this condition was called "metamorphosis sexualis paranoica" by Krafft-Ebbing who made a distinction between an acquired temporary, and a congenital permanent form of contrary sexual consciousness, the latter today being known as "transsexualism" [97]. The term "transvestism" was coined in 1910 by Hirschfeld and widely used since then, making no further distinction between transvestism and transsexualism [98]. Without knowledge of the diagnosis "transsexualism", clinical cases have been described in 1897, 1916, 1921 and 1927 [99-102], and sex reassignment surgery - castration, penectomy and the creation of an artificial vagina lined with Thiersch grafts - was depicted in two male "transvestites" in 1931, by Abraham [103].

The case of Christine Jorgensen, who went to Denmark in 1950 to undergo hormonal treatment, castration and surgical refashionning of the external genitalia gained international popularity [104] and prompted Harry Benjamin to define the persistent urge to change one's sex as transsexualism - a term adapted from Cauldwell [105] - and cross-dressing as transvestism [106]. Since then, the transsexual phenomenon [107] has met controversy in medicine, psychiatry and law [108-110]. It was generally agreed that a multidisciplinary approach was appropriate for the consultation, diagnosis and treatment of transsexuals, resulting in the formation of the first Gender Team, in 1965, at the John's Hopkins University Hospital [111-112].

Attempts to explain the etiology of transsexualism, a condition which cannot be treated with psychotherapy, included genetic and neuro-endocrine theories, and imprinting or childhood conditioning [113-114]. Money, who had been preoccupied with hermaphroditism since 1955 [115], noticed that a person's gender is multivariately determined by the chromosomal, prenatal hormonal and genital sex on one hand and gender identity and role on the other [116]. Gender identity, which is templated in the brain, differentiates as a result of sensory input in the postnatal period, is established in early childhood and remains remarkably fixed thereafter. According to Money, transsexualism may result from a differentiation of gender identity and role discordant with one or more of the above stated variables, postnatal hormonal sex and secondary sexual body morphology [117]. If the discordance between the sexual brain and the morphologic, hormonal and gonadal sex is extreme, hormonal and surgical sex reassignment are claimed [95,118]. This condition is known as transsexualism, an extreme type of gender dysphoria [119].

1.4.2. Incidence

Whereas the prevalence of male-to-female transsexualism in the Netherlands had increased steadily until 1986, from 1:45000 males in 1980 to 1:18000 in 1986 [120], it had remained fairly steady since then. Recent estimates indicate a prevalence of 1:12900 males [121]. It is assumed that the initially increasing prevalence may have been relative rather than absolute, due to a decreasing treshold for sex reassignment applicants [120]. In the Netherlands, 673 male-to-female transsexual subjects have received hormonal therapy and 455 sex change operations have been performed from 1976 until 1992 [122]. Since the early eighties, the ratio of male-to-female compared with female-to-male transsexuals had constantly remained between 2.4 and 3:1 [120-121,123-126].

1.4.3. Diagnosis and treatment: The Dutch Gender Team

The Dutch Gender Team was founded in 1972 in Amsterdam and consisted of endocrinologists, psychiatrists, psychologists and plastic surgeons [127]. In 1980, the diagnostic criteria for transsexualism were defined in the *Diagnostic and Statistical Manual of Mental Disorders (DSM-III)*[128]. Five years later, a recommendation concerning the standards of care for gender dysphoric patients was published by the Harry Benjamin International Gender Dysphoria Association [129].

In general, the request for sex reassignment is presented to a member of the Dutch Gender Team, usually a psychologist or psychiatrist, who diagnoses transsexualism and excludes conditions that may be associated with episodic gender dysphoria (e.g. transvestism, fetishism, homosexuality, personality disorders, psychosis) [130]. The diagnosis is based mainly on self-reports concerning genital-erotic, hormonal and physical history, self-image and body-image, partner affiliations and behavioral pathology [119]. Once the preliminary diagnosis "transsexualism" seems appropriate, hormonal sex reassignment may be initiated, taking into account the subject's emotional and physical constitution [131-132].

In the "real-life test", which encompasses a period of approximately one and a half years, the transsexual gradually assumes the opposite gender role full time [133]. Medical observation is indicated because of the complications frequently associated with hormonal treatment [134]. The surgical sex reassignment is the final step in the adaptation procedure. In male-to-female transsexuals, corrective surgery may include breast and facial surgery or thyroid cartilage reduction and, after orchidectomy and penectomy, the creation of female external genitalia and a neovagina [135]. In most instances, genital surgery is performed as a one-stage operation and the artificial vagina is lined with inverted penile or penoscrotal skin [136-145].

1.4.4. Some legal considerations

In 1972, Sweden was the first european country to enact a law concerning the alteration of the birth certificate to assume a different gender in cases of transsexualism [146]. In the Netherlands, a similar decree was passed into law in 1985, enabling the alteration of the sex assigned at birth after judicial examination, thus creating the basis for the social integration and recognition of Dutch transsexuals [147]. Prerequisites of the birth certificate change include that the subject is not married at the time of the request and that at least two medical experts have confirmed the applicant's conviction of belonging to the opposite sex, his infertility and the physical adaptations [148]. Psychiatric counseling, medical and surgical treatment are readily available for transsexuals and the expenses may be refunded within the Dutch health care system [147]. Attempts should now be made to formulate a european consensus regarding the legal and public health care provisions for transsexuals.

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CHAPTER 2

Methods to create an artificial vagina, with the exception of intestinal colpopoiesis

2.1. Introduction

Numerous techniques have been developed and abandoned throughout this century to treat conditions associated with absence of the vagina. Long before the syndrome of Mayer-Rokitansky-Küster was defined, surgeons were familiar with secondary loss of the vagina following traumatic deliveries, and with vaginal dysgenesis with a functioning uterus. Sooner or later, these conditions became symptomatic because of the resulting haematometra and had to be treated. The first therapeutic attempts to facilitate the evacuation of menstrual fluids date back to the 19th century and consisted in the simple dissection of a rectovesical passage [1-4]. Unfortunately, many patients succumbed of peritonitis [5,6]. Asepsis was inadequate and lesions of the surrounding organs, i.e. bladder, rectum and urethra, were not infrequent [7]. Sponges and moulds were used to set against the invariable stenosis of the newly created space [8,9]. Later on, various autologous and allogeneic material was transplanted onto the walls of the tunnel. In the light of history, the different non-intestinal methods to create an artificial vagina will be outlined herein.

2.2. Dissection of a rectovesical cavity without grafting

The treatment of haematometra by dissection of a rectovesical space in cases of vaginal occlusion or dysgenesis has been described with varying end-results since antiquity [10]. Dupuytren of Paris described two cases of vaginal absence in 1827. Both patients were treated by sharp dissection of a passage between the bladder and the rectum; one patient died of peritonitis and in the other, the rectovesical space stenosed [11]. Wharton from the Johns Hopkins University Hospital in Baltimore, who is usually credited for this technique, used a mould covered by a condom to pack a bluntly created rectovesical tunnel. The mould remained in place for three weeks and was to be worn at night thereafter.

The merits of this technique consisted in an unaltered aspect of the external genitals, the relative simplicity of the technique with a short hospital stay, and low morbidity [12]. Biopsies taken one month or more after the dissection revealed squamous epithelium in the neovagina. It was assumed that epithelialization occurs from the external vaginal orifice upwards and that eventually, two to four months after the operation, the raw area would be covered [12-15]. Also, buds of epithelium may surface from remnants of the muellerian ducts and serve as secondary sources of squamous epithelium [16]. Satisfying results were obtained with this technique in some cases [17,18] although several reports indicated a doubtful outcome, with vaginas of inadequate depth and caliber [12,13,19-21]. According to one study, failure rates were 25% [22]. Vesicovaginal and rectovaginal fistulas were reported [14,21,23]. Incomplete epithelialization was noted several years after the operation, due to persistent granulation tissue [24-26]. Mainly for this reason the technique had been abandoned in the Fifties [27-30].

2.3. Skin transplants

Skin has been used incidentally since the late 19th century to line the surgically dissected rectovesical cavity in cases of congenital vaginal absence. Initially, pedicled skin flaps derived from the major and minor labia or the perineal region were employed [31-39].

2.3.1. Skin flaps

The American surgeon Graves used four to six racket-shaped pedicled inlay skin flaps from the labia minora, thighs, and, if appropriate, from the buttocks, to cover the entire inner surface of a previously prepared tunnel between the bladder and the rectum [40]. Three patients were treated successfully [40,41]. Results were disappointing if skin flaps from the labia minora alone were used [42]. Grossmann introduced a similar technique in Germany, in 1939, making use of three pedicled flaps, two derived from the labia minora and a third derived from the perineum [43]. Favourable results were reported [43-45]. Histologic changes in the transplanted skin flaps indicated squamous cell metaplasia [46,47], although a varying degree of keratinization was persistently demonstrable [45]. In 1940 Falls, a Chicago gynaecologist, presented a method consisting of partially lining the rectovesical cavity with four pedicled skin flaps prepared from the labia minora. The skin dissected in the vaginal dimple was pushed inwards to form the new vaginal vault. According to Falls, epithelialization would occur both from the vaginal orifice and from the edges of the labial flaps and was completed within two weeks. Results were satisfactory in only three of six patients [48]. To overcome the drawback of mutilation of the external genitals, the technique was modified by Bhonsale and Sheares who lined the posterior

wall of the rectovesical cavity with a single skin flap dissected from the vaginal dimple, retaining its attachment at the perineum [49,50]. Satisfying results were obtained in only 63% of 35 cases, despite long-time wearing of a mould [16,49,50].

The tube-flap method was adapted for vaginoplasty by Fraenkel in 1924. Two full-thickness skin flaps were prepared from the thighs, formed into a tube and inverted into a previously created channel between bladder and rectum. At laparotomy, the neovagina was fixed to the anterior abdominal wall [51]. Frank and Geist used the same method with a single tubular full-thickness skin flap prepared from the inner surface of one thigh that was gradually freed. The denuded area on the thigh was closed by bringing together the two skin edges, leaving a considerable scar. The neovagina had remained adequate for intercourse seven months after the third operation [52,53]. The technique was modified by Grad who employed a larger skin flap and covered the defect on the thigh with Thiersch skin grafts [54]. In one case, this technique was applied as a six-stage operation [55]. Serious disadvantages of this method, both psychologically and financially, were the multiple operations and a hospitalization period exceeding several weeks [41]. Also, the complication of stenosis of the artificial vagina could not be overcome [54]. Further disadvantages included offensive discharge from sebaceous secretions and hair growing in the vagina if hair-bearing skin was transplanted [56,57]. Interestingly, the tube-flap method was used in plastic and reconstructive surgery to create an artificial penis in biologic males [58], and in female-to-male transsexuals, with varying success [59]. More recently, pedicled full-thickness skin flaps were used in conjunction with radical pelvic surgery [60]. In some cases, free full-thickness skin flaps taken from the buttock [61] or from the groins [62] have been employed to line the rectovesical space. On one occasion, a tissue expansion technique was applied to create large flaps of labial skin prior to vaginoplasty [63].

2.3.2. Split-thickness and Thiersch skin grafts

In 1898 Abbe, a New York plastic surgeon, had described two cases of vaginal dysgenesis he had treated with skin grafts. In one of these cases, he had used several Thiersch grafts upon a stuffed rubber pouch to line a previously created cavity between the bladder and the rectum. The operation was considered a success, although Abbe recognized the necessity for permanent intermittent dilatation to prevent stenosis of the neovagina [33]. A single, rather large Thiersch graft was used by Kirschner and Wagner of Germany in 1930 on one occasion[2], and at short term, the result seemed promising. In their second

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[2] *"Dieser große Epidermislappen wird auf einer Prothese von rotem Gummischwamm, entsprechend der Größe eines erigierten Penis, ... aufgenäht." (Landois 1932)* [162]

case part of the graft didn't take well; one may thus assume that this case had been a failure [64]. Two years later, Stoeckel had equally disappointing results in three patients [65].

In London, McIndoe carried out his first operation in 1937; like Kirschner and Wagner he had used a single Thiersch graft from the thigh, draped it over a hollow balsa wood or acrylic mould that was inserted into a previously prepared tunnel between the bladder and the rectum. The labia minora were split longitudinally and sutured together to prevent the mould, which was permanently kept in place for six months, from being expulsed [66]. Until 1950, McIndoe had operated upon 63 patients; in 80% an adequate vagina was found [67]. Similar results were obtained by others [18,68]. Histological examinations of the neovagina revealed a stratified squamous epithelium with progressive cornification of the superficial cell layers [69,70].

Certain authors refer to the Counseller modification of the McIndoe technique [21,71,72]. Counseller had adapted the McIndoe technique, but unlike McIndoe he favoured the use of a non-rigid mould which would assure a more uniform pressure of the graft to the walls of the rectovesical space. According to Counseller, this would enhance the chances of taking of the graft and reduce the incidence of granulations [25].

Split-thickness skin grafting, generally refered to as the "McIndoe technique", is associated with a low morbidity. Because of the relative simplicity the method has gained worldwide acceptance and is especially popular in the United States. In recent years, the grafts have been taken preferentially from the buttocks, to improve the cosmetic result [71,72]. Nevertheless, a scar remains at the donor site and keloid formation and other wound healing problems have been described [73]. A 100% take of the graft has been observed in less than 80% of the patients, and failures may result from granulations [30,73]. Infrequently reported late complications include neovaginal prolapse [23,74], condylomatosis [30], syphilis [75], intraepithelial neoplasia in combination with Human Papilloma Virus [76] and carcinoma [26,77-82].

2.3.3. Mesh-grafts

The mesh-graft technique was developed by the Amsterdam surgeon Lanz, in 1908. He was concerned about the fact that epithelial defects covered with Thiersch grafts were long healed whilst the donor site was still an open wound and subsequently designed the first device to cut a mesh-like structure into a skin graft, thus enlarging the surface of the graft by the factor three, which in turn permits to cover the recipient as well as the donor site [83]. The principles of this technique were applied mainly in the treatment of exten-

sive burns [84] and adapted for the treatment of vaginal dysgenesis in Germany [85]. It was stated that full epithelialization of the neovagina was completed within three weeks. A Teflon mould was kept in place for ten days; thereafter, intermittent dilatation was recommended only temporarily, until the fourth postoperative week.

It was assumed that separation of the contractile elements of the epithelium would reduce the stenosing tendency. However, distal stenoses of the neovagina were observed in 30% of the cases [86]; dilatations may thus be advisable beyond the third postoperative week. In another study, good functional and anatomical results were obtained in nine patients, with no failures [45]. Patients are immobilized during the first ten days postoperatively; deep venous thrombosis was described in one case [85]. Whilst the mould is in place, suprapubic drainage is recommended to reduce the incidence of urethral necroses [86].

2.4. Peritoneum

The first reference to peritoneal grafting dates back to 1897 [87]. Unsuccessfull attempts at creating a neovagina with this technique were described in 1912 and 1916 [88-90]. Glowinski reported a successfully treated case in 1937. The peritoneum from the pouch of Douglas was mobilized to line a previously created channel between the bladder and the rectum in a patient with vaginal dysgenesis [91]. The method is generally attributed to Davydov who published a series of 67 patients treated according to his method in 1974 [92]. The operation, which had been designed initially as a three-stage procedure involving laparotomy, was performed as a one-staged, perineal procedure from 1970 onwards [92-93]. Until 1980, 220 operations were performed. Postoperatively, a narrow vagina was found in more than 30% of the patients [93]. Inadequate neovaginas were found in 22% of the patients in another study [94]. Full epithelialization of the neovagina takes three to 16 months, and granulations were reported [95]. Stenosis of the upper third of the neovagina may occur if regular dilatations are discontinued [96].

2.5. Bladder, ureter and urethra

Incidental cases have been described in which an everted bladder [97], parts of a mega-ureter [98], or the urethra [99] have been used to create a neovagina. In another patient, a defunctioned urinary bladder was employed to reconstruct a vagina that had been lost after radiotherapy [100]. A pedunculated bladder flap served to line a surgically dissected rectovesical space in four patients with vaginal dysgenesis. According to the authors, postoperative bladder function was not impaired, and the resulting neovagina was adequate [101].

2.6. The myocutaneous flaps

Compound skin-muscle flaps supported by a neurovascular pedicle are used mainly in vaginal reconstructions after pelvic exenteration or extensive perineal radiotherapy. Additionally, these rather bulky flaps may serve to cover large perineal defects and thus precipitate wound healing. Myocutaneous flaps, either uni- or bilateral, may involve the gracilis muscle [102-106], a vulvobulbocavernosus transplant [107], and the rectus abdominis muscle [108-109]. Because of extensive scarring at the donor site, these techniques have limited indications and are best reserved for post-malignancy treatment [110].

2.7. Vulvovaginoplasty

Vulvovaginoplasty, the creation of an extracorporal neovagina, was originally described by Williams in 1964. In the introital region a U-shaped incision is deepened to expose the superficial perineal muscles. The margins of the inner cut edges are first united in the midline, subsequently the outer edges are sutured to each other, thus creating a vulvar pouch [111]. Although the technique is simple and morbidity is neglectable, the main disadvantage is the almost vertical axis of the neovagina, necessitating adjustment of coital positions [112]. It was reported that the vaginal axis assumed a normal direction within a few weeks postoperatively [111,113], but this wasn't confirmed by others [112]. The external genitalia are unesthetically disfigured, urine may collect in the vaginal canal [16,114], and the anterior edges of the pouch may tear during intercourse [112]. Regular dilatations are recommended to maintain the patency of the neovagina [113]. Although this technique has been used in vaginal dysgenesis [115-116], it may be preferable to reserve it for cases in whom more extensive procedures are contraindicated because of poor general health, and for secondary vaginal loss due to trauma or cancer surgery [73, 117-119].

2.8. Vecchietti's technique

A rather complicated method of creating an artificial vagina by traction, without dissection of a rectovesical cavity, was described by Vecchietti in 1980 [120]. At laparotomy, the peritoneal fold between the rudimentary uterus and the bladder is identified and incised. From below, with the aid of a large needle, two non-resorbable threads holding an olive-shaped structure, are led into the peritoneal cavity, and from there extraperitoneally along the lateral abdominal wall, to the abdominal opening. The peritoneal fold and the abdominal wall are closed. From the outside, gradual traction is exerted on the threads with a device holding springs. As a consequence, the olive is pulled cranially and, accor-

ding to the author, a neovagina with a length of 12 cm may thus be created within seven to eight days. Vecchietti presented 307 cases operated according to his technique, with two failures. In three cases, a vaginal prolapse occurred [120]. A modified Vecchietti technique is currently applied in Vienna [121].

2.9. Non-surgical procedures

A method of creating an artificial vagina without operation was described by Frank in 1938. Pyrex tubes were used to apply intermittent pressure to the introital region. Initially, pressure was directed posteriorly to create a vaginal dimple, then directed inwards to enhance the channel's depth [122]. Mechanical invagination is simple, and surgical or anaesthesic risks are discarded. Late complications may include prolapse of the neovagina [48,123]. Assuming that a patient is cooperative, well motivated, and willing to sustain months of painful dilatations, vaginal depths of six or seven centimeters may be achieved [44,122,124-125]. Hence, despite encouraging case reports [126-129], the success rate with the Frank method alone may be less than 15% [16]. However, a conservative approach may serve as preliminary treatment prior to surgical reconstruction [16,130-131]. A modified pressure technique making use of a bicycle seat stool has been developed by Ingram in 1981. With this device, patients are able to exert steady pressure for a long time, and are able to use their hands freely. Favourable results were reported in 71% of the cases [131-132]. Incidentally, a neovagina may be created by repeated coitus [48,72, 125,133-137].

2.10. Allografts

Amnion. Human fetal membranes are composed of an outer layer, the chorion or cytotrophoblast, and an inner layer, the amnion [138]. The role of human amnion as an adjunct in wound healing has long been recognized [139]. In 1934, the French Brindeau introduced intact fetal membranes draped over a mould as a lining for a previously created tunnel between the bladder and the rectum in vaginal dysgenesis. With the chorionic side facing the channel's wall, the membranes took well. A neovagina with a length of five centimeters was thus created [140]. Others have employed this technique in the past [141-145]. The amniotic layer of fetal membranes with the mesenchymal surface facing the wound is currently used for the lining of artificially created vaginas, with encouraging results as long as dilatations are performed regularly [146-149]. According to one report, eight weeks postoperatively, and after several regrafting procedures, the entire neovagina was lined with normal vaginal squamous epithelium [150]. As opposed to skin grafting, donor-site scar formation is discarded. Amnion is readily available, inexpensive, has a

low antigenicity, a high antimicrobial potential, and may have pain relieving effects [150-151]. It may be superior to skin autotransplants because of immediate adherence to the wound surface, precipitation of epithelialization and wound healing, and inhibition of granulation tissue activity [152]. Most of these mechanisms, although persistently demonstrable, are still poorly understood and warrant further research. Also, it is unclear whether the human immunodeficiency virus (HIV) may be transmitted by amnion transplantation.

Vernix caseosa. The first report recommending the application of vernix onto poorly healing wounds to reduce exsudation and infection was published in 1931. It was assumed that epithelial cells within the vernix would serve as secondary sources of epithelialization [153]. In patients with vaginal dysgenesis a mould covered with vernix had been used incidentally to line an artificially created rectovesical space, with satisfying results [19,154-155].

Lyodura. In 1982, one author advocated the use of lyodura as a lining for the rectovesical space. A series of 23 patients was presented; in 21 patients good functional results were obtained. Full epithelialization of the neovagina took between three and twelve months. Permanent dilatation was recommended for three years [156]. Lyodura is expensive and may not be superior to other transplanted material in the treatment of vaginal dysgenesis. Hence, the technique had no followers.

Vaginal mucosa. With the present knowledge about immunology and transplant rejection, transplantation of allogeneic vaginal mucosa seems to be of historical importance only. However, this technique has been applied in the past. Inspired by Küstner [157], Mackenrodt described two cases of lining an artificial vagina with mucous membrane obtained during operations for vaginal prolapse, in 1896. According to the author, both cases were treated successfully [158]. In 1912, the same procedure was applied by Dreyfus [159]. More recently, on one occasion, Papanicolaou had transplanted vaginal mucosa from mother to daughter [160].

2.11. Conclusions

It was demonstrated in this section that various non-intestinal techniques have been developed to create an artificial vagina. Most of these techniques are based on the dissection of a rectovesical cavity; if appropriate, various materials may be transplanted onto the walls of the channel. Alternatively, the neovagina may be created by externally applied pressure, or extracorporally by suturing the labia. The advantages and drawbacks of the different methods have been outlined from the historical point of view. Nowadays, the most popular method consists of lining a surgically created rectovesical space with split-

thickness or Thiersch skin grafts, although failures are reported in approximately 25% of the cases. As a rule, favourable results are obtained in the immediate postoperative period[3]. However, quite irrespective of the chosen procedure, the major drawback is the stenosing tendency of the newly created channel and life-long dilatations are required to assure its patency [161].

Regular dilatations may be even more important for the success of creating a functional, non-intestinal neovagina than the transplanted material [156]. Assuming that epithelialization occurs from surfacing remnants of the muellerian ducts and from the introitus upwards [150,152,156], the function of the transplant would be to cover the open wound, thus reducing the incidence of infections and granulations, to prevent adhesions of the wound surfaces, allow drainage of exsudates, inhibit an antigenic response, and minimize fibroblast activity and subsequent scarry contractions. With respect to these features, amnion may seem more appealing than skin, but amnion transplantation has become less popular because of the hypothetical risk of HIV transmission.

2.12. References

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CHAPTER 3

100 years of colpopoiesis using intestine
The history of intestinal vaginoplasty

3.1. Introduction

Since the end of the previous century, professionals were concerned with the problem of scar tissue contraction and secondary stenosis of a vagina created by blunt dissection and transplantation of adjacent skin surfaces. The search for methods to construct an artificial vagina that wouldn't shrink has prompted surgeons who were familiar with colonic and rectal cancer surgery, and with oesophageal reconstruction to adapt their knowledge for vaginoplasty. Various parts of the large or small intestine have since been used to line the rectovesical cavity. It was confirmed that intestinal neovaginas were not subjected to secondary obliteration, but the operative techniques were complicated and fatalities were reported [1-3]. In the preantibiotic era, abdominal surgery entailed a considerable risk of postoperative peritonitis. Many surgeons avoided laparotomy for this reason, and extraperitoneal vaginoplasties involving rectal transplantation were carried out preferentially. Simplified and modified within the past century, and especially popular in Europe, the different intestinal vaginoplasties will be described herein, with special emphasis on the specific advantages, drawbacks, and complications.

3.2. Rectum[4]

The first pioneer of rectal transplantation was probably the Russian surgeon Sneguireff. In 1892 he presented his method, which consisted of an extraperitoneal, dorsal approach. After resection of the coccyx, the rectal ampulla was transsected, and the proximal end was diverted to the sacral region to create an artificial "anus sacralis". The distal cut edge was closed to form the neovaginal top. An introitus was created by severing the anal sphincter and the perineum. According to the author, no major complications occurred, and fecal incontinence had been a problem only initially [4]. The method was rejected on moral grounds - in fact, intercourse was performed anally - and because of problems as-

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[4] *"The Germans prefer to work from below" (Ward 1915)* [92]

sociated with an anus praeter [5]. A more complicated technique was devised in 1897 by Gersuny of Vienna. He isolated a flap from the anterior part of the rectal ampulla, which formed the ventral wall of the neovagina after suturing the rectum [6]. The dorsal, raw area within the neovagina was lined with Thiersch grafts [7-9], or with perineal pedicled skin flaps [10]. In cases with a large ampulla[5], the rectal flap was formed into a tube which lined the entire neovaginal tunnel [10-12]. Rectovaginal and rectosacral fistulas were not infrequent because the rectal blood supply was disturbed as a consequence of mobilization, and fecal incontinence resulted from transsecting the anal sphincter [7,13]. The Russian surgeon Popow refrained from excising the coccyx; instead, he dissected the rectal ampulla via the anus. The sphincter was spared, but it had to be dilated excessively, and its postoperative function may have been disturbed [14]. Concerned with the problem of fecal incontinence, the German Schubert introduced a method that consisted of transplanting the entire rectal ampulla to the vulvar region, and anastomosing the sigmoid
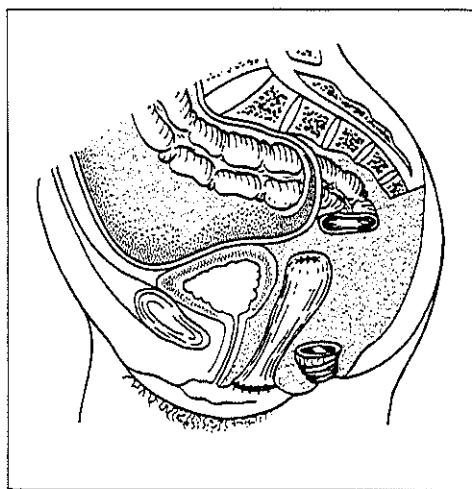
Figure 7: Transplantation of rectal ampulla to vulvar region according to Schubert.
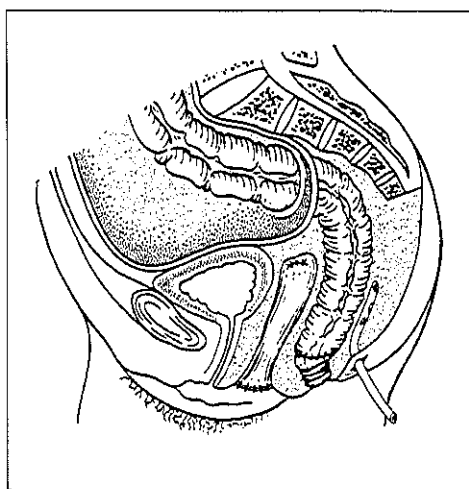
Figure 8: Anastomosis of sigmoid to sphincter according to Schubert.

to the sphincter, which had remained intact (Figures 7 and 8)[15,16]. For the relief of fecal incontinence, which nevertheless developed in several patients, a strip of fascia obtained from the thigh was wrapped around the anal sphincter [17-19]. Because of scarry constrictions at the rectoperineal anastomosis, dilatations of the introitus were advised [20-23]. Schubert encouraged the publication of every case operated according to his

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[5] " ... das Mastdarmrohr war von einer kolossalen Dimension (vielleicht Folge der massigen Landkost) ... " (Brossmann 1921) [13]

method to facilitate statistical evaluation [15], so that a large number of case reports is available [2,13,22,24-43]. Until 1927, he collected 95 cases of vaginal formation from the rectum, and calculated a mortality of 3.2% [44]. In his own series of 32 patients, one woman died of peritonitis, although the operation is presumably carried out extraperitoneally [45]. A functioning uterus was connected to a rectal neovagina in three cases; the first patient delivered spontaneously of three healthy children [46], the second patient menstruated from the neovagina - whether she became pregnant wasn't stated [47] - and the third patient died of purulent peritonitis [48]. A further lethal outcome resulted from ligation of one and accidental transsection of the second ureter [49]. Because of iatrogenic complications, seven operations were required in another patient to obtain a tolerably satisfying result[6] [50].

Schubert's technique was modified by Straßmann, who left an intact cuff of mucous membrane around the anus, about three to five centimeters long, to prevent damage to the innervation of the sphincter. The peritoneum was opened to improve mobilization of the sigmoid [25,51,52]. Further modifications were introduced in France [53,54], but after World War II, rectal vaginoplasties became increasingly unpopular. One of the latest reports dates back to 1973. A series of 23 patients was presented, operated according to a modified Schubert technique between 1944 and 1970. Although none of the patients had died, multiple complications were noted: nine rectovaginal fistulas, necrosis of the transplanted rectum in one case, introital and anal stenoses in four, respectively five cases. Problems associated with sphincter disturbance were reported by a majority of the patients [55]. In another retrospective study involving 257 patients who underwent rectal vaginoplasties, the complication rate exceeded 40%, and a 5% mortality rate was calculated [56]. Infrequently reported long-term complications include excessive vaginal secretions [52], ulcerative colitis [57], gonorrhoea [2], descent of the neovagina [39,46], and prolapse of the anal mucosa [13,19,31].

3.3. Small intestine

In 1904, Baldwin devised the use of small intestine for the creation of an artificial vagina [58]. He first performed this operation in 1907, on a young girl with postpartum slough of the vagina. At laparotomy, a double-looped segment of terminal ileum with intact mesenterial blood supply was pulled into a previously created channel between the bladder and the rectum. The uterus was removed in the same session. Ten days postoperative-

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[6] *"Bei dieser Kranken bot sich ein ganz originelles Bild der äußeren Geschlechtsteile, wo anstatt drei Hauptöffnungen der natürlichen Kanäle vier solcher vorhanden waren, und zwar von vorn nach hinten: Die Öffnung der Urethra, die Öffnung des Uterus, die Öffnung der Vagina und die Öffnung des Rektums."* (Kakuschkin 1924) [50]
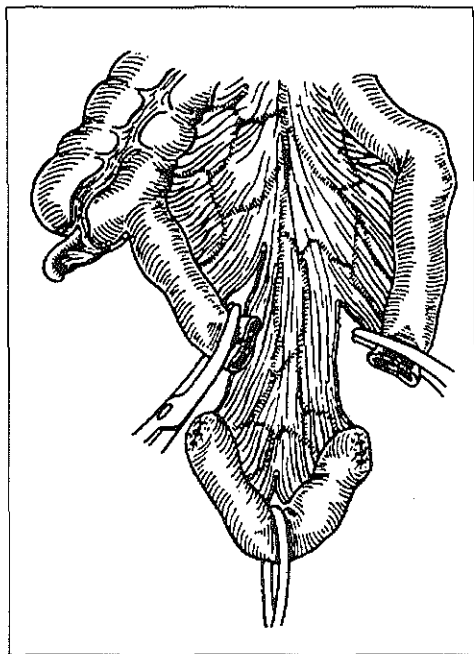
Figure 9: The Baldwin technique: Isolation of a segment of terminal ileum. [56]
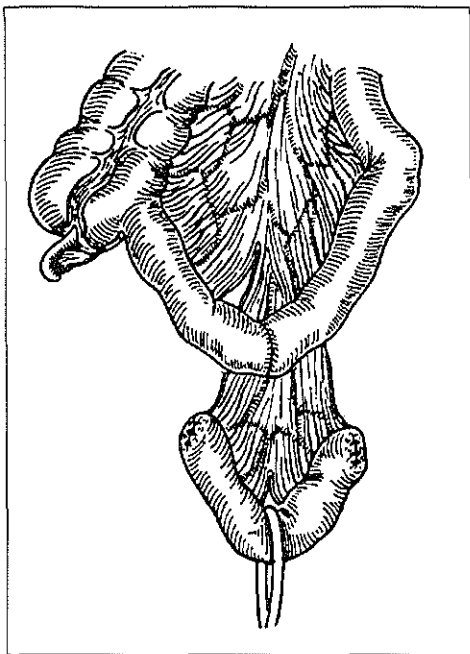
Figure 10: End-to-end anastomosis of small intestine according to Baldwin.

ly, the septum formed by the two intestinal limbs was severed, thus creating a neovagina with a single lumen (Figures 9-12). The functional result was excellent, and the neovagina didn't show any signs of contraction [59]. Judin employed Baldwin's technique with some modifications and obtained equally satisfying results in six cases [60]. As suggested by Häberlin [61], Mori of Japan used a single loop of ileum to line the rectovesical tunnel. The operation was performed in 1908, and the result was satisfying [62]. Mori was followed by others [63-76], although some authors were sceptical about the adequacy of the caliber of a one-armed ileal neovagina [77,78]. Postoperative dilatations were advised to prevent stenosis at the ileo-perineal junction [72].

Despite of initially encouraging reports with regard to the Baldwin operation [23,28,79-87], the drawbacks of ileal vaginoplasty soon became evident. Excessive secretions from the transplant, up to 250 ml daily [88], were embarrassing and troublesome [60]. Sanitary napkins had to be worn permanently and patients were complaining about irritations and chronic eczema in the perineal region [56,89-91]. In an effort to reduce mucous discharge, low-protein diets were advised, because it was assumed that the intake of proteins
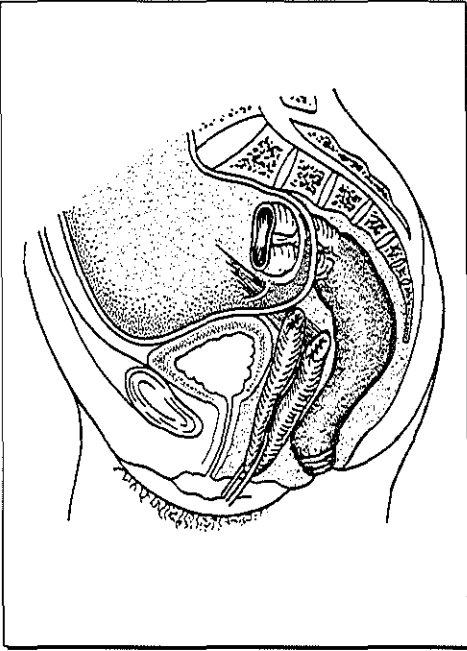
Figure 11: The double-looped segment of ileum with intact mesenterial blood supply is brought down to the perineum.
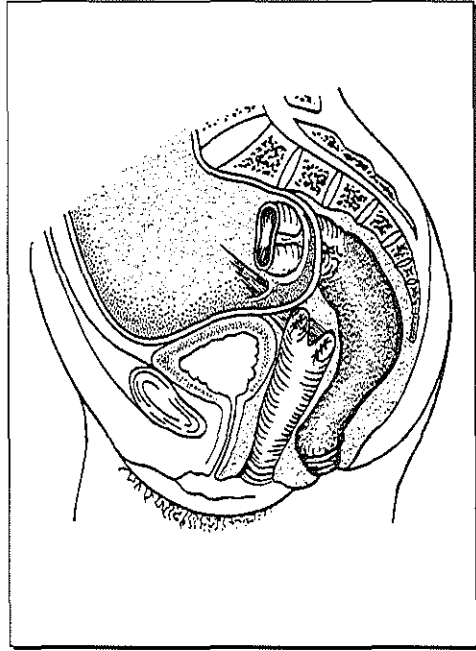
Figure 12: A neovagina with a single lumen is created by severing the septum between the two intestinal limbs.

lead to increased ileal secretions [66,79]. Crampy pains in the transplant were attributed to strong peristalsis and subsequent straining of the mesentery [60]. Parumbilical discomfort with intercourse was reported, and the thin and friable ileal mucosa was traumatized easily, resulting in postcoital haemorrhage [68,90]. At long-term, prolapse may occur [13,22,26,68,89-91]. In one case, the Baldwin operation was performed on a 13-year-old girl with a functioning uterus [92]. Fourteen years later, the woman died of neovaginal adenocarcinoma [93]. The major argument advanced against ileal vaginoplasty was the assumed high mortality of 20% [31,34,94-96], varying from 10% to 29% in different studies [60,88,89]. In one study dating back to 1931, 242 Baldwin operations were reviewed. The calculated absolute mortality rate was 12%, and 6.5% after correction for fatalities attributed to technical errors [3]. Fatal outcomes resulted from anastomosis leakage and peritonitis[7] [2], neovaginal abscess formation with subsequent intraperitoneal perforation [97], strangulation of bowel segments, intestinal obstruction with ileus due to adhesions, and necrosis of the transplant [70,89,98-102].

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[7] *"In one case the anastomosis had been made so imperfectly that at autopsy ascarides were found crawling out." (Rabinovitch 1931)* [3]

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3.4. Sigmoid

In 1913, Albrecht introduced the use of sigmoid colon for the creation of an artificial vagina. He chose a two-stage, dorsoperineal approach for the isolation of the transplant. During the first stage, the sigmoid was mobilized from the pelvis, transsected at its transition with the rectum and brought down to the perineum after creation of a rectovesical cavity from below. A side-to-end or side-to-side anastomosis between the sigmoid and the rectal stump was established. At a later date, and without anaesthesia, the neovagina was isolated from the fecal stream [103]. Albrecht's technique never became popular, probably because Schubert introduced his relatively simpler, extraperitoneal, one-stage method of rectal transplantation around the same time [15]. One year later, a one-stage abdomino-perineal approach for sigmoid vaginoplasty was introduced by Ruge [104]. As opposed to the dorsoperineal techniques, the visibility of the operative field was superior, and an inspection of the internal sexual organs was possible. Also, the coccyx and the anal sphincter were spared. Instead of displacing both rectum and sigmoid, it seemed more ap-
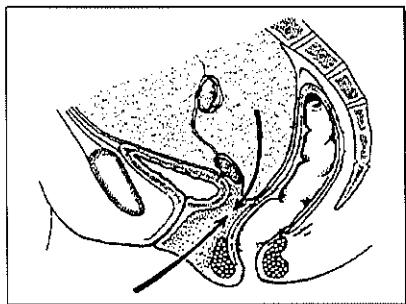
Figure 13: Creation of a tunnel between bladder and rectum.
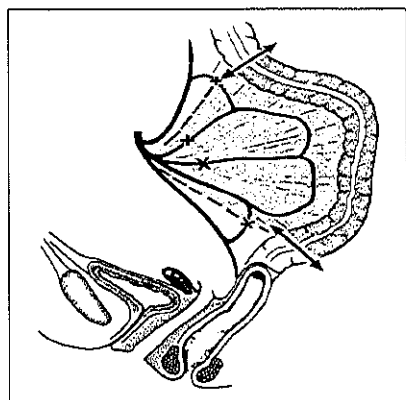
Figure 14: Sigmoid vaginoplasty: isolation of a sigmoid conduit 15-20 cm in length, distally preserving a single vascular pedicle.
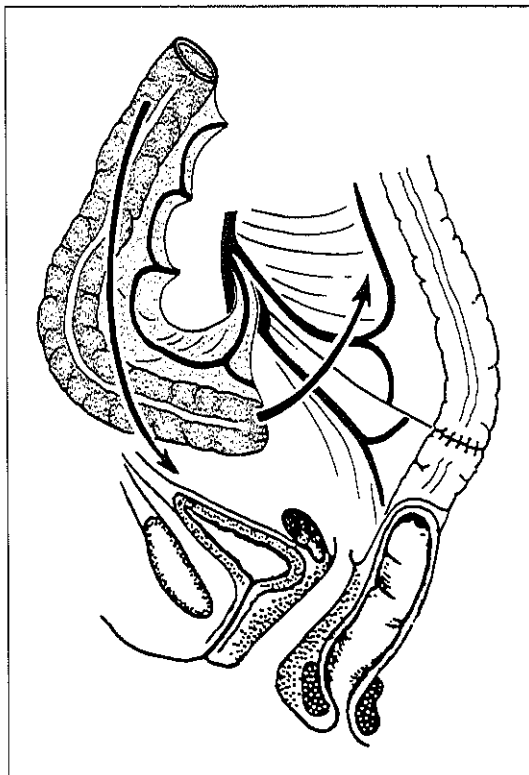
Figure 15: "Champeau's modification": antiperistaltic reversal of conduit.

pealing to leave the rectum at its natural place and suffice with the isoperistaltic transposition of the sigmoid alone, thus banning the risk of rectal necrosis. Compared to small intestine, the anatomic location closer to the future vaginal cavity and greater mobility made sigmoid more suitable for vaginoplasty. Also, the sigmoid was more resitant to trauma, and secretions were minimal.

Vigorously opposed by Ruge [105], Faehrmann and Frankenberg suggested the systematic ligation under transillumination of those mesenterial blood vessels that were irrelevant to the nutrition of the sigmoid segment, to improve its mobility. Carefully selected, one artery and one vein were sufficient to assure adequate circulation in the transplant [106,107]. Depending on the location of this vascular pedicle, the conduit may be implanted in the isoperistaltic or antiperistaltic direction; the latter usually being referred to as "Champeau's modification" (Figures 13-17)[78]. A meticulous extraperitonealization of the neovagina and the intestinal anastomosis was recommended to minimize the risk of peritonitis and incarceration of small intestine [55,104,108-111]. As a consequence of this proce-
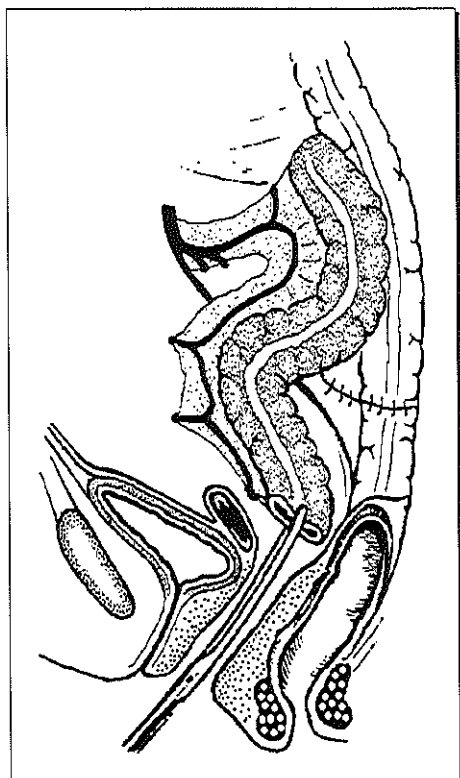
Figure 16: The oral end of the sigmoid segment is brought down to the perineum.
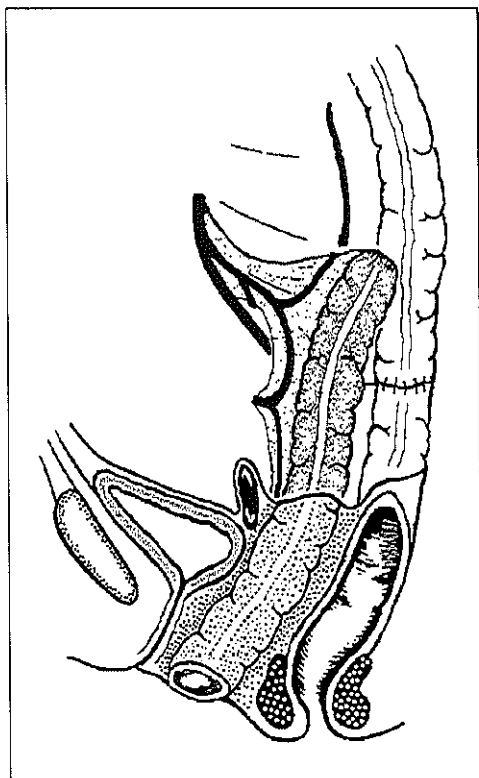
Figure 17: Partly extra- and partly intraperitoneal neovagina.

dure, increased tension of the mesentery and kinking of the vascular pedicle has entailed ischaemic necrosis of the conduit in some cases [112-115]. Crampy pains, strong peristalsis and spontaneous haemorrhage have occurred incidentally [52,116]. A constrictive tendency of the sigmoido-perineal anastomosis was recognized by several authors and postoperative dilatations were advised to reduce scarry strictures at the introitus [2,55,108, 114,117,123,134]. Prolapse of the transplant was reported; in most cases the protruding mucosa was extirpated [52,90,107,117,118]. Sigmoid vaginoplasty was performed predominantly in patients with vaginal agenesis. In a few cases, the technique was applied in patients with postirradiation [120-121] or postpartum loss of the natural vagina [117], after pelvic exenteration [122], and in male-to-female transsexuals [123-125].

Within the past 80 years, 34 authors have reported on 912 sigmoid vaginoplasties with a mortality rate of 0.88% (see table 1). Eight fatalities occurred as a consequence of peritonitis, either due to leakage or disruption of the intestinal suture line [112,126], accidental bladder injury [116], or transplant necrosis [52]. In the cases reviewed, the neovagina was lost in 15 patients, which corresponds to a failure rate of 1.7%.

3.5. Ascending colon

So far, ascending colon has been used only in a restricted number of cases for the creation of an artificial vagina. In 1975, Kun had employed caecum and ascending colon if no part of the sigmoid was suitable for transplantation; 12 patients were operated, with satisfying anatomical and functional outcome in all cases [56]. Markland and Hastings used caecal vaginoplasty in five transsexuals with good results in all but one patient who required an operative widening of the introitus. The technique was abandoned in favour of sigmoid vaginoplasty as the authors found the sigmoid mesentery longer and more easily mobilized [124]. Ileocecal segments may be used in cases with sigmoid diverticulitis, extensive adhesions in the left pelvis, and in patients with previous sigmoid resections [137]. In two different series including 23 patients, four patients underwent minor revision procedures to enlarge the introitus, and in one patient, a protrusion of the neovagina was resected [138-139]. None of the authors described major complications.

3.6. Jejunal mucosa-muscularis grafts

In 1971, Wilflingseder wanted to combine the relative simplicity of skin grafting techniques with the advantages of intestinal transplantation, i.e. permanent patency without long-term dilatations. At laparotomy - which was performed at that time to assess the internal genitals in cases of vaginal dysgenesis - an ileal segment, 15 to 30 cm in length,

Table 1: Mortality and complications associated with sigmoid vaginoplasty (1913-1993).

Year	First Author	No. of cases	Deaths	Complications	Ref
1913	Albrecht	3	-	3 fistulas, 1 transplant necrosis	103
1914	Ruge	1	-	-	104
1914	Boldt	2	-	-	127
1928	Ruge	4	-	-	128
1929	Faehrmann	1	-	-	106
1930	Frankenberg	5	-	3 prolapses, 1 transplant necrosis	107
1930	Petermann	1	-	-	129
1930	Faltin	1	-	-	101
1931	Bazala	2	-	-	2
1932	Gilmer	3	1	1 death: peritonitis from transplant necrosis, 1 prolapse	52
1932	Landois	1	-	1 anastomosis leakage, purulent peritonitis: relaparotomy	130
1934	Rudolf	2	-	-	131
1939	Hejduk	2	-	2 minor introital stenosis: dilatation	108
1949	Schäfer	3	-	1 prolapse	119
1952	Schmid	10	-	-	109
1952	Kraatz	2	-	-	132
1957	Counseller	1	-	-	133
1960	Shirodkar	40	1	1 death: peritonitis from disruption of anastomosis, 2 transplant necrosis	112
1961	Alexandrov	275	5+(1)	5 deaths: peritonitis from anastomosis leakage, 1 death: cardiac failure, 29 fistulas, 2 transplant necrosis	126
1963	Champeau	1	-	-	78
1968	Gigovsky	220	1	1 death: peritonitis from bladder injury, 4 rectovaginal fistula	116
1972	Pratt	51	-	1 prolapse, 2 transplant necroses, 1 sigmoidovaginal fistula, 1 vesicovaginal fistula	90
1973	Gagnaire	13	-	1 prolapse; 1 ileus: relaparotomy, 1 introital stenosis: operative widening	55
1975	Zängl	23	-	2 transplant necrosis	113
1975	Kun	27	-	1 partial transplant necrosis, 1 obliteration (inflammation)	56
1978	Markland	4	-	-	124
1980	Monseur	17	(1)	1 death: bilharziotic liver cirrhosis and splenomegaly, 4 prolapses, 2 minor introital stenosis: dilatation	117
1981	Dalton	6	-	1 introital stenosis: operative widening	123
1984	Guillet	12	-	2 introital stenosis: operative widening	134
1984	Eicher	1	-	-	135
1984	Heung-Tat Ng	2	-	-	122
1980	Novak	106	(1)	1 death: cardiac failure, 2 transplant necrosis, 2 prolapses, 3 introital stenosis, 1 fistula	114
1987	Kindermann	23	-	1 transplant necrosis, 5 introital stenosis: dilatation, 1 excessive secretions: partial resection of transplant	115
1987	Radhakrishnan	2	-	-	136
1993	Freundt	45	-	1 peritonitis: several relaparotomies, 3 prolapses, 12 introital stenosis: operative widening, 1 denervation of transplant (* this thesis)	*

was isolated, stripped from its peritoneum, drawn over a mould, and inserted into a previously prepared rectovesical cavity [140]. According to the author, most of the graft took well. Five patients were treated; in one patient, a relaparotomy was performed because of strangulation ileus. Biopsy specimens, taken 18 months postoperatively, showed progressive metaplasia into a single layer of flat cylindrical epithelium. Also, a distinct stenosing tendency was observed [141]. Follow-up beyond 24 months is not available, although the author last reported on the technique in 1975 [142].

Wilflingseder's method is outdated because exploratory laparotomy was substituted by ultrasound and laparoscopy. Moreover, the risks associated with an intestinal anastomosis are not eliminated, and advantages over the transplantation of a conduit with intact mesenterial blood supply were not demonstrated.

3.7. Summary and conclusions

The history of attempts to create an artificial vagina with segments of intestine dates back to the end of the 19th century. The first reconstructions were realized at the expense of fecal continence, by diversion of the fecal stream to an artificial sacral anus, and simple substitution of the anal sphincter for an introitus [4]. The extraperitoneal techniques involving transplantation of the rectum to the vaginal region with subsequent connection of the sigmoid to the anus were popular in the preantibiotic era [15]. The main disadvantages of rectal transplantation consisted in the difficulty of the technique, the inevitable contamination of the operative field with infectious material resulting in persistent wound healing problems [3], and in the frequent occurrence of fistulas and fecal incontinence [17]. Methods to create a neovagina with an isolated loop of small intestine [58,62] were associated with a high mortality, and excessive secretions from the conduit were inacceptable [60,66].

Colpopoiesis by transplantation of sigmoid segments with intact mesenterial blood supply has been known and utilized since 1914 [104]. The main advantage over the skin grafting techniques consists in a permanently patent neovagina retaining its immediate postoperative dimensions even without regularly performed long-term dilatations. A constrictive tendency may be observed at the sigmoido-perineal anastomosis, which is easily corrected with minor operative procedures [125]. The problems associated with descent of the neovagina and excessive secretions from the conduit are discussed in other sections of this manuscript. The colonic mucosa is similar to the natural vaginal lining [56]. Although statistics have to be interpreted cautiously because negative outcomes may not have been

published [17,19,40,70], more than 900 cases were collected with an overall mortality of 0.88 %, and a 1.7 % failure rate was calculated, mostly due to necrosis of the transplant (see table 1). A majority of the fatalities occurred as a consequence of anastomosis leakage and subsequent peritonitis. Within one century, mortality was reduced as technical facilities improved, but postoperative peritonitis is still a life-threatening complication of intestinal surgery even in the hands of experienced surgeons.

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CHAPTER 4

A modified technique to create a neovagina with an isolated segment of sigmoid colon

I. Freundt[1], T.A.M. Toolenaar[1], F.J.M. Huikeshoven[1], A.C. Drogendijk[1], H. Jeekel[2]

*From the Departments of Obstetrics & Gynecology[1] and Surgery[2],
University Hospital Rotterdam Dijkzigt, Rotterdam, the Netherlands*

4.1. Abstract

The creation of a functional vagina in patients with congenital vaginal aplasia or male transsexualism is a challenging problem. A group of 40 patients, including 23 male transsexuals, in whom a neovagina was created using a sigmoid transplant, is reported. The technique, a modification of Kun's "colocolpopoiesis" is described in detail.

Ten patients showed some direct postoperative complications and five were readmitted the first six weeks postoperatively for a variety of reasons. No extensive complication occurred. Thirty-two patients were evaluated at the routine six week postoperative check-up. Four patients had had intercourse at that time and an adequate vagina was found in 21 other patients.

It is concluded that this modification of Kun's technique, known as "colocolponeopoiesis", has had, at short term in the majority of patients, functionally good results and an acceptable complication rate.

4.2. Introduction

Congenital vaginal aplasia is one of the primary features of the Mayer-Rokitansky-Küster syndrome. The frequency of this syndrome is estimated to be between one in 4,000 and one in 80,000 [1,2]. It is usually detected during late adolescence. The initial complaints are primary amenorrhea and impaired coital function, or both. Since the beginning of this century, numerous procedures have been described to create an artificial vagina in women with congenital vaginal aplasia. More recently, these procedures also have been applied in male transsexuals for gender reassignment operation. According to one study, transsexualism is a condition in which a person manifests, with persistent conviction, the desire to live as a member of the opposite sex and progressively takes steps to live in the role of the opposite sex [3]. In 1980, the diagnostic criteria for transsexualism were defined in the *Diagnostic and Statistical Manual of the American Psychiatric Association* (DSM-III)[4]. In the Netherlands, the incidence of male-to-female transsexualism is estimated to be one in 35,000 [5]. Approaches to create an artificial vagina include Frank's nonoperative method and a variety of surgical techniques using free or pediculated grafts derived from skin or other tissues [6]. Although prolonged use of obturators can have satisfactory results, all of these artificially generated vaginas have a tendency to contract.

In 1914 the creation of an artificial vagina with an isolated segment of sigmoid colon that did not shrink was reported [7]. In 1975, this technique was improved and named "colocolpopoiesis". It was stated that long-term anatomic and functional results were superior to that of other techniques. Furthermore, wearing a mold for a long time is not necessary [8]. In 1983, we decided to abandon the McIndoe technique that we had been using [9]. Within the next five years, 40 patients, mainly women with Mayer-Rokitansky-Küster syndrome and male transsexuals, were operated upon in our hospital using the modified colocolpopoiesis technique. This new technique, called colocolponeopoiesis, is presented herein.

4.3. Materials and methods

Between May 1983 and September 1988, 40 patients without functional vaginas were operated upon at the University Hospital Rotterdam. In 14 patients, vaginal aplasia was part of the Mayer-Rokitansky-Küster syndrome. Within this group, two patients, after a Davydov operation, presented with a stenosed vagina [10]. In eight of the remaining 12 patients who had never undergone vaginal operations, the diagnosis of Mayer-Rokitansky-Küster syndrome was made in our hospital. Prior to operation, ten patients had tried Frank's nonoperative method of perineal self-dilatation with little success; four patients refrained from initially trying this method.

All 23 transsexual patients had had previous operations in which the external genitalia were changed. The diagnosis of transsexualism had been confirmed by sex counselors and andrologists from the Dutch Gender Team that now works in accordance with the Standards of Care made by the Harry Benjamin International Gender Dysphoria Association [11]. Of the 23 transsexual patients, one patient never had vaginoplasty; only orchidectomy and penectomy were performed elsewhere. The remaining 22 patients presented with a stenosed vaginal vault and introitus, or both, after one (15 instances) or more (seven instances) vaginoplasties, using the penile inversion or McIndoe technique, or both, performed elsewhere, one to 11 years before. One patient had undergone 11 reconstructive vaginoplasties before being referred to our hospital. In three patients, stenosis was diagnosed after vaginal infection. All 23 patients had initially tried perineal self-dilatation and had disappointing results.

The remaining three patients included a patient with testicular feminization, one with incomplete androgen insensitivity and one who had undergone an anterior exenteration, because of sarcoma botryoides, at the age of one year.

The patients with Mayer-Rokitansky-Küster syndrome were between 16 and 27 years of age (median age of 17 years) at the time of the operation. In all instances, preoperative assessment revealed a vaginal cul-de-sac in which one finger or less could be inserted at a depth varying from 0.5 to 7.0 centimeters (mean of 3.7 centimeters and median of 4.0 centimeters).

Preoperative gynecologic examinations of the 22 patients with male transsexualism who underwent at least one vaginoplasty revealed that 15 patients had vaginal depths varying from 0.5 to 8.0 centimeters (mean of 4.6 centimeters and median of 5.0 centimeters). In seven of these, less than two fingers could be inserted into the vagina. The remaining seven patients presented with totally stenosed vaginas. Patients were between 18 and 52 years of age (median of 34 years), when operated upon. In all 40 instances, the indication for colocolponeopoiesis was nonacceptance or failure of conservative treatment or unacceptable result of previous surgical treatment.

4.4. Technique

The patient is admitted two to three days preoperatively for mechanical and antibiotic (neomycin, metronidazole and cefoxitine) intestinal preparation. During the operation, the patient is in a semilithotomy position, and abdominal and perineal operations are performed by two teams simultaneously. An indwelling Foley catheter is inserted into the bladder.

Abdominal operation. After laparotomy by a Pfannenstiel incision, inspection and palpation of abdominal contents are performed with emphasis on aspects and localization of internal genitalia. After mobilization of the sigmoid colon from the left iliac fossa, one segment of the sigmoid flexure, with a length of 15 to 20 centimeters, is selected for isolation. The mobility of this segment is enhanced by reducing its blood supply to one single distal vascular pedicle containing one major artery and vein large enough to assure adequate circulation in the entire segment. All other branches of the sigmoid artery to the arcade are isolated while transilluminating the mesosigmoid, clamped and ligated, after careful control of the vitality of the intestinal segment.

After isolation of the sigmoid transplant, its aboral border is closed with one continuous polydioxanone or Vicryl^R (polygastin 910) suture, or with the help of GIA™ (Auto Suture, U.S. Surgical Corp.) automatic stapler. The oral end of the transplant remains open or is closed temporarily. Using a clamp, this part of the conduit is brought down to the perineum at a later stage of the operation. The continuity of the intestinal tract is subsequently restored with one layer running polydioxanone suture.

Perineal operation. Prior to dissection, the depth and width of the vaginal pouch is assessed. If the orifice is wide and there is sufficient vaginal depth, a U-shaped vaginal tissue flap retaining its attachment laterally on the left is dissected in the vaginal pouch. This flap will meet the shorter mesenteric side of the conduit. In stenosed vestibule, respectively, absent vagina, an appropriate shape incision (H-, X- or Y-shape) in the vestibule, respectively, perineum, is chosen. Generally in such an instance, there is no further vaginal tissue available. When appropriate, the introitus is enlarged by incision of the bulbocavernosus muscle and some of the most distal fibers of the levator ani muscle. A cavity between the bladder and rectum is prepared, partly bluntly and sharply, and if necessary guided by a finger in the rectum, until the peritoneum is reached. If appropriate, scar tissue from earlier vaginal constructions is removed. The Foley catheter is used to locate the urethra and neck of the bladder while preparing this cavity.

At this stage of the operation, the surgeon of the abdominal team has opened the peritoneum and facilitated the preparation of the tunnel from below by pushing down with two fingers. In patients with Mayer-Rokitansky-Küster syndrome, this channel is created by first dissecting bluntly dorsal of the rudimentary uterus if present, and bilaterally along the midline rectovesical septum, which is then severed under visual control. In transsexuals, the cavity is prepared in the plane between the prostate and rectum. If the channel is large enough, two fingers can be inserted with ease. Additional space is created in the depth of the cavity by severing the superficial layers of the levator muscle. Hemostasis in the channel is ensured by ligation, cauterization or tamponade of bleeding points before proceeding to the incision of the peritoneum. The peritoneal incision is digitally enlarged

so that the proximal end of the isolated sigmoid segment can be brought down to the perineum without tension or kinking of its vessels. With the mesenteric side of the conduit situated laterally on the left, two Vicryl anchoring or situation sutures are placed at the three and nine o'clock positions to fix the antiperistaltic transplant to the levator fascia that represents the wall of the channel. If necessary, the antimesenteric border of the conduit is incised over a few centimeters to increase its diameter. Using interrupted catgut sutures, an anastomosis between the oral side of the sigmoid conduit and the perineal vaginal epithelium is established. After completion of the perineal procedure, routine closure of the abdominal wall is performed. Neither the perineal wound nor the abdominal area are drained. Packing of the neovagina is omitted, and the Foley catheter remains in the bladder for at least 24 hours.

In some patients, additional interventions, other than colocolponeopoiesis, were performed at the same session. The urethral orifice was corrected in four transsexual patients, the remnants of the corpora cavernosa were excised in six transsexual patients, one urethrovaginal fistula was resected and in one patient, the scrotal skin was transposed to improve the aspect of the labia majora. The patient with incomplete androgen insensitivity underwent bilateral gonadectomy.

4.5. Results

Minor rectal laceration occurred twice while dissecting the vaginal cavity in heavily cicatrized tissue. In both instances, the lesions were repaired directly with one continuous polydioxanone suture. Subsequent end to end anastomosis was considered safe in one patient. It was decided to construct a temporary end colostomy in the other patient, and intestinal continuity was restored three months later.

No injuries to the urinary tract or major vessels were noted. Because of impending tension at the mucocutaneous junction in one patient, the sigmoidoperineal anastomosis was established by means of pedicled perineal skin flaps. Blood loss varied from 200 to 1,600 milliliters (average of 630 milliliters), exceeding 1,000 milliliters in two instances because of diffuse oozing from the vaginal cavity. Eighteen patients received blood transfusions during or after the operation, or both.

Six patients had postoperative complications from the neovagina. Partial necrosis of the transplant occurred twice. In one instance, the transplant could not be implanted without tension to the mesentery. In the other instance, circulatory insufficiency was caused by packing the neovagina. The resulting local stenosis required corrective surgical treatment in both patients. Four instances of infected hematoma - twice originating from the vaginal

71

vault and twice from the mucocutaneous junction - were successfully managed with conservative treatment. Postoperative fever (>38 degrees C.) occurred twice as a result of cystitis and was successfully treated with antibiotics. Abdominal wound complications developed twice. Healing was delayed because of abscess formation in one instance and wound dehiscence in the other. Leakage of the rectosigmoid anastomosis did not occur. The Foley catheter was maintained for a median period of two days (range zero to eight days); thereafter, in three instances, intermittent catheterization produced more than 100 milliliters of urine. Normal diet was begun between the fourth and the 18th postoperative day (median seventh day). In one patient, a transient prolonged postoperative ileus required nasogastric aspiration between the third and fifth postoperative day.

Dilatation with obturators of the sigmoidoperineal junction was started between the sixth and 11th postoperative day (median seventh day) to avoid primary stricture in this area. All patients were discharged from the hospital between the ninth and 34th postoperative day (mean 14th day). All 40 patients were given an appointment for their first follow-up examination six weeks postoperatively. Sexual intercourse was not encouraged until the first postoperative examination.

Five patients had to be readmitted for various surgical interventions within a six week period after colocolponeopoiesis. Three patients underwent an operative widening of the introitus because of scarry stricture at the sigmoidocutaneous junction, after failure of conservative treatment with conical shaped obturators. One patient inserted an obturator so deeply that it could only be removed abdominally. Because of a persistent abdominal wound infection, one patient underwent two operations in which the abdominal wound was drained. The defect, which appeared to be caused by automutilation, was eventually repaired with a split skin graft.

Although all 40 patients were given an appointment for their first follow-up examination six weeks postoperatively, eight patients did not return. Most of these patients do not live within easy traveling distance of our hospital. At their first examination after the operation, four of the remaining 32 patients reported satisfying coitus in the neovagina. Twenty-one patients had not yet taken up sexual activity for reason of fear or inability to find a partner. However, their vaginas were suitable for cohabitation, allowing entry of at least two fingers, with a depth exceeding 12 centimeters. Some patients complained of purulent or mucous discharge from the neovagina. In seven patients, some introital stenosis was noted. These patients, and those who did not have sexual intercourse on a regular basis, were advised to perform self-dilatation with obturators in order to avoid secondary stricture at the sigmoidocutaneous junction. None of the patients had complications at the rectosigmoid anastomosis. Vesicovaginal or rectovaginal fistulas did not develop. The postoperative complications and data, divided between the group of transsexual patients

and the group of patients with vaginal dysgenesis, including the three patients with miscellaneous disorders, are listed in table 1. There was a slight, but not significant, increase in immediate postoperative complication rate in the transsexual group. The number of patients in the transsexual group who did not appear for follow-up examination is somewhat larger, but not significantly. However, there was a significant ($p < 0.05$) increase in (minor)-introital stenosis in the transsexual group.

4.6. Discussion

Colpoplasty involving transplantation of the colon is a radical intervention with significant surgical risks, even in physically healthy individuals. Mortality, although none occurred in our series, should always be considered. This type of colpoplasty was selected as the treatment in the group of patients we treated because of the merits presented by Kun. To

Table 1: Postoperative complications.

	Vaginal dysgenesis*	Male transsexualism
Number of patients	17	23
Immediate postoperative period		
Uneventful	15	15
Complicated	2	8
Temperature >38°C	1	1
Postoperative ileus	0	1
Abdominal wound hematoma	1	0
Abdominal wound dehiscence	0	1
Infected vaginal hematoma	0	3
Partial necrosis of transplant	0	2
First six weeks after discharge		
Uneventful	15	20
Readmitted	2	3
Introital stenosis corrected	1	2
Persistent infection of abdominal wound,		
automutilation	1	0
Obturator removed abdominally	0	1
Results at first follow-up visit		
No follow-up visit	1	7
Available for evaluation	16	16
Adequate vagina, no intercourse	12	9
Adequate vagina, satisfying intercourse	4	0
Some introital stenosis	0	7**

* Includes 14 patients with Mayer-Rokitansky-Küster and three patients with miscellaneous disorders
** Statistically significant ($p < 0.05$), tested using chi-square methods with Yates corrections

improve long term functional results and for time-saving purposes, certain modifications in colocolponeopoiesis have been introduced when comparing it with the classical Kun technique (Table 2). A Pfannenstiel incision leaves a cosmetically more appealing scar and provides sufficient access to the pelvic cavity. We applied Champeau's method of antiperistaltic reversal of the conduit in all instances [12]. A longer segment can be obtained when a distal vascular pedicle is preserved. Furthermore, tension of the mesentery is more easily prevented, thus minimizing the risk of circulatory insufficiency and subsequent ischemic necrosis of the neovagina. Partial necrosis occurred only twice in our group of patients.

Table 2: Colocolponeopoiesis versus Kun's technique

Colocolponeopoiesis	*Kun's colocolpopoiesis*
Two teams working simultaneously	One team moving from abdominal to perineal field
Pfannenstiel incision	Median laparotomy
Preparation of vaginal cavity from the perineum	Abdominal approach in preparing the vaginal cavity
Antiperistaltic transplant	Isoperistaltic transplant
Intestinal end to end anastomosis in one layer	Intestinal end to end anastomosis in two layers

The vaginal cavity was prepared from a combined abdominoperineal approach. Depending largely on the expertise of the two surgeons, the correct plane can be secured in the perineal dissection without increased risk of injuries to the bladder or rectum. However, especially in the antropoid pelvis, difficulties may be encountered in the presence of extensive scar tissue that developed from previous attempts to form a vagina. Moreover, accidental rectal perforation becomes more probable when diffuse oozing, as a result of transsecting muscle fibers, disturbs good visualization. The intestinal continuity is safely restored by an end to end anastomosis in one layer. Anastomosis leakage or peritonitis did not occur in any of the patients in our study.

At short term, colocolponeopoiesis provides a good functional result with an acceptable morbidity in the majority of the patients. At their first follow-up examination six weeks postoperatively, 25 of 32 patients were found to have a vagina suitable for intercourse. It is generally accepted that an intestinal transplant does not shrink. This has been confirmed for the isolated blinded sigmoid segment used in our series. However, irrespective

of the shape of the initial perineal incision, we observed a constrictive tendency at the sigmoidocutaneous junction. This tendency appeared to be even more pronounced in transsexual patients. A possible explanation may be that scar tissue from previous vaginal constructions has been present prior to implantation of the sigmoid vagina. The three patients who underwent an operative widening of the introitus within the first six postoperative weeks had one or more vaginal operations previously. To prevent recurrent constriction, intermittent introital dilatation with graduated obturators was begun during the first postoperative week and continued until regular intercourse took place. Patients who, because of fear, pain or moral considerations, are not prepared to perform dilatation of the introitus at regular intervals, may be at higher risk of developing secondary stenosis. Excision of scar tissue is possible, but new fibrous tissue often leads to recurrent stricture if the patient is not motivated enough to perform intermittent dilatation.

Two reports mention congestion of discharge in the vaginal top [13,14]. In our series, this was reported by a minority of the patients. The results of one study suggested that the formation of these mucus plugs could be prevented by douching the neovagina once or twice a week [13]. In another study, it was noted that douching enhances the formation of excessive mucus [14]. The correct approach to this problem will only be determined when the physiologic factors of this isolated intestinal segment is fully understood.

4.7. Summary

A group of 40 patients - including 23 male transsexuals and 14 patients with Mayer-Rokitansky-Küster syndrome - in whom a neovagina was created using a transplant of an isolated segment of sigmoid, is reported. This modification of an earlier reported technique is described in detail.

Complications of this method are evaluated. No major complication occurred. Thirty-two patients were evaluated at the routine six week postoperative examination. The majority of the patients showed an adequate vagina at that time.

It is concluded that this modification of Kun's technique, called colocolponeopoiesis, is a technique with, at short term, good functional results in the patients with Mayer-Rokitansky-Küster syndrome and in most of the male transsexual patients. The complication rate was acceptable. In the group of male transsexuals in our series, a small but significant number of patients with minor introital stenosis was reported six weeks postoperatively.

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CHAPTER 5

Long-term psychosexual and psychosocial performance of patients with a sigmoid neovagina

I. Freundt[1], T.A.M. Toolenaar[1], F.J.M. Huikeshoven[1], H. Jeekel[2], A.C. Drogendijk[1]

From the Departments of Obstetrics & Gynecology[1] and Surgery[2],
University Hospital Rotterdam Dijkzigt, Rotterdam, the Netherlands

5.1. Abstract

Objective: We aimed to study the long-term psychosexual and psychosocial performance of patients with a sigmoid vagina in vaginal dysgenesis and male-to-female transsexuals.

Study design: Nineteen patients who had undergone surgery to create a neovagina with the use of a sigmoid segment participated in a long-term follow-up study. Evaluation was done with standardized gynecologic examination and a structured interview.

Results: The anatomical result was good in 18 patients, although several reoperative procedures had been necessary. Sexual adjustment was good or satisfactory in 12 of 19 patients. Of the 19 patients, 16 were capable of reaching an orgasm. Social adjustment was good or satisfactory in 16 patients.

Conclusions: The creation of a sigmoid neovagina results in a long-term anatomically satisfactory situation, in both patients with vaginal dysgenesis and male-to-female transsexuals. In a majority of the patients sexual and social adjustment is good or satisfactory.

5.2. Introduction

The creation of a functional vagina in cases of congenital or acquired absence remains a challenging problem. A great number of different techniques that use conservative and surgical approaches have been developed and abandoned throughout this century to construct a missing vagina. Most of the currently applied techniques have been accepted in the relative absence of follow-up studies with a mean postsurgical observation period exceeding several years. Intestinal transplants have been used since the beginning of this century to create an artificial vagina. The claimed advantage of intestinal versus skin transplants is that intestinal transplants do not shrink. This has been confirmed in a study by Markland and Hastings, who reported on nine male transsexuals in whom a neovagina derived from cecum or sigmoid colon had remained patent two to eight years after colpopoiesis [1]. Kun has reported on 39 biologically female subjects with vaginal dysgenesis who had colpopoiesis. He stated that in all his patients the neovagina was suitable for intercourse. Long-term performance was not assessed by means of structured interviews and the follow-up period was not noted [2]. A modified colocolpopoiesis technique with the use of an isolated sigmoid segment has been applied in our clinic since 1983. At short term, this technique has provided good functional results [3]. The objectives of the current study were to evaluate whether the claimed advantage of long-term patency is valid for the sigmoid vagina and to determine long-term functional and psychosexual outcome after colpopoiesis from the sigmoid colon in both male-to-female transsexuals and patients with vaginal dysgenesis.

Table 1: Preoperative and reoperative patient data.

(Numbers in parentheses refer to patients who participated in the long-term follow-up study)

	vaginal dysgenesis		*male-to-female transsexualism*	
No. of patients	17[1]	(9)[2]	23	(10)
age (yr)	16-27	(17-22)	18-52	(19-41)
median (yr)	17	(18)	34	(34)
previous vaginal surgery				
one	3	(1)	15	(5)
> one	0	(0)	7	(4)
none	14	(8)	1	(1)
reoperated				
introital stenosis	4	(4)	8	(4)
prolapse	1	(1)	1	(0)
denervation	0	(0)	1	(0)

[1] Includes 14 patients with Mayer-Rokitansky-Küster and three patients with miscellaneous disorders
[2] Includes eight patients with Mayer-Rokitansky-Küster and one patient with testicular feminization

5.3. Materials and methods

Forty patients without a functional vagina were operated at the University Hospital Rotterdam Dijkzigt between May 1983 and September 1988 according to a modified colocolpopoiesis technique that is described elsewhere in detail [3]. After laparotomy by Pfannenstiel incision, the sigmoid colon is mobilized and a sigmoid segment with a length of 15 to 20 cm is selected for isolation. A vascular pedicle that ensures adequate circulation in the entire segment is distally preserved. After isolation of the transplant, its aboral border is closed. The continuity of the intestinal tract is subsequently restored with one layer running polydioxanone suture. In the perineal surgery being performed simultaneously, a cavity is prepared between the bladder and rectum. The channel is adequate when it admits two fingers with ease. If necessary, more space can be created by incision of the bulbocavernosus or levator ani muscle. The proximal or oral end of the sigmoid transplant is brought down to the perineum. Its antimesenteric border may be incised over a few centimeters to increase its diameter. Subsequently, the sigmoido-perineal anastomosis is established. Neither the perineal nor the abdominal area is drained. Packing of the neovagina is omitted. Preventive intermittent introital dilatation is recommended until regular intercourse takes place.

Patients. The group of 40 patients consisted of 14 women with the syndrome of Mayer-Rokitansky-Küster and 23 male transsexuals. The remaining three patients included one patient with testicular feminization, one with incomplete androgen insensitivity, and one who had undergone an anterior exenteration at the age of one year because of sarcoma botryoides. All but one of the transsexual patients had had construction of a neovagina with penile skin, resulting in total or nearly total secondary obliteration. Efforts were made to invite all 40 patients to attend our outpatient clinic for the structured evaluation of long-term postsurgical outcome. Seventeen patients could not be traced, and four refused to cooperate for various reasons. Nineteen patients were available and willing to participate in this study. The follow-up period of the 19 patients was 21 to 93 months (mean 52 months). Ten patients were male-to-female transsexuals, and of the nine patients with vaginal dysgenesis eight had the syndrome of Mayer-Rokitansky-Küster and one had testicular feminization. Nine reoperative procedures, mostly corrections of introital stenosis after failure of conservative treatment with obturators, were performed on patients of this study group. In Table 1 the preoperative and reoperative data of these patients are compared with the data of the whole group of patients who were operated on.

Procedure. Structured interviews and standardized pelvic examinations were conducted by the first two authors. The interviews were held on the basis of a questionnaire that was sent to and filled out by the participating patients before their visit. Most of the questions were of the multiple choice type. A few questions were discussed in depth. On request,

a copy of the questionnaire can be obtained from the authors. On the basis of the psycho-social rating format developed by Hunt and Hampson [4], the answers given by the patients were then used to assess the following psychosocial performance categories: sexual adjustment, social adjustment and the ability for self-support. The possible ratings as assigned by the authors, were good, satisfactory, doubtful and unsatisfactory.

As a part of the standardized pelvic examination, vaginal dimensions were determined. Dilators of varying diameters were used to assess the width of the neovagina, and its length was measured with marked gradations in cm on the dilators. Whenever resistance from perineal muscle contraction was felt at insertion of the dilator, the patient was invited to insert the dilator herself. A neovagina with a length exceeding 12 cm and a diameter of 3.5 cm was considered adequate.

Table 2: Long-term performance ratings according to individual patients.

		doubts about surgery	experien-cing self as female	sexual rela-tions	functional nature of vagina	sexual satis-faction	OVERALL SEXUAL ADJUST-MENT	OVERALL ABILITY FOR SELF-SUPPORT	OVERALL SOCIAL ADJUST-MENT	ANATOMICAL OUTCOME
VD	1	-	S	D	S	D	D	G	G	adequate
	2	-	D	G	S	G	S	D	G	adequate
	3	-	G	G	S	G	G	G	G	adequate
	4	+++	D	S	S	S	D	G	S	adequate
	5	+	G	G	S	G	S	G	G	adequate
	6	+	D	G	S	G	S	U	G	adequate
	7	-	D	U	S	D	D	S	S	adequate
	8	-	G	G	S	G	G	G	S	adequate
	9	+	D	S	S	G	S	G	G	adequate
TS	1	++	S	S	D	D	D	S	G	introital stenosis
	2	-	S	D	D	D	D	S	S	adequate
	3	-	G	G	S	D	S	S	D	adequate
	4	-	G	D	S	D	D	G	U	adequate
	5	+	S	G	S	S	S	G	S	adequate
	6	-	S	U	S	U	D	S	G	adequate
	7	-	S	S	S	G	S	G	G	adequate
	8	-	G	S	S	D	S	G	G	adequate
	9	++	G	S	S	S	S	U	S	adequate
	10	-	G	S	S	G	S	U	D	adequate

Legend: - none   + occasional, not significant   ++ occasional, significant   +++ chronically
           G = good   S = satisfactory   D = doubtful   U = unsatisfactory
           VD: patients with vaginal dysgenesis, includes eight patients with Mayer-Rokitansky-Küstersyndrome and one patient with testicular feminization
           TS: male-to-female transsexuals

5.4. Results

In 18 of the 19 patients an adequate neovagina was found. The remaining transsexual patient was diagnosed with an introital stenosis that caused considerable dyspareunia. The ratings of the various categories to assess long-term performance are given for each individual in Table 2.

Answers given to questions regarding sexual adjustment are presented in Table 3. Overall, the sexual adjustment of 12 patients was rated either satisfactory or good. Eighteen patients reported having had intercourse since colocolpopoiesis was performed. With regard to experiencing themselves as female, five patients with vaginal dysgenesis were rated doubtful. They reported that they had occasional but significant doubts about being a woman even though none of them was dissatisfied with appearance as a whole. Overall, 15 of 19 patients were either satisfied or neutral about the neovagina. Sexual satisfaction was considered satisfactory or good in 11 patients. Three patients were anorgasmic. Social adjustment was rated satisfactory or good in 16 cases. The relation with most members of the family was good and the current employment situation was satisfying. Two transsexual patients were rated doubtful; both are content with their social life and current employment situation, but in one, acceptance by the family is low and causes considerable distress, and in the other, the current family relations are dissatisfying even though there is acceptance by most family members.

5.5. Comment

To our best knowledge, this is the first follow-up that comprises structured interviews, as well as pelvic examinations, to assess the long-term results of colpopoiesis from the sigmoid colon. It is also the first study that comprises both male-to-female transsexuals and patients with vaginal dysgenesis. This last feature can provoke criticism; lumping male and female subjects obviously creates heterogeneity. However, this study shows that, with the exception of experiencing themselves as females, there is a resemblance.

The psychosocial postsurgical evaluation of both groups of patients was performed with a rating format, which was developed originally for transsexuals who had received sex reassignment surgery [4,5], and has been applied to assess postsurgical transsexuals since then [6,7]. Although the psychologic background is completely different in patients with vaginal dysgenesis the same questions were jugded to be appropriate. There are several

limitations inherent to the type of evaluation. First, there is no comparable information on the presurgical psychosexual and psychosocial state of these patients other than the retrospective information available at the time of the follow-up study. Hence, conclusions about changes in the psychologic field may be drawn only cautiously. Second, the information that was obtained through the questionnaire concerning the current psychosexual and psychosocial state of these patients is based entirely on self-report without supplemental data from other sources. The selection of patients on the basis of availability alone may introduce a bias. Nevertheless, the retrospective and subjective approach was the best possibility of evaluating the outcome of this surgical technique in this group of pa-

Table 3: Long-term performance: Sexual adjustment.

	Vaginal dysgenesis[1] (n=9)	Male transsexualism (n=10)
FUNCTIONAL NATURE OF VAGINA		
intercourse		
yes, regularly	7	5
yes, occasionally	2	4
no	0	1
dyspareunia		
yes	7	4
no	2	5
complaints of blood loss	8	8
complaints of discharge	8	7
EXPERIENCING SELF AS FEMALE		
satisfaction with vagina		
satisfied	5	4
neutral	1	5
dissatisfied	3	1
doubts about female identity		
occasional, but significant doubts	5	0
occasional, but not significant doubts	0	2
no doubts	4	8
satisfaction with own appearance		
satisfied	5	9
neutral	4	1
dissatisfied	0	0
SEXUAL SATISFACTION		
currently experiencing orgasms	9	7
in or around vagina	8	6
satisfaction with sex-life		
satisfied	6	2
neutral	1	4
dissatisfied	2	4
SEXUAL RELATIONS		
choice of sexual partner		
chooses only male partners	9	8
current sexual partner		
none	2	3
temporary	0	3
steady	7	4
current sexual relationship situation		
dissatisfying	2	2
neutral	0	3
satisfying	7	5

[1] *includes eight patients with Mayer-Rokitansky-Küster and one patient with testicular feminization*

tients. In this study only 19 of 40 patients were available. This relatively low attendance is not uncommon in this kind of study [7,8]. Available patients were equally divided over two subgroups of patients, and of the 15 patients readmitted for subsequent vaginal procedures 9 participated in our study.

Surgical outcome. Persisting patency, the claimed advantage of using an intestinal segment for the creation of a neovagina in comparison with other techniques, has been confirmed in this long-term follow-up study [9-11]. In none of the cases was the anatomic result considered as a failure. However, the relatively high incidence of introital stenoses, which has already been noticed in the short-term follow-up of this series, constitutes a drawback that warrants further attention [3].

Psychosexual and psychosocial outcome. Two distinct groups of patients were evaluated in this study. The patients with vaginal dysgenesis were raised as females. These patients were diagnosed quite abruptly with a missing vagina, mostly in their adolescent years, when the self-image is formed. In this period anomalies, particularly anomalies of the sexual organs, may lead to serious identity problems, a disturbed body image [11], and, because of the inability to conceive, to a deep feeling of inadequacy [12]. It was confirmed in this study that these feelings may persist even after the creation of a neovagina [13]. More than half of the patients with vaginal dysgenesis expressed significant doubts about their female identity. None of the patients within the transsexual group reported these significant doubts. The transsexual patients were all raised as boys. From early childhood, they had the conviction of being female, however, with the wrong sexual organs. They progressively took steps to live the female sex role full-time [14]. The creation of a functional vagina is the final step in a long and straining adaptation procedure that has the aim of correlating a female gender identity with a feminine physical appearance. It is therefore not surprising that these patients reported having less doubts about their female identity than patients with vaginal dysgenesis.

Sexual satisfaction is difficult to assess with this kind of questionnaire. Moreover, it is closely linked with current sex life, which depends largely on the availability of a sexual partner, orgasmic capacity, sexual activity, and frequency of satisfying intercourse. This in turn depends on the individual's libido. In the past transsexuals have been reported to be hyposexual [15,16], but in more recent reports this could not be confirmed [17-19]. All five patients who had ratings doubtful or unsatisfactory with regard to sexual relations also had doubtful or unsatisfactory ratings with regard to sexual satisfaction. Four of these five patients were involuntarily single and therefore forced into sexual passivity. Another criterion for the determination of sexual satisfaction was orgasmic capacity. The majority of patients in this series reported at least some capacity for orgasm. One might indeed expect that in the subjects who were biologically female this capacity is not reduced as a

consequence of surgical procedures at the perineum. In their series of 20 patients treated for vaginal agenesis Hecker and McGuire [13] found some orgasmic capacity in 80%; 20% of their patients were anorgasmic. In our series all the women with vaginal dysgenesis and seven of 10 transsexuals reported achieving orgasm. Orgasmic capacity in postoperative male-to-female transsexuals has been described previously, with incidences between 80% and 100% [17-20]. It is probable that some erectile tissue remains even after several vaginoplasties and swells with sexual arousal [20]. Several other physiologic reactions during orgasm, including levator and urethral contractions, are centered near to the neovagina and may contribute to the experience of a neovaginal orgasm. However, the reports of six transsexuals experiencing orgasms in or around the vagina must be viewed with some skepticism because it is difficult to investigate the extent to which such reports are colored by the transsexual's need to perceive herself as a normal female [20]. Several authors describe postsurgical male-to-female transsexuals who become involved with female sexual partners, either preferably or incidentally [18-20]. In one study more than half of the patients had had sexual relations with women. We could not confirm these findings in our series.

In this study none of the patients were considered as failures with regard to sexual adjustment and anatomic result. Lindemalm et al. [17] reviewed a series of publications on the outcome of surgical attempts to create a functional vagina in male-to-female transsexuals according to the penile inversion or McIndoe technique. They concluded that in an estimated 50% of the cases severe complications occurred (e.g., occluded or non-functional vagina). In subjects who are biologically female with vaginal agenesis the percentage of failures appears to be a little less disappointing. Hecker and McGuire [13] investigated the results of vaginal reconstruction according to the Frank and/or McIndoe or Williams technique in subjects who are biologically female with vaginal agenesis. In 17% of their cases a vagina shorter than 6 cm was found after an observation period that ranged from 5 months to 7 years (the median follow-up period was not given). Cali and Pratt [21] reported that in 18% of patients with vaginal agenesis followed up for 10 years or more after a McIndoe operation a complete stenosis of the neovagina had occurred. The reported anatomic failure rates of 50% for male-to-female transsexualism and 20% for vaginal dysgenesis that were assessed for various other techniques were not found in our series for the sigmoid neovagina.

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5.7. Appendix A: Questionnaire for the structured evaluation of long-term performance after colocolpopoiesis.

1. GENERAL PATIENT DATA AND PATIENT HISTORY
marital status:
> *married - single*

current employment situation:
> *unemployed - temporary job - stable employment*

profession:
> *open ended*

age at diagnosis (for vaginal dysgenesis):
> *open ended*

age at start of hormonal treatment (for male-to-female transsexuals):
> *open ended*

previous vaginal surgery and additional vaginal operations after colocolpopoiesis:
> *open ended*

2. SEXUAL ADJUSTMENT
doubts about surgical decision:
> *none - occasionally, not significant - occasionally, significant - chronically*

experiencing self as female:
> doubts about female identity:
> > *none - occasionally, not significant - occasionally, significant - chronically*
>
> satisfaction with own appearance all together, vagina, size and shape of breasts and clitoris:
> > *completely dissatisfied - dissatisfied - neutral - satisfied - completely satisfied*
>
> satisfaction with voice, body-hair and facial hair distribution (transsexuals only):
> > *completely dissatisfied - dissatisfied - neutral - satisfied - completely satisfied*

sexual relations:
> number of sexual partners per annum pre- and postoperatively:
> > *none - one - 2 to 10 - >10*
>
> current status of sexual relationship:
> > *no sexual partner - temporary sexual partner - steady sexual partner*
>
> choice of sexual partner:
> > *only male - predominantly male - predominantly female - only female*
>
> satisfaction gained from current sexual relationship situation:
> > *completely dissatisfied - dissatisfied - neutral - satisfied - completely satisfied*

functional nature of vagina pre- and postoperatively:
> frequency of coitus, dyspareunia, use of dilators, use of lubricants with intercourse or dilatation:
> > *never - occasionally - regularly*
>
> problems with vaginal blood loss, discharge and pruritus:
> > *never - occasionally - frequently*

sexual satisfaction:
> current satisfaction with sex-life:
> > *completely dissatisfied - dissatisfied - neutral - satisfied - completely satisfied*
>
> orgasmic capacity pre- and postoperatively in vagina, around vagina, in the breast area, elsewhere:
> > *non-existent - incidentally - regularly*

3. SOCIAL ADJUSTMENT
relation with family members:
> *no contact (anymore) - occasional contacts - good relations with some members - good relation with most members - good relation with all members*

satisfaction with current family relation, social life and employment situation:
> *completely dissatisfied - dissatisfied - neutral - satisfied - completely satisfied*

5.8. Appendix B: Answers given by the individual patients, and performance ratings as assigned by the authors.

Legend: U = unsatisfactory   D = doubtful   S = satisfactory   G = good   ? = don't know   n = neutral
VD: vaginal dysgenesis, includes eight patients with Mayer-Rokitansky-Küster syndrome and one patient with testicular feminisation   TS: male-to-female transsexuals

Functional nature of the vagina

		inter-course	dyspa-reunia	blood loss	dis-charge	vaginal anatomy	RATING
VD	1	+ +	+	+	+	adequate	S
	2	+ +	+	+	-	adequate	S
	3	+	-	-	+	adequate	S
	4	+ +	+	+	+	adequate	S
	5	+ +	-	+	+	adequate	S
	6	+ +	+	+	+	adequate	S
	7	+	+	+	+	adequate	S
	8	+ +	+	+	+	adequate	S
	9	+ +	+	+	+	adequate	S
TS	1	+ +	+	+	+	introital stenosis	D
	2	-	?	+	-	adequate	D
	3	+ +	-	+	+	adequate	S
	4	+ +	-	+	-	adequate	S
	5	+	+	-	+	adequate	S
	6	+	-	+	+	adequate	S
	7	+ +	+	+	+	adequate	S
	8	+	-	+	+	adequate	S
	9	+	-	+	+	adequate	S
	10	+ +	+	-	-	adequate	S

+ + regularly   + occasionally   - never

Experiencing self as female

		satisfaction with appearance	doubts about female identity	satisfaction with vagina	satisfaction with breasts	satisfaction with clitoris	RATING
VD	1	n	none	-	-	+ +	S
	2	+ +	occ, sign	n	+ +	+ +	D
	3	+	none	+ +	+ +	+ +	G
	4	n	occ, sign	-	+	+ +	D
	5	+	none	+	+ +	+ +	G
	6	n	occ, sign	+	n	+	D
	7	n	occ, sign	-	-	+	D
	8	+	none	+	+	-	G
	9	+ +	occ, sign	+	+	n	D
TS	1	+ +	none	-	+ +	+ +	S
	2	+	occ, not sign	+	+	-	S
	3	+ +	none	n	+ +	n	G
	4	+	none	n	+	?	G
	5	+	occ, not sign	n	+	n	S
	6	+	none	+	+	+	S
	7	+	none	+	+	+	S
	8	+	none	n	+ +	?	G
	9	+ +	none	+ +	+ +	+ +	G
	10	n	none	n	+	?	G

+ + completely satisfied   + satisfied   - dissatisfied   occ, (not) sign: occasionally, (not) significant

Sexual satisfaction

		experiencing orgasms preoperatively	*experiencing orgasms postoperatively*	*in or around vagina*	*elsewhere*	*satisfaction with sex-life*	RATING
VD	1	++	++	-	++	-	D
	2	++	++	++	-	++	G
	3	+	++	++	++	++	G
	4	++	++	++	+	n	S
	5	++	++	++	+	++	G
	6	++	++	++	++	+	G
	7	+	+	+	-	-	D
	8	++	++	+	-	+	G
	9	-	+	+	-	+	G
TS	1	++	++	++	++	-	D
	2	-	+	-	+	-	D
	3	+	-	-	-	n	D
	4	-	++	++	-	-	D
	5	+	+	+	+	n	S
	6	-	-	-	-	-	U
	7	+	+	+	+	+	G
	8	-	-	-	-	n	D
	9	+	+	+	-	n	S
	10	-	++	++	-	+	G

++ regularly/completely satisfied   + occasionally/satisfied   - never/dissatisfied

Sexual relations

		choice of sexual partner	*current sexual partner*	*satisfaction with sexual relationship*	*number of partners preop.*	*number of partners postop.*	RATING
VD	1	♂♂	-	-	0	2-10	D
	2	♂♂	steady	++	0	1	G
	3	♂♂	steady	++	0	1	G
	4	♂♂	steady	++	0	2-10	S
	5	♂♂	steady	++	0	1	G
	6	♂♂	steady	++	1	1	U
	7	♂♂	-	-	0	1	G
	8	♂♂	steady	+	1	1	G
	9	♂♂	steady	+	1	>10	S
TS	1	♂♂	steady	++	>10	>10	S
	2	?	-	n	0	0	D
	3	♂♂	steady	++	1	1	G
	4	♂♂	steady	-	2-10	2-10	D
	5	♂♂	steady	n	0	1	G
	6	?	-	-	0	1	U
	7	♂♂	temp.	+	1	2-10	S
	8	♂♂	-	+	0	1	S
	9	♂♂	temp.	n	2-10	1	S
	10	♂♂	temp.	+	>10	2-10	S

♂♂: only male   temp.: temporary   - none/dissatisfied   + satisfied   ++ completely satisfied

Ability for self-support

		current employment situation	profession	RATING
VD	1	stable employment	waitress	G
	2	unemployed	dancer	D
	3	stable employment	domestic helper	G
	4	stable employment	secretary	G
	5	stable employment	dietician	G
	6	unemployed	none	U
	7	student	none	S
	8	stable employment	parish nurse	G
	9	stable employment	production assistant	G
TS	1	stable employment	domestic helper	S
	2	student	none	S
	3	stable employment	domestic helper	S
	4	stable employment	teacher	G
	5	stable employment	secretary	G
	6	student	journalist	S
	7	stable employment	secretary	G
	8	stable employment	nurse	G
	9	unemployed	none	U
	10	unemployed	none	U

Social adjustment

		relation with family members	satisfaction with family relation	satisfaction with employment situation	satisfaction with social life	RATING
VD	1	good with some	+	+	+	G
	2	good with most	+	+ +	+ +	G
	3	good with all	+ +	+	+	G
	4	good with most	n	n	+	S
	5	good with most	+	+ +	+	G
	6	good with most	+	n	+	G
	7	good with all	+	n	+	S
	8	good with some	+	+	n	S
	9	good with most	+	+	+	G
TS	1	good with all	+ +	+ +	+ +	G
	2	good with some	n	+	+	S
	3	good with most	-	+ +	+ +	D
	4	no contact	--	+	-	U
	5	good with all	n	-	+	S
	6	good with most	+	+	+	G
	7	good with most	+	+ +	+	G
	8	good with most	+	+	+	G
	9	good with all	n	-	+	S
	10	no contact	--	+	+ +	D

++ completely satisfied   + satisfied   - dissatisfied   — completely dissatisfied

General patient data

		age at: diagnosis (VD) start hormones (TS)	previous vaginal operations	age at colocol- popoiesis	follow- up (months)	reoperations after colo- colpopoiesis
VD	1	22	0	22	68	-
	2	15	0	17	33	introital plasty
	3	17	0	20	82	introital plasty
	4	16	0	18	93	-
	5	14	0	20	32	-
	6	17	0	18	58	prolapse
	7	16	0	17	23	introital plasty
	8	16	0	20	76	-
	9	16	1	18	66	introital plasty
TS	1	36	2	41	86	*
	2	31	1	35	42	-
	3	25	1	28	42	introital plasty
	4	33	1	36	55	-
	5	24	1	28	27	-
	6	35	1	38	77	introital plasty
	7	21	2	28	30	-
	8	29	0	33	49	introital plasty
	9	14	2	19	21	introital plasty
	10	24	11	36	33	"

* laparotomy to remove a dilator that had been inserted so deeply that it could not be removed vaginally

CHAPTER 6

The occurrence of diversion colitis in patients with a sigmoid neovagina

T.A.M. Toolenaar[1], I. Freundt[1], F.J.M. Huikeshoven[1], A.C. Drogendijk[1],
H. Jeekel[2], S. Chadha-Ajwani[3]

From the Departments of Obstetrics & Gynecology[1], Surgery[2], and Pathology[3], University Hospital Rotterdam Dijkzigt, Rotterdam, the Netherlands

6.1. Abstract

Diversion colitis is an inflammatory process occurring in segments of the colorectum surgically diverted from the fecal stream. Clinical symptoms of this condition are rectal discomfort, pain, discharge and bleeding. We diverted isolated segments of sigmoid to create neovaginas in patients with aplasia vaginae and in male to female transsexuals. In contrast to what is reported in most studies of diversion colitis, the neovagina consists of an isolated segment not connected to the anus in patients without any pre-existing bowel disease. To investigate the occurrence of diversion colitis in these sigmoid neovaginas we studied biopsy specimens from 13 patients.

Most of the patients complained of discharge and slight blood loss from their sigmoid neovagina. Microscopic examination of the biopsy specimens showed lymphocytic infiltration in all cases. Four cases showed an acute inflammatory infiltrate in the lamina propria. Our results indicate that the changes observed on clinical and histopathologic examinations represent the entity of mild diversion colitis. We conclude that diversion colitis also occurs in a sigmoid neovagina.

6.2. Introduction

Patients who have a segment of the colorectum surgically diverted from the fecal stream frequently develop a condition known as diversion colitis [1,2]. Many of these patients become symptomatic with complaints related to the defunctionalized bowel, including rectal discomfort, pain, discharge and bleeding. Endoscopic features include erythema, friability, edema, ulceration, and obvious bleeding [3]. Histologic abnormalities described include aphthous ulceration, crypt distortion, atrophy and abscesses, a villous surface to the colon and a mixed acute and chronic inflammatory infiltrate with patchy lymphoid hyperplasia [4]. The incidence of diversion colitis may be as high as 100% when it is observed prospectively, with the onset between three and 36 months after operation [5]. Patients with diversion colitis initially had loop colostomies or Hartmann's procedure performed for various reasons, including perforated diverticulitis, carcinoma, or trauma. Encouraged by the results of Kun [6], we diverted an isolated sigmoid segment and used it to create a neovagina [7]. In contrast to what is reported in most studies of diversion colitis, the neovagina consists of an isolated segment not connected to the anus in patients without any pre-existing bowel disease. To investigate whether diversion colitis also occurs in these patients, we studied the histology of this isolated sigmoid segment.

Figure 18: Biopsy specimen showing crypt distortion.

6.3. Materials and Methods

The operative procedure to create a sigmoid neovagina has been described earlier [7]. Briefly, after dissecting a plane between the bladder and rectum and isolating a sigmoid segment 15 to 20 cm in length, the oral side of the sigmoid loop is connected with the perineum or the vulva and the aboral side is closed. All patients undergoing operation between 1983 and 1988 were eligible for the study. Twenty-three patients were male to female transsexuals with an obliterated vagina after various procedures. Fourteen patients had aplasia vaginae as a part of the Mayer-Rokitansky-Küster syndrome. Three patients underwent surgery for other reasons. Thirteen patients could not be located. Of the remaining 27 patients, ten refused to participate in our study for various reasons. Those consenting to participate in this study were given a questionnaire concerning their operation, complaints and sexual habits.

Speculum examination was done to determine whether erythema, edema, friability, erosions, or stenosis was present. In addition, the luminal content of the neovagina was cultured to detect the presence of aerobic and anaerobic bacteria. If the patient consented, a biopsy was taken. Biopsy specimens were fixed in buffered formalin, stained with hematoxylin and azophloxin, and serially sectioned. After standard histopathologic examination, the slides were reviewed for histologic features of diversion colitis as described by Komorowski [4].

6.4. Results

Of the 17 patients examined, four did not consent to a biopsy due to fear of pain. The characteristics of these 17 patients are given in Table 1. None of the patients had a history of gastrointestinal disease. The period between surgery and the follow-up study ranged from 23 to 80 months (mean, 53 months).

Fourteen patients had regular sexual intercourse. The other three had no sexual partner. Fifteen patients used a lubricant. Thirteen patients experienced white sticky discharge from their neovagina. Fifteen patients reported slight blood loss, nine of them spontaneously and six only after sexual intercourse. Three patients complained of cramps in the neovagina, one of them only after intercourse.

Speculum examination revealed erythema in five patients and friability of the sigmoid neovagina in six patients. Edema, erosions, or stenosis was not found. In most patients the top of the neovagina contained some cellular debris with mucous strands. The clinical features are summarized in Table 2. There was no difference found between male to fe-

Table 1: Patient characteristics.

	Male to female transsexuals	Females with aplasia vaginae	Total
Number of patients	11	6	17
Age			
Mean (yr)	37	23	32
Range (yr)	22-48	19-28	19-48
Follow-up period			
Mean (mo)	50	59	53
Range (mo)	27-87	23-80	27-87
No. of biopsies	7	6	13

male transsexuals and females with aplasia vaginae. Microscopic examination of the biopsy specimens showed a spectrum of histopathologic changes, which are summarized in Table 3. All biopsy specimens showed lymphocytic infiltration in the lamina propria and six biopsy specimens showed fibrosis.

Although speculum examination revealed no cases with severe diversion colitis, four cases showed histopathologic signs of a more acute inflammatory infiltrate in the lamina propria, with decreased mucin secretion in one patient and erosions of the surface epithelium in another. Table 3 gives the features of diversion colitis described by Komorowski [4] and the frequency of occurrence of these features in our patients. Some of these features are shown in Figs 18 and 19. In most of our patients the specimens showed a mild diversion colitis. Results of the bacterial cultures of the luminal content of the neovagina revealed only normal inhabitants of the colon.

Table 2: Clinical features in 17 patients with a sigmoid neovagina.

	Male to female transsexuals	Females with aplasia vaginae	Total
Number of patients	11	6	17
Complaints			
Discharge	8	5	13
Blood loss	9	6	15
Only after intercourse	2	4	6
Spontaneously	7	2	9
Cramps	2	1	3
Speculum examination			
Erythema	4	1	5
Edema	0	0	0
Friability	4	2	6
Stenosis	0	0	0
Erosions	0	0	0

Table 3: Histologic features in 13 patients with a sigmoid neovagina.

	Male to female transsexuals	Females with aplasia vaginae	Total
Number of patients	7	6	13
Surface epithelium			
Absence of mucous layer	2	2	4
Decreased mucin secretion	0	1	1
Erosions	1	0	1
Villous surface	0	0	0
Crypts			
Distortion	4	3	7
Bifid form	1	0	1
Cystic dilatation	1	0	1
Atrophy	2	2	4
Abscesses	0	0	0
Paneth cell metaplasia	2	2	4
Lamina propria			
Edema	2	0	2
Fibrosis	3	3	6
Lymphocytic infiltrate	7	6	13
Neutrophilic infiltrate	2	2	4
Mucin granuloma	0	0	0
Lymphoid follicles	2	2	4

Note: The criteria used are those of Komorowski [4].

6.5. Discussion

To our knowledge the histopathologic changes in a sigmoid neovagina have not been previously reported in the literature. In 1913 Albrecht reported the first three cases of the successful creation of a neovagina with an isolated sigmoid segment [8]. The method gained acceptance in Eastern Europe, from which Aleksandrov and Gigovski reported 275 and 220 cases of successful operations, respectively, between 1935 and 1968 [9].

In more recent reports Kun [6], Pratt [10], Dalton [11], and Novak et al [12] reported satisfactory results for patients with congenital aplasia or loss of the vagina after radical cancer surgery and in male to female transsexuals. Most patients have reported routine sexual intercourse. All investigators have reported some discharge from the sigmoid neovagina. In 1981 Glotzer et al were the first to describe the development of inflammation in segments of colon and rectum after diversion of the fecal stream as a specific entity [1]. In their series of ten patients the main features of the disease were described. All patients but one were asymptomatic when the lesion was discovered. The endoscopic findings were similar in appearance to those of mild ulcerative colitis. Microscopic altera-

tions were focal and included crypt abscesses, epithelial cell degeneration, acute and chronic inflammation in the lamina propria, and degenerative changes in the crypts. When bowel continuity was restored the condition subsided.

Recently, Geraghty and Talbot described the histopathologic features of diversion colitis in resected specimens of defunctioned large bowel from 15 patients [13]. Their findings comprised diffuse mild chronic inflammation with or without mild crypt architectural abnormalities, crypt abscesses, or follicular lymphoid hyperplasia. The incidence of diversion colitis may be as high as 100% when it is observed prospectively, with the onset occurring between three and 36 months after operation [5].

The pathologic features described by Geraghty and Talbot [13] are fairly similar to those found in our patients. Therefore, we believe that our results indicate that the changes observed on clinical and histopathologic examinations are caused by a diversion colitis leading to the discharge reported in our patients as well as those included in other series. To our knowledge, we are the first to describe the occurrence of this condition in patients with a sigmoid neovagina. Our patients, healthy women with the Mayer-Rokitansky-Küster syndrome or male to female transsexuals, differ from patients in other published series
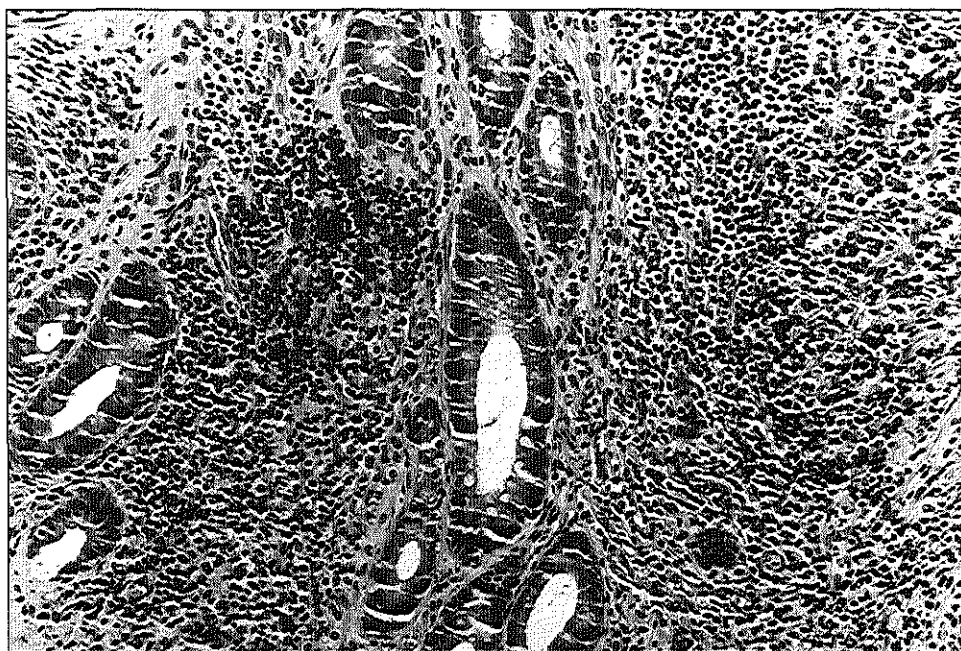

Figure 19: Biopsy specimen showing lymphoid hyperplasia.

due to the fact that the isolated sigmoid segment is used as a vagina in which regular intercourse takes place. All our patients had minor complaints, such as slight blood loss or discharge from their neovagina, and the diversion colitis we found in our material was mild.

Various unproven etiologies have been proposed for diversion colitis [3]. These include the effect of stasis, bacterial overgrowth in the bypassed segment, and the invasion by pathogenic organisms. In our series we cultured only normal inhabitants of the colon. This is in agreement with the finding of Neut et al in their study of bacterial flora of human excluded colon [14].

The deprivation of essential nutrients (specifically, short chain fatty acids) is another proposed etiology. Short chain fatty acids are the predominant solutes in the aqueous phase of colonic contents and stool. These acids are produced by the anaerobic fermentation of carbohydrates. Roediger demonstrated that short chain fatty acids are the preferred energy source for human colonic epithelium [15]. Evidence to support a nutritional deficiency as the etiology of diversion colitis has been offered by Harig et al [16], who found the absence of any notable bacterial fermentation-producing short chain fatty acids in patients with diversion colitis. These investigators reported marked improvement in the endoscopic and histologic alterations in the diverted segment after short chain fatty acids were supplied to the colon by local application. Because our study was performed after a long follow-up period (mean, 53 months), we expected to find cases with macroscopic signs of an active inflammation. All our patients who have routine sexual intercourse use lubricants of which methylcellulose or carboxymethylcellulose is the main ingredient. Although we did not measure the amount of short chain fatty acids in the sigmoid neovagina, they may be produced in sufficient amounts by the fermentation of methylcellulose by anaerobic bacteria to prevent a full-blown diversion colitis.

6.6. References

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CHAPTER 7

Bacterial flora of the sigmoid neovagina

T.A.M. Toolenaar[1], I. Freundt[1], J.H.T. Wagenvoort[2], F.J.M. Huikeshoven[1],
M. Vogel[2], H. Jeekel[3], A.C. Drogendijk[1],

*From the Departments of Obstetrics & Gynecology[1], Microbiology[2], and Surgery[3],
University Hospital Rotterdam Dijkzigt, Rotterdam, the Netherlands*

Abstract

The bacterial microbiota of 15 sigmoid neovaginas, created in patients with congenital vaginal aplasia or male transsexualism, was studied. No specimen was sterile, and only normal inhabitants of the colon were cultured. The total counts of bacteria were lower than those reported for healthy sigmoid colons.

A healthy human adult colon contains a microbial flora, of which most of the species are strict anaerobes [2]. The average pH is alkaline. The microbial flora of the vagina consists mainly of lactobacilli which are responsible for the acidity of vaginal secretions. In patients with a sigmoid neovagina, an isolated segment of the colorectum is used as a neovagina. Only scarce information exists about the bacterial flora of the excluded colon, and to our knowledge, none is known about the flora of the sigmoid colon used as a vagina. The aim of the present study is to determine the microflora of the sigmoid neovagina.

The operative procedure to create a sigmoid neovagina has been described earlier [3]. Briefly, preoperative mechanical bowel decontamination was performed. At the beginning of the operation a single-dose prophylactic antibiotic was given. After dissecting a plane between the bladder and rectum and isolating a sigmoid segment, the oral side of the sigmoid loop is connected with the perineum or the vulva; the aboral side is closed.

Fifteen patients were studied. Ten were male-to-female transsexuals, and five patients had vaginal aplasia as a part of the Mayer-Rokitansky-Küster syndrome. None of the patients had any preexisting bowel disease. The time between surgery and the bacteriological study ranged from 23 to 87 months (mean, 52 months).

After the patients provided informed consent, they filled out a questionnaire concerning the operation, complaints, and sexual habits. Eleven patients complained of sticky discharge. Thirteen patients experienced slight blood loss, eight of them spontaneously and five only after sexual intercourse. Twelve patients had regular sexual intercourse; all of them used methylcellulose as a lubricant. Condom use was not reported. No patient was using antibiotics at the time of the study.

Speculum examination was done, and in most patients, the top of the neovagina contained some cellular debris with mucous strands. To measure the pH a Neutralit R pH 5 to 10 paper (E. Merck, Darmstadt, Germany) was inserted in the neovagina. A direct smear was taken from the discharge and examined microscopically to detect the presence of Tri-

Table 1: Facultative anaerobes isolated from 15 patients with sigmoid neovaginas.

	No. of isolates	CFU/g discharge
Total number of isolates	48	
Gram-negative rods		
Escherichia coli	14	2×10^8 to 2×10^{11}
Morgnella morganii	2	2×10^4 to 4×10^7
Proteus vulgaris	1	2×10^4
Proteus mirabilis	2	2×10^5 to 3×10^5
Providencia	1	2×10^6
Gram-positive spheres		
Staphylococcus epidermidis	2	2×10^4 to 4×10^4
Streptococcus viridans	3	2×10^3 to 8×10^7
Streptococcus species	5	8×10^3 to 2×10^7
Streptococcus haemolyticus	2	2×10^4 to 2×10^5
Streptococcus bovis	1	3×10^4
Streptococcus pneumoniae	1	8×10^5
Enterococcus species	1	8×10^7
Gram-positive rods		
Lactobacillus species	10	4×10^3 to 2×10^9
Corynebacterium species	3	4×10^3 to 4×10^7

chomonas species and clue cells. Also, an amine test was done for the detection of bacterial vaginosis. A sterile loop was used to collect discharge from the neovagina for quantitative bacterial analysis. This sample was placed in 2 ml prereduced peptone yeast medium [5] with a known weight, and the mixture was immediately transported to the laboratory. Specimens were also taken to detect infections with Candida albicans, Trichomonas vaginalis, Neisseria gonorrhoea, Mycoplasma hominis, Ureaplasma urealyticum and Chlamydia trachomatis.

On arrival at the laboratory, the sample for quantitative analysis was transferred to an anaerobic cabinet for processing. After weighing and thorough mixing, four 100-fold dilutions were made. Samples of 0.05 ml of each dilution were then plated onto several media. Blood agar medium (Oxoid Ltd., Basingstoke, England) was used for aerobic culture, and brucella blood agar medium (BBL Microbiology Systems, Beckton Dickinson and Co., Cockeysville, Md.) was used for anaerobic culture. Several other media were used for culture of gram-positive cocci and gram-negative rods (MacConkey; Oxoid), Haemophilus (Levinthal; Oxoid), Candida species (Sabouraud; Oxoid), Mobiluncus species (brain heart infusion agar plus 5% horse blood, vitamin K, hemin, and 10 mg of vancomycin per liter), Gardnerella species (human bilayer Tween agar plate), lactobacilli and bifidobacteria (Rogosa; Difco Laboratories, Detroit, Mich.), Trichomonas species (Trichosel broth, modified BBL, plus 5% horse serum), Chlamydia trachomatis (monolayer of HeLa 229 cells in Eagle's modified minimum essential medium; Flow Laboratories, Irvine, Scotland, as described by Thewessen et al [11]), Mycoplasma hominis and Ureaplasma urealyticum (Trypticase soy broth agar with horse serum) and Neisseria gonorrhoea (GC medium, Difco, with hemoglobin, Difco).

After an incubation period of 2 to 5 days, colony types were described, counted, and subcultured for identification. Anaerobic and facultatively anaerobic gram- negative rods were identified with the Minitek (BBL) and API 20E (Bio-Merieux, Marcy-l'Etoile, France) systems, respectively. Facultatively anaerobic gram-positive spheres and gram-positive rods were identified as described by others [1,5,10].

The average pH of the neovagina was 8 (range, 7 to 9). The facultatively anaerobic and anaerobic bacteria cultured are listed in Tables 1 and 2, respectively. No specimens were sterile. In one patient, we isolated only an Escherichia coli isolate. In all other patients we isolated more species (average, six; range, one to nine).

Most often found were Escherichia coli (14 patients), Bacteroides species (13 patients), and lactobacilli (10 patients). A total of 85 different species representing 17 different genera were isolated. In one patient, we found Ureaplasma urealyticum, in one patient we found Mycoplasma hominis, and in one other patient we found both organisms. Of

the 85 species isolated, 37 were anaerobic, with mean counts of 1×10^3 to 3×10^{10} CFU/g of discharge. Forty-eight species were facultative anaerobes, with mean counts of 2×10^3 to 2×10^{11} CFU/g. We did not detect Trichomonas vaginalis, Candida albicans, Chlamydia trachomatis, or Neisseria gonorrhoea.

Studies performed during the past 20 years have given an appreciation of the complexity of the normal colonic microbial flora [4]. The sigmoid colon and rectum, because of their stool "holding" function, have the highest bacterial counts of the intestinal tract. There are about 10^{11} bacteria per g of contents. Of the resident bacterial flora, 96 to 99% consists of anaerobes, mainly Bacteroides species, fusobacteria, and lactobacilli.

The lower female genital tract contains a cornucopia of bacteria which are similar to the fecal flora, although with lower mean counts [6,7]. The viable counts average 10^8 to 10^{10} CFU/ml of vaginal fluid from the fornices, which is characterized by a predominance of lactobacilli (75 to 80%).

Table 2: Anaerobes isolated from 15 patients with sigmoid neovaginas.

	No. of isolates	*CFU/g discharge*
Total number of isolates	37	
Gram-negative rods		
Bacteroides thetaiotaomicron	2	2×10^5 to 8×10^7
Bacteroides fragilis	5	8×10^3 to 1×10^9
Bacteroides distasonis	2	2×10^5 to 3×10^8
Bacteroides vulgatus	1	2×10^4
Bacteroides species	5	4×10^3 to 3×10^{10}
Prevotella bivius	1	3×10^5
Prevotella disiens	1	2×10^5
Prevotella intermedia	1	2×10^8
Porphyromonas asaccharolytica	2	3×10^5 to 4×10^7
Gram-negative spheres		
Veilonella parvula	1	4×10^3
Gram-positive spheres		
Peptostreptococcus asaccharolyticus	2	3×10^5 to 3×10^6
Peptostreptococcus magnus	1	3×10^6
Peptostreptococcus micros	1	2×10^5
Peptostreptococcus prevotii	1	1×10^8
Peptostreptococcus species	1	2×10^8
Peptococcus anaerobius	2	2×10^7 to 1×10^9
Streptococcus parvulus	1	3×10^6
Gram-negative rods		
Bifidobacterium bifidum	1	1×10^3
Bifidobacterium species	3	3×10^3 to 2×10^5
Eubacterium lentum	3	1×10^6 to 4×10^8

In the present study, only normal inhabitants of the colon were isolated. The flora that we isolated is the remnant of the flora already present at the time of the operation or comes from contamination of bacteria from the perineal region. The average pH of 8 was similar to the pH of a healthy colorectum. The total counts of bacteria (10^3 to 10^{11}) were lower than those reported for a healthy sigmoid colon. This is probably caused by the lack of content or the lack of stasis in the sigmoid neovagina.

Little is known about the microflora of human excluded colon. Neut et al. [9] found in 16 patients with surgically excluded colorectums that the total bacterial counts were only slightly lower than those in healthy controls but that the variety of the flora was significantly reduced. This reduction was confined to strict anaerobes, mainly the genera Eubacterium and Bifidobacterium [9]. Miller et al. [8] suggested that a stable microbial community can exist in parts of the colon with no connection to the upper part of the intestinal tract. We cultured mainly facultative anaerobes. The environment of the sigmoid neovagina may be more suitable for the growth of these bacteria.

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CHAPTER 8

Prolapse of the sigmoid neovagina
Report of three cases

I. Freundt[1], T.A.M. Toolenaar[1], H. Jeekel[2], A.C. Drogendijk[1], F.J.M. Huikeshoven[1]

*From the Departments of Obstetrics & Gynecology[1] and Surgery[2],
University Hospital Rotterdam Dijkzigt, Rotterdam, the Netherlands*

8.1. Abstract

Background: Prolapse of a sigmoid neovagina, created in patients with congenital vaginal aplasia or male transsexualism, is rare. In correcting this condition, preservation of coital function and restoration of the vaginal axis should be of primary interest.

Cases: One patient with Mayer-Rokitansky-Küster syndrome developed a protrusion of the sigmoid neovagina almost 4 years after the initial operation. The prolapse was treated successfully using an abdominal approach to suspend the neovagina to a Cooper ligament. The second patient is a male-to-female transsexual who developed a prolapse 3 years after the creation of a sigmoid neovagina. After suspension of the neovagina to a Cooper ligament, the prolapse recurred; in a repeat approach, the neovagina was successfully suspended to the sacral promontory. The third patient, with Mayer-Rokitansky-Küster syndrome, complained of a protrusion immediately after creation of the neovagina. Initially, the redundant sigmoid was resected vaginally. However, the prolapse recurred, and an abdominal suspension to a Cooper ligament was performed. Finally, after 1 year, another recurrence was treated successfully with a vaginal approach.

Conclusion: Prolapse of an artificially created vagina is a rare occurrence, without a standard treatment. Both abdominal and vaginal approaches may be needed to restore the neovagina without compromising its function.

8.2. Introduction

In patients with congenital or acquired absence of the vagina, the creation of a coitally functional vagina is an important part of sexual rehabilitation. A neovagina also may be created in male-to-female transsexuals as a part of sex-reassignment surgery. Therapeutic options to treat absence of the vagina include a variety of techniques, which may be non-invasive, operative, or a combination of both.

Total or partial loss of the neovagina as a result of stenosis has been reported frequently, except for cases in which an intestinal segment is used for colpopoiesis [1,2]. Therefore, although such an operation is a major procedure and the intestinal segment produces abundant vaginal secretions, we believe that the sigmoid colon is the structure of choice to replace the vagina.

Since 1983, 45 patients have had surgery according to a modified colocolpopoiesis technique, described elsewhere in detail [2]. Briefly, a 15-20-cm segment of sigmoid colon is isolated and fixed antiperistaltically in a previously prepared channel between the bladder and the rectum. The transplant is fixed to the wall of the tunnel with two anchoring or situation sutures. The opening of the peritoneum of the pouch of Douglas is not closed separately. When this technique is applied, the mesentery containing the vascular pedicle of the conduit comes to lie laterally on the left side of the newly created channel.

Prolapse of an artificially created vagina is a rare and infrequently reported complication of colpopoiesis. Three cases of prolapse of a sigmoid neovagina occurred in our series and were corrected by various surgical procedures.

8.3. Case reports

Case 1.

A 17-year-old woman with Mayer-Rokitansky-Küster syndrome underwent an uneventful colocolpopoiesis in August 1985; the length of the sigmoid conduit was 20 cm. Protrusion symptoms gradually developed beginning in March 1989. The patient complained of progressive lower back pain, difficulty walking and sitting, and a bearing-down sensation. The coital function was undisturbed, and there were no urinary or defecation difficulties.

Vaginal examination demonstrated a prolapse on the left. With augmentation of intra-abdominal pressure, the mucous membrane of the sigmoid neovagina was seen to protrude approximately 1 cm beyond the introital ring (Figure 20). There were no signs of ulcera-

tion. In September 1989, we performed a laparotomy. After exposure of the space of Retzius, the vault of the sigmoid neovagina was suspended to the left Cooper ligament with five interrupted atraumatic Mersilene-0 sutures, which were placed through the entire thickness of the neovaginal wall. The postoperative course was uneventful. So far, the prolapse has not recurred.

Case 2.

A 41-year-old male-to-female transsexual underwent a colocolpopoiesis in May 1984; the sigmoid conduit was 15 cm long. The patient presented in March 1987 with progressive lower back pain and a bearing-down sensation. Coital function and defecation were undisturbed. Urge incontinence had be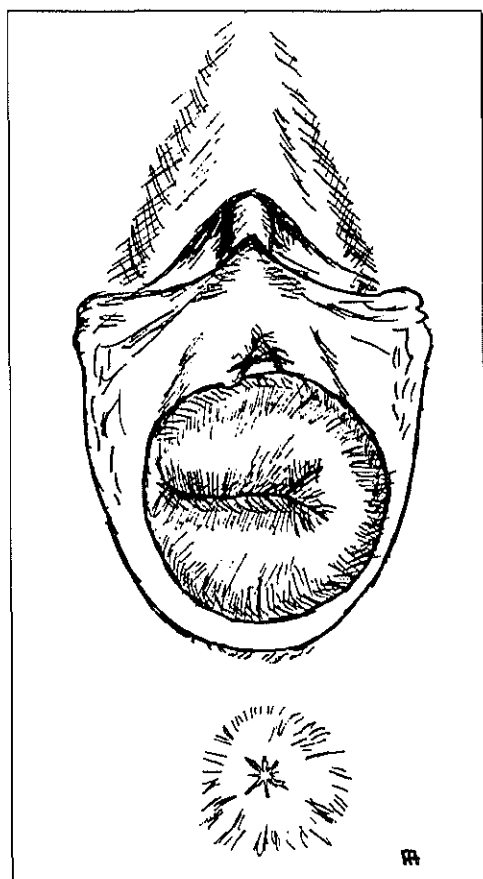en present for years. At vaginal examination, the left-side prolapse protruded with pressure approximately 2 cm beyond the introital ring. There were no signs of ulceration. In February 1988, we performed a laparotomy. After exposure of the space of Retzius, the left half of the anterior part of the sigmoid neovagina was suspended to the left Cooper ligament with the aid of a polyglactin mesh. The postoperative course was uneventful. Six months later, the patient developed complaints suggesting recurrent prolapse, eg, lower back pain and a bearing-down sensation. In January 1989, vaginal examination revealed a protrusion of the neovaginal mucosa on the left at the 3-o'clock position. The prolapse was visible outside the introitus upon application of pressure. At repeat laparotomy, the neovagina was first mobilized from extensive adhesions, predominantly in the left paravesical area of the previous suspensory operation. The neovagina was subsequently suspended to the sacral promontory with the aid of a nylon mesh measuring 6 x 5 cm, which was extraperitonealized carefully. The postoperative course was uneventful. To date, there have been no signs of recurrent prolapse.

Figure 20: Prolapse of the left lateral wall of the sigmoid neovagina (Courtesy F.J.M. Huikeshoven).

Case 3.

A 20-year-old woman with Mayer-Rokitansky-Küster syndrome wanted to engage in sexual relations and desired the creation of a neovagina. Initially, she refrained from trying the Frank method of intermittent pressure [3]. An uneventful colocolpopoiesis, with an 18-cm sigmoid conduit, was performed subsequently in August 1989. At the first postoperative follow-up visit 6 weeks after colocolpopoiesis, she complained about protrusion symptoms, progressive difficulties walking and sitting, a bearing-down sensation, and lower back pain. Urinary function and defecation were undisturbed. Vaginal examination revealed a prolapse of the mucous membrane of the sigmoid neovagina, situated on the left in the 2-o'clock position. The prolapsed vaginal wall protruded 3 cm beyond the introitus and was ulcerated, indurated, congested, fixed, and nonreponible. In December 1989, the vaginal route was chosen to correct the prolapse. The redundant intestine was resected circumferentially just above the level of the sigmoidoperineal anastomosis. The remaining vagina, after resection of a ring measuring 3 cm on the left and 1 cm on the right, was 15 cm long. The postoperative course was uneventful. On examination at 6 weeks postoperatively, the patient exhibited a recurrent prolapse of the neovagina, again laterally on the left. Over the ensuing 4 months, she developed progressive protruding symptoms with lower back pain and a bearing-down sensation. At vaginal examination, the neovaginal mucosa was seen to protrude in the introitus even without augmentation of intra-abdominal pressure. In a second attempt at surgical correction, a laparotomy was performed in May 1990. After exposure of the space of Retzius, the neovaginal vault was suspended to the left Cooper ligament with three interrupted atraumatic Mersilene-0 sutures penetrating the entire thickness of the neovaginal wall. The postoperative course was complicated by fever, probably due to an infected hematoma in the space of Retzius, which was treated successfully with antibiotics. The neovagina appeared to be well supported for the subsequent 13 months. In June 1991, the patient presented again with symptoms suggesting vaginal prolapse, eg, lower back pain and progressive difficulties walking and sitting. At vaginal examination, a prolapse was seen, once again on the left. The neovaginal wall showed signs of ulceration and protruded 1 cm beyond the introital ring. In October 1991, the third corrective surgery took place. Using a perineal approach, the redundant part of the sigmoid vagina was resected, consisting of a ring measuring 4 cm on the left and 2 cm on the right. As we separated the neovagina from the underlying structures, the mesentery, situated on the left, appeared to slide freely behind the wall of the neovagina. To prevent further sliding, we sutured the mesentery to the left levator muscle. Subsequently, the neovaginal wall was fixed bilaterally to the levator fascia with one interrupted polyglactin suture on each side, and the continuity of the sigmoid neovagina was restored. The postoperative course was uneventful, except for a minor hematoma in the rectovaginal space which required no further treatment. To date, the prolapse has not recurred.

8.4. Discussion

The first case of descent of a neovagina, created with a double loop of small intestine, was described by Stoeckel in 1919 [4]. This prolapse was corrected by simple resection of the redundant part of the intestine. A case of cystocele of a neovagina created with a free skin graft was reported in 1930 [5]. An anterior colporrhaphy was suggested to correct this condition. A prolapse of a neovagina created by self-dilatation was reported in 1990 [6]. The literature includes only four surgical corrections of prolapses of a neovagina derived from sigmoid colon; all cases were treated with circumferential resection of the redundant intestine. Thereafter, in one reported case, coitus was impaired because the remaining neovagina was too short [7-9]. Because the preservation of coital function is of primary interest in this group of patients, one should be cautious when removing neovaginal tissue. In recent years, there has been an increasing tendency to choose an abdominal approach for the correction of prolapses of the vaginal wall and vault when preservation of coital function and restoration of the vaginal axis are of primary interest [10-12]. Therefore, in our patients, we also considered an abdominal approach. As far as we know, this is the first report of abdominal surgical correction of prolapse of a neovagina derived from sigmoid colon. Ideally, the prolapsed vagina is attached posteriorly within the pelvis; however, prolapses of the outer vagina wall will not be corrected by such a procedure, and a less optimal attachment to the Cooper ligament may be needed.

A common feature of these three cases is that the prolapses all appeared laterally on the left, between the 2- and 3-o'clock positions. As previously stressed, this is the location of the mesentery and vascular structures, which assure adequate circulation in the conduit. Although in time the antimesenteric side of the transplant may adhere to the surrounding tissue in the channel, these adhesions are not formed on the mesenteric side. The etiology of prolapse of a sigmoid neovagina is unclear. To avoid a prolapse, several authors have stressed the importance of extraperitonealizing a neovagina derived from the intestine [13,14]. In their opinion, an extraperitonealized conduit should not be longer than the channel that is created between the bladder and the rectum, ie, 8-12 cm, which is considerably shorter than the antiperistaltic segment transplanted in our clinic. An antiperistaltic segment is chosen to obtain a sufficient length for the neovagina and to minimize the vaginal discharge. To obtain adequate vascularization of the antiperistaltic segment, a length greater than 12 cm is necessary in most patients. Prophylactic fixation of the bowel segment to the posterior pelvic area should be considered for patients at an increased risk for prolapse. For comparison, prolapses of colostomies have been reported with an overall incidence of 2.4% to 26% [15] and are treated with resection of the redundant colon and fixation of the colon and its mesentery to the parietal peritoneum [16].

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CHAPTER 9

Postoperative peritonitis complicating colocolpopoiesis

Case report

9.1. Introduction

The claimed disadvantage of the use of intestinal segments for the creation of a neovagina is the possibility of occurrence of intraabdominal sepsis, due to anastomotic leakage or dehiscence, which is associated with a high morbidity and mortality rates varying from 30% to 60% [1].

Yet, fatalities associated with postoperative peritonitis after the formation of an intestinal neovagina have not been published within the past decades, whilst mortality rates up to 28% have been reported in the preantibiotic era, at the beginning of this century [2-6]. Since then, antibacterial treatment, operative procedures, suture materials and intensive care facilities may have contributed to the reduced incidence of postoperative peritonitis [7] following the creation of intestinal neovaginas, although it may also be likely that surgeons refrain from reporting an adverse outcome of surgery [8,9].

A series of 40 patients in whom a sigmoid neovagina had been created, was reported. Major complications did not occur. Since then, five more patients were operated according to the previously described technique [10]. Postoperative peritonitis with subsequent intra-abdominal abscess formation due to anastomotic leakage occurred in one of these patients. This case, which has been associated with serious complications, will be described herein.

9.2. Case report

Born in 1957, this male-to-female transsexual started hormonal sex reassignment in February 1988 after having assumed a female gender role for the past eight years. Following the first stage of surgical sex reassignment in April 1989 with bilateral orchidectomy, penectomy and construction of female external genitalia from scrotal skin, the patient was readmitted in December 1989 for the creation of an artificial vagina. Particularities of the preoperative assessment included smoking (20 cigarettes daily), a discrete hypertension (170/95 mmHg) and marked obesity (length 172 cm, weight 93 kg).

Colocolpopoiesis, which had been technically demanding because of the patient's obesity, was performed on December 7th, 1989, according to the previously described technique [10]. The sigmoido-perineal anastomosis had been established under slight tension. Temperature periodically exceeded 39° C from the second postoperative day and was initially attributed to postoperative pneumonia. Antibiotic treatment was initiated with cefuroxim and tobramycin, but the fever and leucocytosis with a left-shift persisted. Neovaginal examination revealed a vital transplant although a dehiscence of the introital sutures was noted along with profuse purulent discharge yielding Klebsiella and E. Coli species. Metronidazol was added to the antibiotic regime. Gradually, abdominal distension and tenderness became more evident, suggesting postoperative peritonitis.

On the eighth postoperative day, December 15th, relaparotomy by median incision was performed, revealing fecal peritonitis from dehiscence of the colocolonic anastomosis. Following Hartmann's procedure and peritoneal lavage the abdomen was closed by suturing the fascia. Intra-abdominal drains were not applied.

Thirty hours postoperatively, intraabdominal fluid sequestration with subsequent diaphragmatic elevation had critically impeded pulmonary ventilation necessitating progressive positive end expiratory pressure levels so that a second relaparotomy had to be performed. Several liters of exsudative, turbid fluid were aspirated from the abdominal cavity and a leak in the rectal stump was resutured. Drains were placed for continuous peritoneal lavage and the abdomen was closed with a vicryl mesh.

On the 20th of December, because of persisting sepsis and obstructed drains with subsequent intraabdominal fluid accumulation critically impeding ventilation, a third relaparotomy was performed. The abdominal cavity was cleansed and the drains were exchanged. Distinct intraabdominal abscesses were not seen. After radical peritoneal debridement the abdomen was left open and covered with opsite to facilitate regular inspection and lavage at the ICU. The postoperative course was complicated by renal failure from acute tubular necrosis resulting in overhydration and pulmonal congestion which necessitated intermit-

tent hemodialysis from December 29th. Repeated blood transfusions were required because of marked blood loss along the lavage drains. Recovery was delayed because of persisting fever and leucocytosis, although repeated abdominal ultrasound examinations and computed tomography scans did not reveal an intraabdominal abscess. A colocutaneous fistula resulted from persisting leakage of the sigmoidorectal stump. The patient remained at the ICU for 56 days.

On February 13th, 1990, the abdomen was closed with a vicryl mesh and the laparostomy defect was covered with a split thickness skin graft taken from the inner surface of the right thigh. At the patient's discharge from the hospital, on February 23rd, the neovagina was vital, but the introitus was completely stenosed.

Four and a half months later, on the 6th of July 1990, the patient was readmitted because of acute abdominal pain, absence of bowel sounds, clinical signs of septic shock with a blood pressure of 60/40 mmHg and leucocytosis. Although the temperature had been normal an intraabdominal abscess was suspected and laparotomy was performed. Two liters of purulent fluid were aspirated from the abdominal cavity and a large subphrenic abscess was drained. After abdominal lavage the abdomen was closed with a vicryl mesh.

Because of persisting intraabdominal sepsis despite broad spectrum antibiotic treatment a relaparotomy was required on the 9th of July, but new abscesses were not identified. Again peritoneal lavage was performed and intraabdominal drains were placed for postoperative lavage.

Despite continuous antibiotic therapy the temperature remained around 39° C. Positive end expiratory pressure ventilation was required until July 15th. Five days thereafter, following repeated blood cultures and cultures from trachea, nose and abdominal wound yielding, amongst others, Pseudomonas resistant to tobramycin, the antibiotic therapy was discontinued. Gradually, the patient's condition improved and discharge from the hospital was possible on the 7th of August, 1990.

In December of the same year, a mucocele had developed in the neovagina because of near-total obliteration at the perineal junction, and a VY-introital plasty was performed. In May 1991 the patient was readmitted for the correction of a hernia cicatricalis covering an area of 30 cm extending from the xyphoid to the symphysis. The defect was successfully covered with a unilateral pedicled rectus femoris muscular flap. In the same session an end-to-side reanastomosis of the descending colon to the rectosigmoideal stump was performed. A recurrent stenosis of the neovaginal introitus was corrected and drains were placed intravaginally to facilitate the drainage of purulent material which had accumulated in the neovaginal top. Postoperative fever, probably due to the vaginal infection and insta-

bility of the colostomy wound, was successfully treated with antibiotics. At discharge from the hospital, after 23 days, intermittent introital dilatation was recommended.

Since then, the patient has been readmitted for operative corrections of the colostomy scar and recurrent introital stenoses. At present, a plastic surgeon is consulted for the correction of the unfavourable abdominal scars.

9.3. Discussion

Secondary peritonitis is an intriguing medical entity. It is rarely seen in gynecology, but it is not uncommon in gastrointestinal surgery. The diagnosis of postoperative generalized peritonitis, often considered separately because of its poor prognosis [1], is mainly based on clinical observations. Abdominal pain, tenderness, guarding and increased abdominal wall tone may be associated with fever, and leucocytosis with a left-shift [11].

In the case presented herein a pulmonary infiltrate was seen on day two on a chest X-ray film, suggesting postoperative pneumonia as a cause for the fever and the leucocytosis. The classical signs and symptoms of secondary peritonitis may have been masked by antibiotic treatment and sedation. Because of the patient's obesity, physical examination may have been unreliable. The early recognition of intraabdominal sepsis might have limited the extent of the associated complications, although postoperative peritonitis is commonly diagnosed between the 7th and 10th postoperative day [11], and is highly unlikely on day two after surgery.

The treatment of secondary peritonitis is based on the elimination of the contaminating source, adequate antibiotic therapy, and support of cardiac and respiratory function [1,12]. Early hemodialysis is recommended in cases of acute renal failure [13]. It is generally agreed that a colostomy should be established in cases of anastomotic breakdown [1], but there is controversy concerning the effectivity of different means to reduce bacterial contamination of the peritoneal cavity, the treatment of residual and the prevention of recurrent infection [1,7,13-20].

Total dehiscence of an internal anastomosis may result in generalized peritonitis [17]. Clinical anastomotic leakage occurs in approximately 5% of the cases in whom a primary colocolonic anastomosis is established without defunctioning colostomy [21]. The etiology of the anastomotic breakdown remains unclear. Apart from technical deficiencies in the establishment of an internal suture line, disruption may also occur in the course of an acute inflammatory reaction, when proteolytic enzymes are released so that collagen lysis exceeds collagen synthesis [17]. In this case, an extensive neovaginal infection was

diagnosed on day two after surgery, with profuse purulent discharge and dehiscence of the sutures at the sigmoidoperineal anastomosis. The colocolonic anastomosis may thus have been affected by the neovaginal infection.

Postoperative peritonitis may seriously complicate intestinal surgery. It has occurred in one case of a series of 45 patients in whom a sigmoid conduit was used to create a neovagina. However, the advantages outweigh the disadvantages of the method and colocolpopoiesis remains the treatment of choice for absence of the vagina in this hospital.

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CHAPTER 10

General discussion
Algemene beschouwingen

10.1. General discussion

Since the 19th century, vaginal aplasia has been a regularly featured topic in the medical literature. Many methods were developed to create an artificial vagina. Modern surgical and anaesthesiological techniques have enabled the application of increasingly invasive methods for vaginoplasty. Also, with more radical oncologic surgery and a consistently improving acceptance of transsexuality a broader indication was created for this type of treatment. Due to changes in the attitude towards sexuality an absent or inadequate vagina is less easily tolerated. Despite an increase in the demand for this type of vaginal surgery little is known about the short- and long-term results of these surgical procedures. The creation of a neovagina with an isolated segment of intestine is one of the most invasive methods. The justification for this major operation is based on the experience that an intestinal conduit will not be subjected to stenosis and obliteration, problems frequently occurring in neovaginas derived from skin.

The extensive experience that was accumulated with vaginal construction using an isolated segment of sigmoid colon gave us the opportunity to evaluate the results of this technique in many ways. Along with a study on the immediate morbidity it was possible to determine the long-term functional aspects of this type of surgery. Also, the conduit's microbiologic and histopathologic features were mapped. The latter, not merely being of documentary interest, contribute to the understanding of the pathophysiologic processes that may cause problems encountered in intestinal conduits isolated from the fecal stream. In our series of 40 patients who underwent surgery to create a sigmoid neovagina no major complication occurred. Shortly after completion of this study, one case was reported with anastomosis leakage resulting in life-threatening complications. Less invasive procedures refraining the use of intra-abdominal structures might account for a lower morbidity. However, reports of large series are too scarce to allow for a comparison.

Vaginoplasty is an elective operation. However, the issue of a functional neovagina is so essential to the majority of the patients that a certain morbidity risk is accepted if outweighed by a high success rate. Our long-term follow-up study, comprising approximately 50% of our patients, showed a functional vagina in all and good or satisfactory sexual adjustment in a majority of the cases. Again, despite the large number of different techniques, insufficient follow-up data are available to justify a comparison with other surgical techniques.

When evaluating the functional outcome of a surgical technique it is essential to consider the long-term complications. Three of our patients developed a neovaginal prolapse that required several operative corrections. No major microbiologic or histopathologic problems were associated with the sigmoid neovagina, and are not to be expected in the future, as demonstrated by our documentary study. The diversion colitis meeted in all examinated cases represents the typical complication of colon segment isolation. However, in our patients the histopathologic changes were of the mild type, and the reported problems with discharge or blood loss from the neovagina that might be associated with diversion colitis did not influence the subject's satisfaction with the neovagina. The colitis might also account for painful neovaginal cramps that were reported in a small amount of cases.

It may be concluded that the morbidity associated with colocolpopoiesis is acceptable though not neglectable. At long-term, the results remain good and further major complications are unlikely. A comparison with other vaginoplasty techniques is required to determine the place of sigmoid vaginoplasty. However, the lack of documentation with regard to morbidity, success rate, and long-term complications does not allow a comparison at present. Based only on our experience we therefore may recommend the following:

1. In patients with vaginal aplasia, the primary surgical treatment consists of colocolpopoiesis if the non-operative Frank's method fails.

2. In transsexuals, the method involving the lining of the neovagina with inverted penile skin is an obvious and justified first choice. In case of stenosis or obliteration, colocolpopoiesis ought to be the treatment of choice.

3. Technical modifications are required to reduce the incidence of introital stenosis and prolapse.

4. The use of (new) vaginoplasty techniques should be substantiated by adequate follow-up evaluation.

10.2. Algemene beschouwingen

In de medische literatuur is vanaf de 19e eeuw regelmatig aandacht besteed aan de aplasia vaginae. Vele methoden zijn ontwikkeld om een kunstmatige vagina te creëren. De moderne chirurgische en anaesthesiologische technieken hebben ertoe geleid dat steeds invasievere methoden voor de creatie van een kunstmatige vagina werden toegepast. Daarnaast heeft de steeds radicalere oncologische chirurgie en de steeds betere acceptatie van transsexualiteit geleid tot een groter indicatiegebied voor deze vorm van behandeling. De veranderde houding ten opzichte van sexualiteit heeft ertoe geleid dat een afwezige of inadequate vagina minder makkelijk geaccepteerd wordt. Ondanks deze toename van de vraag naar constructieve vagina chirurgie is weinig bekend over de korte en lange termijn resultaten van deze ingrepen.

De neovagina constructie met behulp van een geisoleerd stuk tractus digestivus is een van de meest invasieve methoden. De ratio achter deze grote ingreep is de ervaring dat een darmlis niet tot stenosering en afsluiting neigt, hetgeen een vaak optredend probleem is bij neovagina's die met huid bekleed zijn.

De uitgebreide ervaring die opgedaan is met vagina constructie met behulp van een sigmoidlis gaf ons de gelegenheid de resultaten van deze techniek in vele opzichten te evalueren. Naast een onderzoek van de directe morbiditeit van deze ingreep was het mogelijk de functionele aspecten op lange termijn te bestuderen. Ook de microbiologische en histopathologische eigenschappen van deze structuur konden in kaart worden gebracht. Deze laatste aspecten zijn niet alleen interessant als documentatie maar dragen ook bij aan de kennis van de pathofysiologische processen die ten grondslag liggen aan problemen bij van de fecale stroom geisoleerde darmdelen. In onze serie van 40 patienten waarbij een sigmoid neovagina geconstrueerd werd, trad geen grote morbiditeit op. Kort na het afsluiten van deze serie was er echter een casus met darmnaad lekkage, waarna levensbedreigende complicaties. Minder invasieve ingrepen waarbij geen intra-abdominale structuren gebruikt worden, zullen mogelijk een minder grote morbiditeit geven. Er zijn echter te weinig resultaten van voldoend grote series om deze vergelijking te kunnen maken.

De creatie van een functionele neovagina is een electieve ingreep die echter voor het merendeel van de patienten dusdanig essentieel is, dat een zeker morbiditeitsrisico aanvaard wordt indien het succespercentage hoog is. Bij bijna 50% van onze patienten kon dit in een lange termijn follow-up studie geëvalueerd worden. Al de patienten uit deze groep hebben een functionele neovagina en de meeste patienten hebben een goede of bevredigende sexuele aanpassing. Ook hier geldt dat, ondanks het grote scala van technieken, er onvoldoende onderzoek is gedaan om een vergelijking met andere technieken goed mogelijk te maken.

Naast het functionele resultaat moeten bij de beoordeling van een techniek de lange termijn complicaties meegewogen worden. Drie van onze patienten ontwikkelden een prolaps van de neovagina, die meerdere operatieve correcties nodig maakten. Er deden zich ook op lange termijn geen microbiologische en geen grote histopathologische problemen voor in de sigmoid neovagina. Gezien ons documenterend bacteriologisch en histopathologisch onderzoek van de sigmoid neovagina is dit ook niet te verwachten. De diversion colitis, die bij al de onderzochte patienten gevonden werd, is een bekende complicatie na isolatie van een colon segment. De histopathologische veranderingen die bij onze patienten waargenomen werden, waren echter gering en de klachten van afscheiding of bloedverlies uit de neovagina die in verband met diversion colitis op zouden kunnen treden leidden niet tot subjectieve ontevredenheid over de neovagina. Bij uitzondering zou de colitis pijnlijke krampen in de neovagina kunnen veroorzaken.

Wij zijn van mening dat wij kunnen concluderen dat de morbiditeit van de colocolpopoiëse acceptabel is, hoewel niet verwaarloosbaar. Op lange termijn blijven de resultaten goed en zijn de te verwachten complicaties gering. Om de plaats van deze techniek te bepalen zou vergelijking met andere technieken mogelijk moeten zijn. Ook hiervoor ontbreken echter voldoende gegevens over morbiditeit, succesrate, en lange termijn complicaties van andere technieken. Wij kunnen dus slechts op basis van onze ervaring de volgende aanbevelingen in overweging geven:

1. Bij patienten met aplasia vaginae lijkt na de niet operatieve methode van Frank de colocolpopoiëse de primaire chirurgische keuze.

2. Bij transsexuelen is een vagina constructie met een inversie van penishuid een voor de hand liggende en verantwoorde eerste keus. Bij stenose of afsluiting van deze neovagina lijkt een colocolpopoiëse de aangewezen keuze.

3. Er moet worden gezocht naar technische modificaties, die de kans op stenose van de huid-darm overgang en prolaps van de neovagina verder verminderen.

4. Het gebruik van (nieuwe) technieken van neovagina creatie dient steeds met adequate follow-up geëvalueerd te worden.

SUMMARY

Numerous techniques have been developed and abandoned throughout this century to construct a vagina. One of these methods is based on the lining of a surgically prepared rectovesical cavity with an isolated segment of sigmoid colon. Since 1983, a modified colocolpopoiesis technique is applied at the University Hospital Rotterdam Dijkzigt to treat conditions associated with a missing vagina. Forty-five patients, mainly female subjects with the syndrome of Mayer-Rokitansky-Küster and male-to-female transsexuals, underwent a modified sigmoid vaginoplasty in our clinic until 1991. Postoperative data from these 45 patients are presented and discussed in this thesis.

Chapter 1 introduces the conditions associated with absence of the vagina. Congenital vaginal dysplasia may occur in biologic females with a rudimentary uterus, as a part of the syndrome of Mayer-Rokitansky-Küster, and in various forms of intersex. Secondary or acquired loss of the vagina may be encountered in patients treated for pelvic malignancies or after extensive birth trauma. Male-to-female transsexuals are biologic males who have the desire to rid themselves from their primary and secondary sex characteristics, and to assume a female sex-role full-time.

Chapter 2 summarizes, from the historic point of view, various therapeutic approaches to create an artificial vagina, with the exception of intestinal vaginoplasty. Most of these techniques are based on the dissection of a cavity between the bladder and the rectum, with subsequent grafting of skin, peritoneum, amnion, or other materials onto the walls of the tunnel. Alternatively, the neovagina may be created by externally applied pressure, or extracorporally by suturing the labia. The major drawback of these techniques is the stenosing tendency of the newly created tunnel. Life-long dilatations are required to assure its patency and failures were reported in approximately 25% of the cases.

Chapter 3 reviews intestinal vaginoplasty within the past 100 years. The techniques involving the lining of a rectovesical cavity with rectum or ileal segments are of historical importance only. Since the beginning of this century, isolated sigmoid conduits were used in more than 900 cases to create a neovagina, with an overall mortality rate of 0.88%. A 1.7% failure rate was calculated, mostly due to necrosis of the transplant. Most of the

fatalities occurred as a consequence of anastomosis leakage and subsequent peritonitis. Colpopoiesis from the sigmoid colon is a technically demanding operation that requires the cooperation of gynecologists and gastrointestinal surgeons. The reported major advantage is a permanently patent neovagina that retains its immediate postoperative dimensions without regular dilatations.

Chapter 4 presents a detailed description of the modified technique to create a neovagina with an isolated segment of sigmoid colon that is applied in our hospital. No major complication occurred in a group of 40 patients operated upon between 1983 and 1988. Thirty-two patients were evaluated six weeks postoperatively; the majority showed an adequate vagina at that time. In seven patients some introital stenosis was noted. At short term, good functional results were obtained in a majority of the patients, with an acceptable complication rate.

In **Chapter 5** a long-term follow-up study of the psychosexual and psychosocial performance of patients with a sigmoid neovagina is presented. The mean follow-up period was 52 months. Nineteen patients participated in this study. Evaluation was done with a questionnaire, a structured interview, and standardized gynecologic examination. Persisting patency, the claimed advantage of using an intestinal segment for the creation of a neovagina in comparison with other techniques, has been confirmed in this study. With regard to the anatomic result, none of the cases was considered a failure, although several reoperative procedures had been necessary. Comparatively, anatomic failure rates of 50% for male-to-female transsexualism and 20% for vaginal dysgenesis were reported for various other vaginoplasty techniques. Sexual and social adjustment was good or satisfactory in a majority of the patients.

Chapter 6 describes the histopathologic features of biopsy specimens from 13 patients with a sigmoid neovagina, to investigate the occurrence of diversion colitis in the isolated conduit. The microscopic evaluation indicated a mild diversion colitis in a majority of the biopsy specimens. Minor complaints, such as slight blood loss and discharge from the neovagina that were reported by most of the patients, may be associated with this condition. The local application of short chain fatty acids may relieve symptoms associated with diversion colitis.

Chapter 7 evaluates the bacterial flora of the excluded sigmoid segment. Fifteen patients were included in this study. Specimens were examined for the presence of various vaginal and colonic microorganisms, including Candida albicans, Trichomonas vaginalis, Neisseria gonorrhoea, Mycoplasma hominis, Ureaplasma urealyticum and Chlamydia trachomatis. No specimen was sterile and only normal inhabitants of the colon were cultured. The total counts of bacteria were lower than those reported for healthy sigmoid colons.

Chapter 8 describes prolapse of the sigmoid neovagina, a rare complication of colo-colpopoiesis, that occurred in three patients of our series. Both abdominal and vaginal approaches may be needed to restore the neovagina without compromising its function. A prophylactic primary fixation of the neovagina to the posterior pelvic wall should be considered in patients with an increased risk for prolapse.

Chapter 9 presents a detailed case report on the occurrence of postoperative peritonitis with subsequent intraabdominal abscess formation due to anastomosis leakage in one patient. Secondary peritonitis is a rare but life-threatening complication of sigmoid vaginoplasty that may occur despite of adequate antibacterial treatment and improved operative procedures, suture materials and intensive care facilities, even in the hands of experienced surgeons.

Chapter 10 discusses the place of colocolpopoiesis in the treatment of conditions associated with a missing vagina. The following is concluded:

1. In patients with vaginal aplasia, the primary surgical treatment consists of colocolpopoiesis if the non-operative Frank's method fails.

2. In transsexuals, in case of stenosis of a neovagina derived from inverted penile skin, colocolpopoiesis ought to be the treatment of choice.

3. Technical modifications are required to reduce the incidence of introital stenosis and prolapse.

4. The use of (new) vaginoplasty techniques should be substantiated by adequate follow-up evaluation.

SAMENVATTING

Veelvuldige technieken zijn in de loop van deze eeuw ontwikkeld voor de constructie van een vagina. Een van deze methodes berust op het bekleden van een tevoren gecreëerde rectovesicale tunnel met een geisoleerde sigmoidlis. Sinds 1983 wordt in het Academisch Ziekenhuis Rotterdam Dijkzigt gebruik gemaakt van een gemodificeerde colocolpopoiëse techniek bij de behandeling van ziektebeelden die gepaard gaan met een afwezige vagina. Vijfenveertig patienten, voornamelijk vrouwen met het syndroom van Mayer-Rokitansky-Küster en man-vrouw transsexuelen, ondergingen een gemodificeerde sigmoid vaginaplastiek in onze kliniek tot 1991. Postoperatieve gegevens van deze 45 patienten zijn verwerkt in dit proefschrift.

Hoofdstuk 1 geeft een inleidende beschrijving van ziektebeelden die gepaard kunnen gaan met een afwezige vagina. Congenitale vaginale dysplasie kan, samen met een rudimentaire uterus, voorkomen bij vrouwen met het syndroom van Mayer-Rokitansky-Küster en bij verschillende vormen van intersex. Secundair of verworven verlies van de vagina kan optreden bij patienten die behandeld zijn voor maligniteiten van het kleine bekken en na uitgebreide baringsverwondingen. Man-vrouw transsexuelen zijn mannen die zich van hun primaire en secundaire mannelijke geslachtskenmerken willen ontdoen om de vrouwelijke geslachtsrol te vervullen.

Hoofdstuk 2 beschrijft vanuit een historische invalshoek de verschillende therapeutische benaderingen voor de constructie van een neovagina, met uitzondering van de darmvagina plastieken. De meeste van deze technieken berusten op de dissectie van een holte tussen blaas en rectum die bekleedt wordt met huid, peritoneum, amnion of ander materiaal. Een neovagina kan ook door impressie van buitenaf gecreëerd worden, of extracorporeel door de labia aan elkaar te hechten. Het voornaamste nadeel van deze technieken is de neiging tot stenosering van de holte. Levenslange dilataties zijn noodzakelijk en stenose komt in ongeveer 25 % van de gevallen voor.

Hoofdstuk 3 geeft een overzicht van de literatuur die in de afgelopen 100 jaar over darmvagina plastieken is verschenen. De technieken waarbij gebruik wordt gemaakt van rectum en dunne darmlissen voor de bekleding van de rectovesicale holte hebben slechts een

historisch belang. Vanaf het begin van deze eeuw zijn meer dan 900 gevallen beschreven waarbij een geisoleerde sigmoidlis wordt gebruikt voor de constructie van een neovagina, met een mortaliteit van 0.88%. In 1.7% van de gevallen werd het verlies van de neovagina beschreven, meestal als gevolg van transplantaat necrose. De meeste sterfgevallen waren het gevolg van naadlekkage en peritonitis. Sigmoid colpopoiëse is een technisch moeilijke operatie die het samenwerken van gynaecologen en gastrointestinale chirurgen vereist. Het voornaamste voordeel is een neovagina, die ook zonder regelmatige dilataties haar postoperatieve afmetingen behoudt en niet stenoseerd.

In **Hoofdstuk 4** wordt een gedetailleerde beschrijving gegeven van de gemodificeerde colocolpopoiëse techniek zoals die in ons ziekenhuis wordt toegepast. Ernstige complicaties werden bij 40 patienten die deze operatie ondergingen tussen 1983 en 1988, niet beschreven. Twee en dertig patienten werden zes weken postoperatief geëvalueerd; het merendeel had een voor coitus adequate vagina op dit tijdstip. Bij zeven patienten was ter hoogte van de introitus enige stenose opgetreden. Op korte termijn werden met deze nieuwe operatietechniek goede functionele resultaten verkregen.

Hoofdstuk 5 beschrijft de psychosexuele en psychosociale aspecten van een lange-termijn studie bij patienten met een sigmoid neovagina. De gemiddelde postoperatieve follow-up tijd was 52 maanden. Negentien patienten namen deel aan deze studie. De gegevens werden verkregen door middel van een enquête, een gestructureerd interview en gestandardiseerd gynaecologisch onderzoek. Bij geen van de patienten was de neovagina gestenoseerd. Het anatomisch resultaat werd bij geen van de patienten beschouwd als mislukking, hoewel er meerdere secundaire ingrepen uitgevoerd werden. Ter vergelijking worden literatuurgegevens vermeldt, waarbij met andere neovagina plastieken in 50% van de man-vrouw transsexuelen en in 20% van de vrouwen met dysplasie van de vagina onbevredigende resultaten werden gevonden. De sexuele en sociale situatie was goed of bevredigend bij het meerendeel van de patienten.

Hoofdstuk 6 behandelt de histopathologische kenmerken van biopsien die bij 13 patienten met een sigmoid neovagina beschreven zijn om het optreden van diversion colitis in de geisoleerde sigmoidlis te onderzoeken. In het merendeel van de biopsien werden kenmerken passend bij een milde diversion colitis gevonden. Bij dit ziektebeeld kunnen klachten, zoals enig bloedverlies en afscheiding, die opgemerkt werden door de meeste patienten, optreden. De locale behandeling met korte keten vetzuren zou mogelijk klachten die geassocieerd worden met diversion colitis kunnen verlichten.

Hoofdstuk 7 beschrijft de bacteriologie van het geisoleerde sigmoid segment. Vijftien patienten namen deel aan deze studie. Het uit de sigmoid neovagina verkregen materiaal werd onderzocht op de aanwezigheid van verschillende microorganismen die in de vagina

en in de darm kunnen voorkomen, waaronder onder meer Candida albicans, Trichomonas vaginalis, Neisseria gonorrhoea, Mycoplasma hominis, Ureaplasma urealyticum en Chlamydia trachomatis. De kweken waren in geen enkel geval steriel en slechts normale darmbacterieën werden gekweekt. Het totale aantal kiemen was lager dan in het gezonde sigmoid.

Hoofdstuk 8 gaat in op prolaps van de sigmoid neovagina, een zeldzame complicatie van colocolpopoiëse die opgetreden is bij drie patienten uit deze studiegroep. Bij de behandeling van deze complicatie en het herstel van de functie van de neovagina zouden abdominale en vaginale benaderingen noodzakelijk kunnen zijn. Een profylactische primaire fixatie van de neovagina aan de bekken achterwand zou overwogen kunnen worden bij patienten met een verhoogde kans op het optreden van prolaps.

In **Hoofdstuk 9** wordt een casus beschreven waarbij postoperatieve peritonitis en intraabdominale abscesvorming als gevolg van naadlekkake opgetreden is. Secundaire peritonitis is een zeldzame maar levensbedreigende complicatie van sigmoid neovaginaplastiek die ondanks adequate antibiotische therapie en verbeterde operatie technieken, hechtmaterialen en intensive care voorzieningen ook bij ervaren chirurgen voor kan komen.

Hoofdstuk 10 bespreekt de plaats van de colocolpopoiëse bij de behandeling van patienten zonder vagina. De volgende conclusies worden geformuleerd:

1. Bij patienten met aplasia vaginae lijkt na de niet operatieve methode van Frank de colocolpopoiëse de primaire chirurgische keuze.

2. Bij transsexuelen is in geval van stenose of afsluiting van een neovagina geconstrueerd met geinverteerde penishuid, een colocolpopoiëse de aangewezen keuze.

3. Er moet worden gezocht naar technische modificaties, die de kans op stenose van de huid-darm overgang en prolaps van de neovagina verder verminderen.

4. Het gebruik van (nieuwe) technieken van neovagina creatie dient steeds met adequate follow-up geëvalueerd te worden.