AXILLARY PLEXUS BLOCKADE IN MICROVASCULAR SURGERY, A STEAL PHENOMENON?

JOHN. F.A. VAN DER WERFF, M.D., GEORGIO MEDICI, M.D.,
STEVEN E.R. HOVIUS, M.D., Ph.D., and
ARIE KUSUMA, M.D., Ph.D.

A case report is presented of an axillary plexus blockade following a second toe-to-hand transfer. After completion of the microvascular anastomoses and restoration of blood flow to the transplanted toe, the axillary plexus blockade was started. Together with the vasodilation of the hand and forearm there was a marked drop in blood flow in the transplanted toe. Possible explanations for this phenomenon are considered. We suggest starting axillary plexus blockade before completion of microvascular anastomoses and maintaining a continuous postoperative blockade.

MICROSURGERY 16:141–143 1995

Since its introduction in 1911 by Hirschel,[1] the technique of percutaneous axillary plexus blockade has gained importance and its application is widespread in surgery of the upper extremity.

The combination of analgesia, partial motorblock, and vasodilation seems to give an ideal situation in reconstructive hand surgery. Through the use of an axillary catheter and an infusion pump, these properties can be maintained during the postoperative period.[2] Whether the effect of vasodilation is beneficial to the transplanted or replanted tissue in microvascular surgery remains an unsolved problem in the literature.[3–5] Measurements of blood flow were performed using laser Doppler flowmetry (Perimed PF2B). In this way a continuous, reliable, and direct assessment of skin blood flow could be obtained.[6–8]

The aim of this case report was to show the change in skin blood flow in a second toe-to-hand transfer following axillary plexus blockade.

CASE REPORT

An 18-year-old male underwent an elective second toe-to-hand transfer following traumatic amputation of his left thumb (Fig. 1).

A catheter (Contiplex-Braun) was placed in the axillary neurovascular sheath on the left side using a neurostimulator (twitch 0.5 mA) and the system was tested. No local anesthetics were given at this stage of the operation. Following the placement of this catheter, general anesthesia was induced with pentothal and maintained by using fentanyl and pancuronium; the patient was ventilated with a mixture of oxygen, nitrous oxygen, and isoflurane 0.5%. The second toe-to-hand transfer was performed by anastomosis of the dorsalis pedis artery end-to-side with the radial artery and three veins to the cephalic vein (Fig. 2). After completion of the vascular anastomoses and before restoration of blood flow, laser Doppler flowmetry (LDF) readings were assessed from the long finger and the transplanted toe by using two identical meters. Eight minutes after the release of the microvascular clamps a bolus of 50 ml mepivacaine 1% with epinephrine (1:200,000) was administered via the axillary catheter. During this period LDF measurements were recorded continuously on both the long finger and the thumb. Room temperature remained constant at 23°C, blood pressure was stable, and the operated hand was left untouched during LDF measurements.

RESULTS

According to the various events the laser Doppler flowmetry measurements can be divided in to four periods (Fig. 3). The first period is the time before opening of the anastomoses; steady blood flow in the long finger and no flow in the thumb (A in Fig. 3). Following the release of the microvascular clamps, the second period is characterised by a reactive hyperemia, which levels off in the thumb, without any significant changes in the long finger blood flow (B in Fig. 3). The third period begins with the onset of the axillary plexus blockade; a small decrease in bloodflow in both fingers is demonstrated (C in Fig. 3). This decrease is explained by a local pressure effect of the bolus. Approximately 5 min following the bolus of anesthetic, there was a marked increase in skin blood flow in the long finger (D in Fig. 3). Simultaneously, blood flow in the transplanted

From the Department of Plastic and Reconstructive Surgery (J.F.A.v.d.W., S.E.R.H.), Department of Anaesthesiology (G.M., A.K.), Academic Hospital Dijkzigt, Rotterdam, The Netherlands.

Address reprint requests to Dr. J.F.A. van der Werff, Department of Plastic and Reconstructive Surgery, Academic Hospital Dijkzigt, Dr. Molewaterplein 40, 3015 GD Rotterdam, The Netherlands.

Received for publication January 4, 1994.

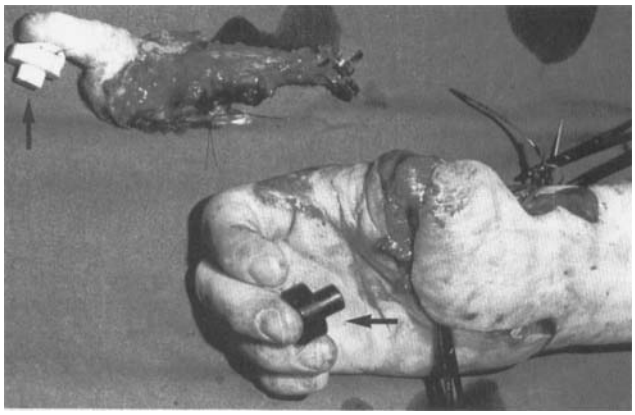

Fig. 1. An intraoperative photograph of the second toe before transplantation to the left hand. The arrows indicate the probe holders for the laser Doppler flowmeter.

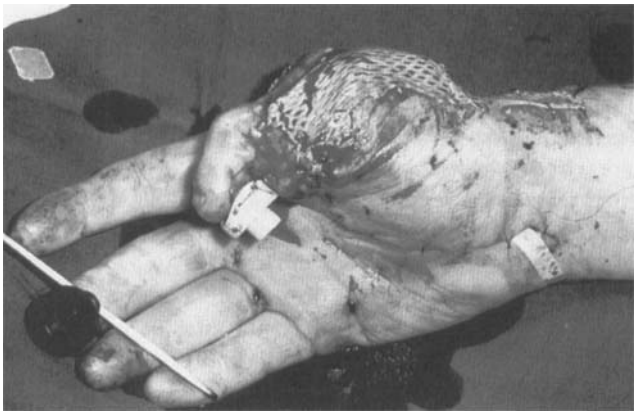

Fig. 2. The toe-to-hand transfer at the end of the operation after completion of all bony, vascular, and tendon connections.

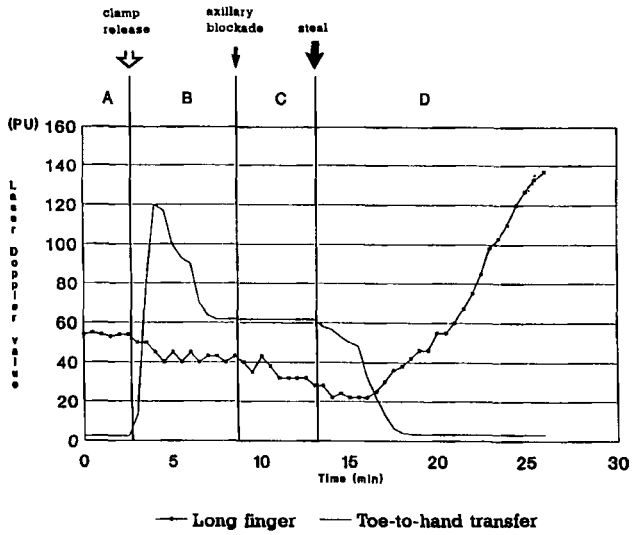

Fig. 3. The values of laser Doppler flowmetry in perfusion units (PU) in the long finger and thumb. The open arrow indicates release of microvascular clamps. The closed thin arrow coincides with the onset of the axillary plexus blockade, the closed thick arrow indicates the start of vasodilation in the long finger. Periods A–D correspond to the text.

thumb decreased progressively to almost zero (D in Fig. 3). At this moment the anastomoses were evaluated without any specific findings except loss of filling of the artery and veins.

The anastomoses were covered with topical xylocaine 20% and left untouched, and the axillary blockade was discontinued. In reaction, blood flow in the toe-to-hand transfer very slowly returned to a viable level. Ultimately, the transfer of this second toe was successful, with an uneventful postoperative course.

DISCUSSION

Regulation of local blood flow depends on three mechanisms: humoral, nervous, and autoregulation. Axillary plexus blockade induces inhibition of motor, sensory, and sympathetic nerve fibers in the forearm. Through the sensory block there is a diminished release of catecholamines. The sympathetic blockade gives a decrease in vascular tone resulting in a clinically obvious vasodilation of the forearm. Reports as to whether this vasodilation is beneficial to a free vascularized tissue transfer are contradictory. Cousins et al.[4] report increased graft flow after epidural anesthesia in patients undergoing peripheral vascular reconstruction. Van Twisk et al.[5] hypothesized that a steal phenomenon was evident following epidural blockade in microvascular surgery.

This case report clearly shows a direct relationship between changes in skin blood flow in the forearm and the toe-to-hand transfer following axillary plexus blockade. The cause of this relationship can be due to a variety of reasons:

- a steal phenomenon following a local drop in blood pressure,
- vasoconstrictive hypersensitivity of the transplanted toe to a slightly increased systemic level of epinephrine,
- release of vasoconstrictor substances in the forearm, causing an increase in vascular tone of the toe.

In conjunction with our empirical finding[9,10] that flow disturbances have never occurred when axillary plexus blockade is started well before restoration of blood flow to the free tissue transfer, the results of this case report justify the following assumptions: axillary plexus blockade should be started well before completion of microvascular anastomoses, and if maintained throughout the postoperative period, should not be changed to a higher dosage. In this way the benefits of this type of analgesia, sensory and partial

motor blockade, are not disturbed by possible side effects to the microcirculation of the revascularized tissue.

We emphasize that when these precautions are taken, axillary plexus blockade is very useful in reconstructive microvascular surgery.

REFERENCES

1. Hirschel G: Anaesthesia of the brachial plexus for operations on the upper extremity. *Munchener Med Wochenschrift* 58:1555–1556, 1911.
2. Raj PP, Denson DD: Prolonged analgesia technique with local anesthetics, in Raj PP (ed): *Practical Management of Pain.* Chicago, Yearbook Medical Publishers, 1986, vol 36, pp 687–700.
3. Berger A, Tizian C, Zenz M: Continuous plexus blockade for improved circulation in microvascular surgery. *Ann Plast Surg* 14:16–19, 1985.
4. Cousins MJ, Wright CJ: Graft, muscle, skin blood flow after epidural blocking vascular surgical procedures. *Surg Gynecol Obstet* 133:59–64, 1971.
5. Van Twisk R, Gielen MJM, Pavlov PW, Robinson PH: Is additional epidural sympathetic block in microvascular surgery contraindicated? A preliminary report. *Br J Plast Surg* 41:37–40, 1988.
6. Jenkins S: Routine use of Laser Doppler flowmetry for monitoring autologous tissue transplants. *Ann Plast Surg* 21:423, 1988.
7. Jones BM: Monitors for the cutaneous microcirculation. *Plast Reconstr Surg* 73:843–850, 1984.
8. Svensson H, Pettersson H, Svedman P: Laser Doppler flowmetry and laser photometry for monitoring free flaps. *Scand J Plast Reconstr Surg* 19:245–249, 1985.
9. Van Adrichem LNA, Gultuna I, Mulder HD, Hovius SER, van Strik R, van der Meulen JC: Differences between arterial and venous occlusion in microvascular surgery. *Scand J Plast Reconstr Hand Surg* 27:23–27, 1993.
10. Hovius SER, van Adrichem LNA, Mulder HD, van Strik R, van der Meulen JC: The predictive value of the laser Doppler flowmeter for postoperative microvascular monitoring. *Ann Plast Surg* 31:307–312, 1994.