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Address: Suite 603, Weite Office Building, A11 East Road, North 3rd Rind Road, Chaoyang District, Beijing, P.R .China
Website: www.capa.org.cn E-mail: cjprs@.capa.org.cn

Original Articles

Application of radial collateral artery perforator flap in severe posterior elbow skin defect

Qing-xin XU, Guang-huai CUI , Zhen-zhen WAN, Yu-shu LIU , Wen-ming LIU*

Binzhou Medical University Hospital, Shandong Province, 256600, China

ABSTRACT

Objective To explore the clinical effect of radial collateral artery perforator flap in repairing the exposed wound of deep tissue behind elbow.
Methods From April 2016 to December 2018, 28 patients with posterior elbow skin and soft tissue defect with exposed bone and tendon were treated in our hospital. the radial collateral artery perforator flap was used to repair the wound. There were 19 cases of skin defect with ulna exposure after electric shock injury, 5 cases of hot compression injury and 4 cases of bone exposure caused by skin contusion after traffic accident.
Results There is no complication after the operation, all the flaps were survived. The flaps had good quality and satisfactory recovery of appearance and function.
Conclusion The lateral upper arm flap designed by perforating branch of radial collateral artery is an effective method for posterior elbow skin and soft tissue defect because of its constant anatomic position and long vascular pedicle.

KEY WORDS

Radial collateral artery; Soft tissue defects; Perforator flap;Transplantation

INTRODUCTION

In recent years, the concept and technology of perforator flap have completely changed the traditional random flap operation. Perforator flap is a kind of skin flap supplied only by skin perforators with small diameter, which belongs to the category of axial flap. Because of its multiple rotation directions, there is a reliable blood supply, which can be used for the simultaneous treatment of defect repair [1]. It greatly reduces the influence of skin flap resection on the function of donor site and the occurrence of deformity, and improves the repair effect, because it obtains the best shape and function of recipient area with the smallest damage of donor area of skin flap, which embodies the new concept of “minimally invasive skin flap”. This technique has been widely used in repair and reconstruction surgery[2]. The design of the perforator flap is not limited by blood supply, as long as the flap contains a branch of blood vessels, the flap can be designed from any position to any shape and size. The perforating branch of the radial collateral artery is anatomical fixed, and the texture of the skin in this position is thin and soft, which is suitable for the repair of the elbow with high activity. It is a commonly used donor site of the perforating branch flap in clinic [3]. From April 2016 to December 2018, 28 patients with skin and soft tissue defect behind elbow with exposed bone and tendon were repaired with radial collateral artery perforator flap

MATERIALS AND METHODS

There were 28 cases in this group, including 21 males and 7 females, aged 21 to 53 years (mean age 31.4 years). Course of disease: 6 days to 5 months. Among the 28 cases, the causes were electric injury (n = 19), hot pressure injury (n = 5) and traffic accident (n = 4). It is difficult to heal the wound without skin flap. The patients were followed up for 6 to 24 months (mean 9 months).

Under brachial plexus block anesthesia, the dead tissue of the wound was completely cleared and washed with hydrogen peroxide, normal saline and dilute iodophor three times to expose the wound completely and stop the bleeding completely. The donor area was drawn according to the shape and size of the wound.Before operation, the course and perforating branch of radial collateral

artery were detected by ultrasonic Doppler[4]. The flap was designed with the stop point of deltoid muscle and the line of lateral epicondyle of humerus as the axis. The upper boundary can reach the middle of deltoid muscle, the lower boundary can reach 5 cm below the elbow, and the anterior and posterior boundary can reach or exceed the midline of the arm. According to the size of the wound, the flap should be designed according to the size of the wound, and the long axis of the flap should be consistent with the stop point of the deltoid muscle and the axis of the lateral epicondyle of the humerus.

The incision was designed on the posterior edge of the flap, cut under the skin, dissociate along the superficial layer of the deep fascia, separate the flap, protect the arterial perforating branch of the flap, find the radial collateral artery, select the thicker perforating branch and expose the posterior branch of the radial collateral artery along the perforating branch. Ligate the muscle branch in the direction of muscle, carefully continue to separate to the distal end along the posterior branch of the radial collateral artery to the desired length. Then cut the anterior edge of the flap, lead the brachioradialis muscle to the front and the triceps muscle to the rear. During the operation, we should pay attention to avoid the injury of the radial nerve and protect the lateral superior brachial cutaneous nerve in order to reconstruct the feeling of the flap. After the loose tourniquet confirmed that the blood supply of the skin flap was good, the free skin flap was sutured with the wound. The donor area of the flap can be sutured directly or free skin grafting. After operation, erythromycin eye ointment was smeared with local moisturizing and anti-inflammatory in the donor area, and routine anti-infective treatment for 2 to 3 days, pay attention to keep the wound warm. The rubber drainage strip was removed 24 hours after operation and the suture was removed 14 days after operation.

RESULTS

After operation, all the 28 cases of skin flap survived, the wound healed in one stage, there was no venous crisis, the flap did not have any necrosis, and felt good. Follow-up for 6 to 24 months showed that the flap had good blood circulation, thin and soft texture and good appearance. 3 cases of skin flap were slightly bloated and could be repaired in the second stage. The injury of the donor area of the flap was small, and the recovery of function and appearance was not significantly affected.

TYPICAL CASE

The patient was a 49-year-old male. He was admitted to hospital for 10 days due to multiple high voltage injuries. Specialist examination: multiple electric injury wounds throughout the body, mainly located in the back of the left elbow, back, buttocks, left lower abdominal wall and left leg outside, no obvious electric injury exit, entrance, a total of about 10% TBSA, wound dry scab, a small amount of exudation under the left leg wound, the surrounding skin slightly red and swollen part of the wound scab shedding, the base pale, the left lower limb many skin ecchymosis. Admission diagnosis: 1. Electric injury (deepII~III 10%); 2. Skin and soft tissue contusion; 3. high blood pressure. The patient underwent debridement under general anesthesia on the 6th day after admission. The residual size of the left elbow was about 10.0cm*6.0cm wound, triceps tendon and ulna olecranon exposed. After covering negative pressure for 10 days, fresh granulation could be seen in the wound, but bone and tendon were exposed, so it was decided to transfer the perforator flap of radial collateral artery. During the operation, according to the size and shape of the wound, the flap was designed and marked on the radial side of the elbow with the middle axis of humerus and radius as the midline. The size of the flap was about 10.0 to 13.0cm. the skin and subcutaneous vessels were cut along the marked line, and the perforating vessels were carefully searched in the deep and superficial fascia space. 3 small perforating vessels were found, and about 6 cm above the lateral epicondyle of humerus, the flap was designed and marked on the radius of the elbow. The size of the flap was about 10.0 and 13.0cm. Along the marked line, the skin and subcutaneous vessels were carefully searched for in the deep and superficial fascia space. It can be seen that the posterior branch of the radial collateral artery is thick, the blood circulation of the skin flap is good after the rest of the perforating branch is clamped, the small branches to the muscle are ligated, the posterior branch vessels are fully dissociated, the free skin flap covers the wound of the elbow and anastomoses the artery and vein under the microscope. After intermittent suture and fixation of the flap, the drainage strip was prevented. The skin knife was used to take the appropriate size medium and thick skin graft on the left thigh, free transplantation in the donor flap area after drilling, packing and pressure fixation after intermittent suture, the blood circulation of the flap was good, and the wound healed smoothly without infection. 2 months after operation, the wound healed well, the shape of the flap was slightly bloated, the second stage was thin, and the flexion and extension function of elbow joint was good (Fig. 1).

Fig. 1: A 10days after VSD negative pressure suction in the wound of left elbow posterior electric shock; B Design of radial collateral artery flap; C Perforating branch of radial collateral artery; D Axial flap E Three days after operation; F 20 days after operation

DISCUSSION

The technique of skin flap transplantation has become more and more mature, which can be used to repair soft tissue wounds, and the success rate can reach about 91% to 99% [6]. The blood supply of the radial collateral artery perforator flap originated from the posterior branch of the radial collateral artery, most of which originated from the deep brachial artery, mostly in the upper part of the radial nerve sulcus. The radial collateral artery is divided into the anterior branch and the posterior branch below the deltoid muscle. The anterior branch is accompanied by the radial nerve and has little to do with the flap. The posterior branch goes down between the triceps brachii and the humerus radialis muscle and anastomoses with the recurrent radial artery to the posterior sulcus of the elbow. Along the way, it sends out 1 to 6 branches, most of which are intermuscular perforators, which nourish the posterior skin of the upper arm [2, 5]. At the proximal end of the radial collateral artery, a perforating branch with a diameter larger than 0.5mm was fixed, about 11 cm above the lateral epicondyle of the humerus. Koshima[7] and other studies have shown that the maximum length of the flap based on a single perforator can reach 35 cm and the width can reach 25cm. In our clinical case, the size of the perforator flap was the largest range of 8.0cm*20.0cm. If a larger flap is needed, it may be necessary to add two or more perforating vessels to the flap, but the defect in the donor area is not beautiful after skin grafting.

Free skin flap of perforating branch of radial collateral artery is suitable for the repair of many kinds of wound defects because of its soft texture and sensory nerve to repair the wound defects of the middle and small area of the back of the finger and the back of the palm. The wound defect with a small amount of bone defect in the upper limb can also be repaired with radial collateral artery perforator flap.

The perforator flap of radial collateral artery has the following advantages[8]: ①the important anatomical structure of the donor area of the flap is preserved, and the blood supply and sensation of the affected limb are not affected. ②the texture of the skin flap is flexible and thin, and the wound after repairing the elbow is resistant to friction. According to the needs of the recipient area, it can contain more or less subcutaneous adipose tissue, reduce the injury of the donor area as far as possible, and the scar left over from the upper arm is lighter, which has little effect on the beauty.③ to repair the elbow, we can choose the ipsilateral upper arm and brachial plexus block anesthesia to save time and cost, and the patients can recover quickly after operation. However, the radial collateral artery perforator flap also has some shortcomings: ①the radial collateral artery perforating branch anatomy has a certain degree of variation, which will affect the clinical operation, which requires the accurate localization of preoperative ultrasonic Doppler [9]. ② if it is a sensory flap, it will cause sensory disturbance in the donor area of the upper arm in a short time. ③ when the cutting area of the skin supply area

is large, it affects the beauty.

Our main experiences during the operation are as follows: ①the wound should be thoroughly debridled, remove the dead tissue and ensure the freshness of the wound. ②Doppler ultrasonography was performed before operation to determine the course of the radial collateral artery and the number and location of the perforating branches, and the flap was designed in advance. ③to avoid destroying the accompanying vein of the radial collateral artery, and the injury of the radial nerve should be avoided when the lateral intermuscular septum was cut free of the vascular pedicle. ④the wound stopped the bleeding completely, and the blood supply of the flap was closely observed to prevent the occurrence of subflap hematomas.

Skin defects behind the elbow mostly occur in car accident trauma, factory accident injury, burn and electric shock injury and so on. Because elbow joint is a joint with large range of motion and more use, repairing soft tissue defect behind elbow can improve the quality of life of patients [10]. The final choice for repairing soft tissue defects will depend on the size and location of the wound, the complexity of the injury, the condition of the surrounding tissue, the exposure of important structures, and the expected results of spontaneous healing of the defect. Skin grafting is only limited to cases where the skin defect is not serious and is not accompanied by tendon and bone exposure, but it is accompanied by varying degrees of scar contracture after skin grafting, which greatly affects the function of the joint. The skin expander needs to be injected with water for a long time and the patient's compliance is low. Soft tissue reconstruction around the elbow requires thin but flexible tissue to withstand bending and stretching of the elbow. Obviously, the skin flap to repair the wound defect is a reasonable choice to solve the more complex joint skin defect. The skin flap of perforating branch of radial collateral artery is flexible and thin, strong extensibility, small wound and surgical scar in donor area, beautiful appearance and good blood supply of perforating branch skin flap of radial collateral artery, which is a good method for repairing skin defect behind elbow.

REFERENCES

[1] Hsieh CH,Yang JC,Chen CC,et al.Alternative reconstructive choices for anterolateral thigh flap dissection in cases in which no sizable skin perforator is available[J].Head & neck,2009,31(5):571-575.

[2] Gill PS,Hunt JP,Guerra AB,et al.A 10-year retrospective review of 758 DIEP flaps for breast reconstruction[J].Plastic and reconstructive surgery,2004,113(4):1153-1160.

[3] Zhang YX,Qian Y,Pu Z,et al.Reverse bipaddle posterior interosseous artery perforator flap[J].Plastic and reconstructive surgery,2013,131 (4):552e-62e.

[4] SHI Xiao-cheng YU Peng-li WANG Shu-qin,et al.Clinical application of ultrasound positioning of peroneal artery perforator flap and its perforating vessel[J].Chinese Journal of Aesthetic and Plastic Surgery,2018,29(10):623-626.

[5] Mei J,Morris SF,Ji W,et al.An anatomic study of the dorsal forearm perforator flaps[J].Surgical and radiologic anatomy : SRA,2013, 35(8): 695-700.

[6] Bui DT,Cordeiro PG,Hu QY,et al.Free flap reexploration: indications, treatment, and outcomes in 1193 free flaps[J].Plastic and reconstructive surgery,2007,119(7):2092-2100.

[7] Chang CC,Wong CH.Free-style free flap[J].Injury,2008,39 (Suppl 3):S57 -61.

[8] XU Dachuan, GU Yudong.Perforator flap[J]. CHINESE JOURNAL OF CLINICAL ANATOMY,2004,22(1): 32- 33,35.

[9] Ao M,Uno K,Maeta M,et al.De-epithelialised anterior (anterolateral and anteromedial) thigh flaps for dead space filling and contour correction in head and neck reconstruction[J].British journal of plastic surgery,1999,52(4):261-267.

[10] Levin LS.Primary and secondary microvascular reconstruction of the upper extremity[J].Hand clinics,2001,17(3):447-55, ix.

Qing-xin Xu , 1993, graduate student majoring in plastic surgery, studying in Binzhou Medical University. Research emphasis : skin defect repair; soft tissue tumor.