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Reconstructive procedure for treatment of trochanteric pressure ulcers in spinal-cord-injured patients

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Abstract
Background Pressure ulcers are frequent complications for spinal-cord-injured patients and, trochanteric pressure sores, are quite
difficult to treat. This site requires to consider some aspects, such as wound dimension, surgical timing, and reconstructive flap choice.
Methods We report our experience from 2011 to 2016 on 82 trochanteric sores in 68 spinal-cord-injured patients. All the
cases were treated with two-time procedures. Firstly, we performed the surgical toilette of the wound, and in the second
procedure, the reconstruction with a muscle or musculocutaneous flap.
Results Using the two-time procedure, we report no recurrences after a mean follow-up of 3 years. The main complication
reported was a seroma that undergo to a spontaneous resolution. Conclusions
Conclusions We believe that the described approach can be useful to treat trochanteric sores and to reduce the recurrence
rate. Muscle flaps seem to be superior to fasciocutaneous or perforator flaps in this site.
Level of evidence: Level III, therapeutic study.
Keywords Pressure sores · Spinal cord injury · Muscle flaps · Local flaps · Trochanteric reconstruction

Introduction

A pressure ulcer is a localized injury to the skin and/or underlying tissue usually over a bony prominence, because of pressure, or pressure in combination with shear [1]. Spinal-cord-injured (SCI) patients are especially at risk shown by a rate of pressure sores of 26–60% [2]. Among the different site at risk for pressure sore development in SCI patients, the trochanteric one is quite difficult to treat. The great trochanter prominenceis mobile with a tendency to create large areas of undermining and osteomyelitis is usually present in these sores, that led to a wide debridement, often extended to femoris head, leaving large deep dead spaces. The treatment of trochanteric sores can be like the one used for prosthetic infection [3]. A 2-stage surgery is usually performed to reduce the risk of early complications. In the first stage, a wide debridement is performed removing all infected or suffering tissues; then, antibiotic therapy is administered, and topical negative pressure therapy is applied to reduce wound's dimensions. In the second stage, reconstruction is performed. Reconstruction must be adequate to cover the wound and fill all dead spaces, reducing the risk of recurrences and avoiding seromas or hematoma formation.
To obtain all this goals, muscle flaps are generally preferred, but several experiences are reported in literature with other flaps, such as perforators flaps or fasciocutaneous flaps. In

this paper we described the surgical technique and reconstructive procedure of trochanteric pressure ulcers according to our experience, comparing it to those reported in literature in terms of timing of surgery and reconstructive flap choice.

Patients and methods

From 2011 to 2018 we treated 82 trochanteric pressure sores in 68 spinal-cord-injured patients. Patients' characters and comorbidities are summarized in Table 1. Data were collected from the medical charts including age, sex, comorbidities (obesity, diabetes, active smoking of more than 5 cigarettes a day, chronic kidney disease (CKD), coronary heart disease (CHD), obstructive sleep apnea syndrome (OSAS)), etiology of SCI/D, neurological level according to ASIA (American Spinal Injury Association) scale, number of treated PIs, minor and major complications, and recurrence. Obesity is defined as a calculated body mass index BMI > 30 kg/m2. Diabetes is defined as reported anamnesis of glycemia > 200 mg/dl in the presence of polyuria or polidypsia, or a fasting blood glucose > 200 mg/dl after oral glucose load. Chronic renal failure is defined as a chronically reduced eGFR in blood tests and chronically increased urine albumine-to-creatinine ratio in urine tests. Chronic heart disease is defined as a reported anamnesis of angina, chest pain, palpitation, unusual breathlessness triggered by physical activity, or stressful situation. Obstructive sleep apnea syndrome (OSAS) is defined by episodes of complete or partial obstruction of the upper airways during sleep, associated with daytime sleepiness and decreased cognitive function.

Surgical procedure

The procedure consisted in a two steps surgery. The first surgery consisted in a wide debridement of the wound. The wound is marked with metylen blue that helps in the excision of all the wound edges. The great trochanter is always removed. If necessary, the resection can be extended to the femoris head, in case of extended infection. All the soft tissues are removed to reach viable tissues (Fig. 1). The defect is frequently very deep, reaching the acetabular region. Specimens of bone and soft tissues are sent for histological and microbiological evaluation. After excision, ostectomy, and hemostasis, the area is irrigated. If there are no evident bleeding, the wound is immediately covered with a topical negative pressure therapy. In case of risk for bleeding, we prefer to wait 24–48 h to start topical negative pressure herapy; therapy is set to a pressure of − 120 mmHg and foam is used as dressing. Initial antibiotic therapy is performed with piperacillin/tazobactam 4.5 g every 6 h, and then it is modified on the results of microbiological evaluation. After debridement, the patient stay in bed until topical negative pressure (TPN) starts and then can seat in chair for 3 h daily. After 1 month we plan the reconstruction that is made with muscle or musculocutaneous flap that guarantees an adequate cover and fill of the area and an abundant blood supply. The first choices are the rectus femoris muscle

flap or the vastus lateralis musculocutaneous flap (Fig. 2). After reconstruction the patient must stay in bed until stitch removal (3 weeks), positioned on the contralateral side. It is particularly important to evaluate patient's chair because it is fundamental to not have any point of contact laterally.

Rectus femoris flap [4]

A line is drawn from the anterior superior iliac spine to the lateral border of the patella. The incision is made on this line to expose the muscle that is cut on its distal tendon and easily lifted to obtain the sufficient length to rotate it to cover the wound. It is rarely necessary to reach the pedicle. The muscle is fixed with 2/0 resorbable stitches to the deep edges of the wound and superficially to the cutaneous margins. If there is no tension, the skin edges can be sutured directly. Otherwise, the muscle is covered with a skin graft harvested from the same thigh or a musculocutaneous flap can be used (Fig. 3). Two suction drains are inserted, one in the thigh and one under the muscle in the trochanteric region. We used this procedure in 37 cases (9 direct suture, 2 musculocutaneous flaps, and 26 skin grafts).

Vastus lateralis flap [5]

A line is drawn from the anterior superior iliac spine to the lateral border of the patella. The skin paddle is drawn with an adequate dimension to allow an easy cover of the wound and a tension-free suture on the donor site. The incision is made on the skin paddle edges to expose the muscle that is cut on its distal tendon and partially removed to obtain the sufficient length to rotate it to cover the wound. It is rarely necessary to reach the pedicle. The muscle is fixed with 2/0 resorbable stitches to the deep edges of the wound and superficially the skin paddle is fixed to the cutaneous margins. Two suction drains are inserted, one in the thigh and one under the muscle in the trochanteric region. We used this procedure in 6 cases.

Other options [6]

In case of large and deep wounds, it is possible to combine these flaps using the rectus femoris muscle to fill the deep defect and cover it with the vastus lateralis musculocutaneous flap (Fig. 4). We used this approach in three cases. In one case of severely large and deep wound, we combined the rectus femoris flap with a muscle flap composed by the vastus lateralis and vastus intermedius muscles

Results

Sample mean age was 50.0 ± 13.5 years (range 15–80). Sixty-six treated PIs occurred in men (97.06%). SCI etiology was traumatic in 83.82%, while the remaining were vascular (13.23%) or by other causes (2.94%). Tetraplegia was present in 17.65% and completeness of lesion (AIS A) in 100% of treated cases. BMI was over 30 in 32.35% of cases, diabetes in 8.82%, and active smokers were 26 (38.23%). Chronic renal failure was present in 1 case (1.47%), chronic heart disease in 4 (5.88%), and OSAS in 3 patients (4.41%). In 11

cases (13.41%) occurred a minor complication (grades 1–2 according to Clavien-Dindo [7]). These were treated conservatively, which prolonged hospitalization but resulted in complete healing. The most frequent complication reported was seroma in 9 cases (10.96%) that spontaneously solved but, in one case, it persisted for a long time (4 months). The other two complications were 1 hematoma that was drained trough the scar and 1 dehiscence that healed using advanced dressings. Three persons (3.66%) had a major complication consisted in flap detachment that was treated by reintervention consisted in the suture of the flap to the wound edges. We report no flap necrosis in this series. After a mean follow-up of 3 years (range 3–59 months), we report no recurrences. The mean hospital stay was 51 days (range 42–60 days). Osteomyelitis was present in all the cases. Results are summarized in Table 2.

Discussion

Pressure ulcers are a frequent complication in spinal-cord-injured patients. The reported recurrence and complication rates in pressure sores surgery are of 8.9% and 18.6% [8]. Trochanteric region is frequently involved, and the surgical treatment often requires a wide bone and soft tissue excision. The resulting defect is generally wide and deep. In these cases, the reconstruction must ensure to fulfill all dead spaces and an adequate cover. In this site is frequent to observe infective process of both soft and bone tissues. Schryvers et al. reported that trochanteric reconstruction leads the highest rate of complications (35%) in flap surgery for pressure ulcers [9], and Foster et al. reported a rate of complications of 15% [10]. For all these reasons we prefer to perform a two-step procedure: firstly, we perform the surgical debridement of the wound and start TPN therapy, after 1 month we perform the reconstruction. This period allows to administer adequate antibiotic therapy, so the reconstruction will be made on a “clean” site. TPN therapy [11] acts reducing wound dimensions, increasing blood flow, and creating a wound bed made by granulation tissues, leading to an ideal surgical site to reconstruct. In addition, TPN allows the sitting position, reducing the risk to worse the wound, and improves the nursing management of the patient, reducing the necessity of frequent dressings. Muscle flaps are reported as first choice in pressure sore reconstruction [12, 13]. These flaps are invasive and not repeatable, but in case of osteomyelitis, such as in trochanteric pressure sores, are particularly indicated because they act as a carrier for antibiotics and fill all dead spaces, consequent to wide debridement [14, 15]. Greco et al. [16] reported the use of fasciocutaneous flaps in pressure sore reconstruction to have other possibilities in case of recurrence and because, in SCI patients, muscle atrophy and fibrotic degeneration led to a minor resistance against pressure. We agree with their observation in case of ischiatic or sacral sores, but in trochanteric sores, we

usually have large and deep defects to repair that are not completely filled with fasciocutaneous flaps. Anterolateral thigh myocutaneous flap is reported by many authors [17, 18] to cover trochanteric sores. This is a good choice, but it requires microsurgical experience to dissect the pedicle and longer surgical time in comparison to muscle flaps. The coverage with a skin graft did not led to recurrences in our experience, and this fact can be explained considering that the trochanteric region is not a pressure point during sitting position using adequate wheelchair. In our opinion, for the same reasons, perforator flaps [19] are not adequate in case of trochanteric sores with large deep defects to reconstruct. We prefer muscle or musculocutaneous flaps for the reconstruction in order to have enough tissue just to fill all dead spaces and ensure a cover with viable tissue. This procedure ensures to obtain good results and to reduce the risk of recurrences. Thanks to this approach, we are sure to cover a clean site, filling all the dead spaces.

Conclusions

Trochanteric sores are difficult to treat, and the reported risk of recurrence is high. We think that two aspects are fundamental in the treatment of this sores. First, the surgical timing: the two-step procedure is useful to adequately treat this wound, such as in prosthetic infections. The first step consists in a wide debridement that allows to remove all infected or suffering tissues. Then, adequate antibiotics are administered and TPN is used to reduce wound dimensions and create a viable wound bed. The second step consists in reconstruction. Flap choice is the second aspect to consider. Muscle or myocutaneous flaps are the better choice to fulfill all dead spaces and cover the wound. These flaps are easy to perform in comparison to perforator flaps and provide more tissues than fasciocutaneous flaps. Our results are good but must be confirmed by further greater prospective study.

Funding None.

Declarations

Ethics approval The study was approved by the Institutional Ethical Committee AVEC with the reference number 1000–2020-OSS-AUS-LIM on 19th November 2020. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Consent to participate The authors affirm that human research participants provided informed consent for sharing their data and publication of their images.

Conflict of interest Luca Negosanti, Siriana Landi, Luca Gaiani, Rita Capirossi, Micaela Battilana, and Rossella Sgarzani declare that no funds, grants, or other support were received during the preparation of this manuscript. The authors have no relevant financial or non-financial interests to disclose.

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Table 1 Patient characters

	Total ($n=68$)
Age	50.0 + 13.5
Gender M, *n* (%)	66 (97,06)
Etiology, *n* (%)	
Trauma, *n* (%)	57 (83,82)
Vascular, *n* (%)	9 (13,23)
Other, *n* (%)	2 (2,94)
Tetraplegic, *n* (%)	12 (17,65)
Complete lesion (AIS A), *n* (%)	68 (100)
At least one comorbidity, *n* (%)	40 (58,82)
Diabetes, *n* (%)	6 (8,82)
Smoking, *n* (%)	26 (38,23)
Obesity, *n* (%)	22 (32,35)
Chronic renal failure, *n* (%)	1 (1,47)
Chronic heart disease, *n* (%)	4 (5,88)
OSAS, *n* (%)	3 (4,41)
More than 1 PU treated, *n* (%)	14 (20,59)

Fig. 1 Trochanter sore after surgical debridement

Fig. 2 Preoperative drawings

Fig. 3 Reconstruction with a rectus myocutaneous flap

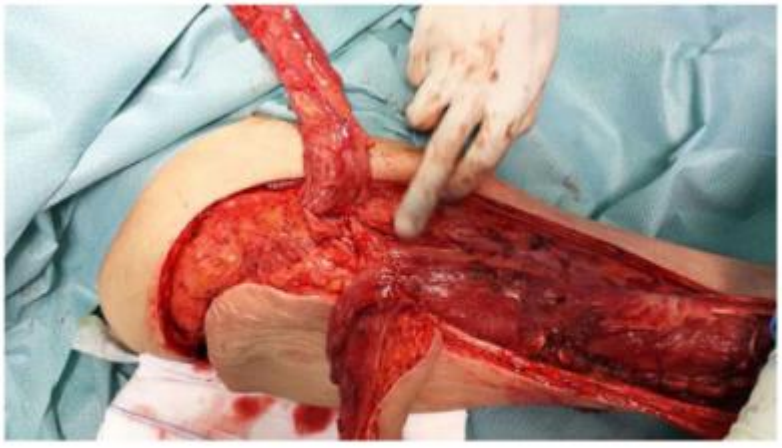

Fig. 4 Combination of rectus femoris and vastus lateralis myocutaneous flap

Table 2 Complications

	Total 82 PU
Minor complications	11 (13,41)
Seroma	9 (10,96)
Hematoma	1 (1,22)
Dehiscence	1 (1,22)
Major complications	3 (3,66)
Flap necrosis	0
Flap detachment	3 (3,66)
Recurrences	0