USE OF GASTROCNEMIUS MUSCLE ON TREATMENT OF INFECTED INJURIES OF THE KNEE

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ABSTRACT

Objective: to prospectively evaluate the use of gastrocnemius muscle flap in the treatment of knee infected injuries. Methods: twelve patients were operated on: eleven males with ages ranging from 19 to 78 years, mean: 55 years. Coverage of injuries with medial gastrocnemius muscle was accomplished in 11 patients and a lateral in 1. The mean number of preoperative surgical debridement procedures was 3.2, ranging from 1 to 9. Results: all flaps survived. The most common etiological agent was S. aureus, in 54.5%. After a mean follow-up of 20.08 months (13 to 31), all patients show stable coverage without recurrence of infection signs or symptoms. Conclusion: gastrocnemius muscle use in knee infected injuries treatment presented good results and low morbity rates.

Keywords: *Knee injuries. Surgical flaps. Muscle skeletal.*

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INTRODUCTION

Seriously infected injuries of the knee are complications resulting from various etiologies, requiring multidisciplinary approaches and have several therapeutic modalities.

The rates of infection after knee osteosynthesis are quite variable, because they depend on countless factors, such as presence of bone exposure, trauma energy, degree of contamination, time to surgery, associated comorbidities, etc.[1] While after knee total arthroplasty (KTA), wound healing problems may occur in up to 22% of the cases[2,3], with deep infection ranging from 1 to 12%.[4,5]

A careful study of patients with such severe injuries is warranted. For didactical reasons, they can be divided into local and systemic factors. Among local factors, we must assess wound's characteristics such as length, site, involved structures, appearance and amount of leakage, presence of osteomyelitis, osteosynthesis material or prosthesis exposure.

Clinically, risk factors such as multiple previous surgeries, rheumatoid arthritis, corticosteroids use, obesity, peripheral vascular disease, kidney failure, previous infection, tobacco use, alcohol abuse, pseudoarthrosis, radiation or immunosuppressive therapy are of great importance in these patients' prognosis.[6]

After debridement, these injuries must be appropriately covered. Several alternatives are available. In this study, we assess coverage with gastrocnemius muscle.

OBJECTIVE

To prospectively assess the use of gastrocnemius muscle flaps in the treatment of infected knee injuries.

METHODS

Between April 2002 and October 2003 twelve consecutive patients with infected knee injuries were operated at the Orthopaedics and Traumatology Institute of University of São Paulo's Hospital das Clínicas. ages ranged from 19 to 77 years (mean: 55). Eleven patients were males. (Table 1)

The surgical procedures were subdivided into two phases: debridement and injury coverage.

Debridement was performed in one or more procedures, in an attempt to obtain a clean, leakage-free wound, with no gross necrosis areas and reduced amount of fibrous tissue.

Injuries coverage was provided by rotating gastrocnemius muscle medially in 11 cases and laterally in one case, followed by skin grafting of the homolateral thigh. (Figure 1)

RESULTS

All flaps survived. In 11 cases, the etiological agent was identified as *Staphylococcus aureus* (54.5 %) the most common one. Other agents found were: *Pseudomonas aeruginosa, Enterobacter cloacae, Enterococcus faecalis* and *Acinetobacter baumannii.*

Among complications, the most frequent ones were suture dehiscence at donor area in two cases, debridement review in other two patients, preserving the flap. All patient evolved with no further complications.

Femorotibial arthrodesis was indicated in one case post knee total arthroplasty, because the patient had malnutrition, hypertension and diabetes, and presented with a spacer with antibiotics at admission (Figures 2 and 3)

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Table 1 – *List of patients containing epidemiological and surgical procedure data.*

Number	Gender	Age	Etiology	Number of pre-flap debridement procedures	Kind of Flap	Post-flap surgeries	Postoperative complications	Follow-up
1	M	72y	Post-KTA infection	1	GM	-	-	12 months
2	M	78y	Post-KTA infection	7	GM	-	-	13 months
3	M	42y	Post-quadricepsplasty infection	2	GM	-	Small peripheral necrosis area	19 months
4	M	57y	COM of the tibia	1	GM	-	-	19 months
5	M	57y	COM of the tibia	3	GM	-	-	20 months
6	F	77y	Post-KTA infection	1	GM	Debridement and primary closing	Suture dehiscence at donor site	20 months
7	M	44y	COM of the tibia	4	GM	Ilizarov and 2 debridement procedures	-	21 months
8	M	42y	COM of the tibia	7	GM		-	21 months
9	M	19y	COM of the tibia	1	GM		-	21 months
10	M	76y	Post-KTA infection	9	GM	Ilizarov	Epidermolysis	22 months
11	M	40y	COM of the tibia	3	GM	-	-	22 months
12	M	63y	COM of the femur	6	GL	3 debridement procedures	Active fistula for 3 months	31 months

Label: COM: chronic osteomyelitis; KTA: knee total arthroplasty; GM: medial gastrocnemius muscle; GL: lateral gastrocnemius muscle.
Source: Orthopaedics and Traumatology Institute – HCFMUSP.

Figure 1 – *Medial gastrocnemius muscle rotation*

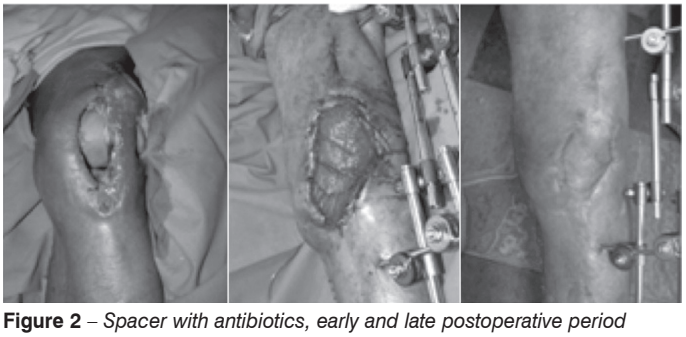

Figure 2 – *Spacer with antibiotics, early and late postoperative period*

After a mean follow-up time of 22.8 months, no patient showed signs or symptoms of new acute processes. The receptor area remains with a stable coverage, with no signs of new acute processes.

DISCUSSION

It is important to emphasize some relevant anatomical aspects of blood inflow on the anterior knee surface. Blood supply on this region is totally random, where multiple vessels contribute, predominantly emerging from terminal branches of the peripatellar arterial ring. This anastomotic ring is supplied by upper medial an lateral, lower medial and lateral genicular arteries, anterior recurrent tibial artery and deep femoral branches. On the other hand, the proximal knee surface does not count on effective perforating vessels, with blood flow in this area depending on the subdermal plexus, of which origin is located on the subcutaneous arteries.[7-9] By knowing these peculiarities, potential healing delays, skin necrosis and infection can be minimized.[10]

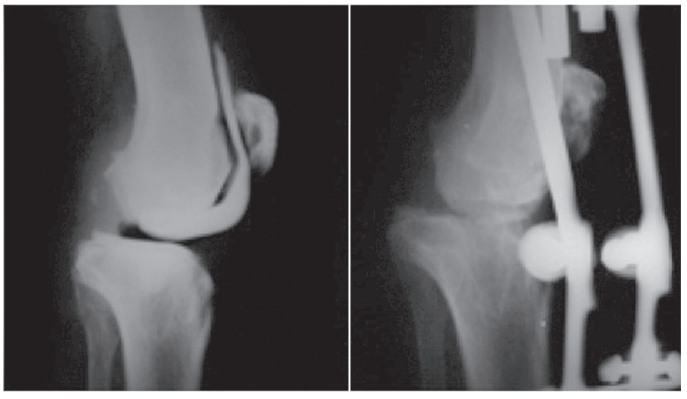

Figure 3 – *Plane X-ray images: spacer with antibiotics and late stage of arthrodesis*

Local factors characteristics must be well documented, such as degree of infiltration and contamination, presence of osteosynthesis material or prosthesis are important for a successful treatment plan.[11] In all cases of post-KTA infection, prostheses (and one case with spacer with antibiotics) were removed, followed by debridement and flap rotation.

We must always ask about any chronic corticosteroid use, because several reports suggest an increased risk of complications on surgical wounds.[7,12] These are assumed to be resultant from a reduced fibroblast proliferation, reduced collagenase clearance, resulting in a diminished collagen accumulation at wound site and subsequent tension forces reduction.[10]

Obese patients also show a stronger likelihood to complications, because additionally to the presence of potential metabolic changes, a more vigorous exposure of the surgical field may occur, increasing the risk of tissue devascularization.[13]

Malnutrition, briefly represented by albumin levels < 3.5g/dl and total lymphocyte count < 1,500 cell/mm^3, has been associated to worse wound healing and rehabilitation delay.[14]

Nicotine, carbon monoxide and many other toxic substances found in a cigarette clearly interfere on tissue healing dynamics, increasing postoperative morbidity, due to angiogenesis reduction, oxygen carrying and use, microvascular injuries production, leukocyte, macrophage and fibroblast dysfunction, platelet depletion and epithelization delay.[15]

Patients with *Diabetes mellitus* show an increased incidence and severity of local and systemic complications resulting from metabolic changes, neuropathies and vasculopathies. Those rates can be extremely expressive after open fractures, with a rate of 64% local complications and up to 42% amputations.[16]

The risk of deep infections after elective knee surgeries, such as quadricepsplasty is very low, but always present.[17] It is higher after open fractures, ranging from 0 to 87%, depending on several factors.[1,18]

After knee total arthroplasty, some wound healing complication may occur in up to 22% of the cases[2,3], with infection rates ranging from 0.8 to 12.4%[19], and, in our environment, from 0 to 6.0%.[20]

Achieving good results in the treatment of seriously infected knee injuries is directly proportional to the quality and effectiveness of surgical debridement. After achieving wounds with favorable appearance on soft parts and bone tissue, coverage becomes necessary. Several options are available: simple dressings[6], negative-pressure dressings[22], fasciocutaneous flaps[23], pedicled muscle flaps[11,24] or free muscle flaps[25], with or without knee arthrodesis[26], up to amputations.[27]

There is no algorithm able to clearly and safely outline one of these alternatives, once each case has its own peculiarities. Probably an orthopaedic doctor certified in reconstructive microsurgery can make a more accurate selection of the approach.

Thinking of a site with a high bacterial concentration, presence of cavitary injury, fibrous and necrotic tissue (even after effective debridement), microvascularization deficit compromising gas, nutrients and humor exchanges[28], the body and antibiotics can hardly promote cure on such an injury.

Muscle flaps are intended to recreate a biological environment, isolating deep structures from the environment, reducing dead spaces, promoting local vascularization, increasing oxygen concentration, nutrients and metabolic exchanges, immunomediators transport and antibiotic concentration *in loco*.[11,29]

In very large injuries, microsurgical flaps can be used as an alternative, such as the abdominal rectus or major dorsal.[11] In the great majority of cases, coverage of the anterior knee surface is achieved with pedicled flaps. The first choice is medial gastrocnemius rotation.[30] It has a constant vascular pedicle, satisfactory length and width, great rotation range, its plasticity allows for closing without tension in most cases, is easy to dissect, and can be performed by most orthopaedic surgeons, in addition to low morbidity rate for donor aras.[11,31]

CONCLUSION

The use of gastrocnemius muscle in the treatment of infected knee injuries provided good results, showing to be a safe method and providing a satisfactory stabilization of soft parts coverage.

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