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

FABIANO INÁCIO DE SOUZA, ARNALDO VALDIR ZUMIOTTI, RAMES MATTAR JUNIOR, TENG HSIAW WEI, MARCELO ROSA DE RESENDE, LUCIANO RUIZ TORRES

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 debride ment 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 morbidity rates.

Keywords: Knee injuries. Surgical flaps. Muscle skeletal.

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. While after knee total arthroplasty (KTA), wound healing problems may occur in up to 22% of the cases, with deep infection ranging from 1 to 12%. 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. 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).

All the authors state no potential conflict of interest concerning this article.
rent 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. By knowing these peculiarities, potential healing delays, skin necrosis and infection can be minimized.

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. 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. 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.

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

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

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

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 anterolateral, 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. By knowing these peculiarities, potential healing delays, skin necrosis and infection can be minimized.

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. 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. 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.
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.\(^\text{13}\)

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.\(^\text{14}\)

Nicotine, carbon monoxide and many other toxic substances found in a cigarette clearly interfere on tissue healing dynamics, increasing the risk of deep infections after elective knee surgeries, such as the abdominal rectus or major dorsal.\(^\text{15}\)

In very large injuries, musculoskeletal flaps can be used as an alternative, such as the anterior knee surface is achieved with pedicled flaps. The first choice is medial gastrocnemius rotation.\(^\text{25}\) 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 area.\(^\text{16,31}\)

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.

REFERENCES