Compartment syndrome is an orthopedic emergency. A high index of suspicion, timely diagnosis, and early decompression are of prime importance. Several factors can cause this unfortunate incident leading to irreversible injury to muscle and nerves. It is quite rare after a total knee arthroplasty (TKA). Further, it becomes extremely difficult to timely diagnose compartment syndrome after such a procedure. Factors which can delay its diagnosis after a knee arthroplasty have been discussed. We report here a case of compartment syndrome of calf after an elective total knee arthroplasty, along with a review of relevant literature.

Case Report
A 67-year-old man was admitted to elective orthopedic unit for a TKA for osteoarthritis (► Fig. 1A, B) of left knee. Patient was having arthritic symptoms of pain for the last 10 years affecting his daily routine activities. Past history included hiatus hernia, high cholesterol, a previous left partial medial meniscectomy, and a right total knee replacement with good recovery without any perioperative or postoperative complications. Patient did not have any coagulation or bleeding disorder and was not on any anticoagulant prior to surgery. His body mass index was 28.13. Drug history included lansoprazole, paracetamol, and statins. After complete pre-assessment, this gentleman was operated for this elective procedure under spinal anesthesia. Regional blocks or epidural anesthesia was not used. Tourniquet pressure and time were 300 mm Hg and 89 minutes, respectively. A cruciate-sacrificing cemented total knee replacement with patellar resurfacing was done with an uneventful immediate perioperative period. Around 300 mL of irrigation was used during the procedure with judicious use of monopolar diathermy. A low vacuum suction drain was used and anticoagulation, in the form of low molecular weight heparin (enoxaparin 3,500 IU s.c. once every evening), was started at night. Postoperatively, patient had OxyContin 20 mg for pain relief on the first day which was taken off the following day. Both active and passive physiotherapy were started the same day, and patient was mobilizing well with the help of Zimmer frame, with 70 degrees flexion at 48 hours of surgery. On day 3, patient developed severe pain in left knee and leg region. On examination, skin staples were dry without any local soakage. Left calf was swollen, firm, and tender. Knee flexion was seen to be limited to only 20 degrees with restricted ipsilateral ankle movements. Peripheral pulses were normal in rate, rhythm, and volume. An urgent Doppler scan excluded deep venous thrombosis. Analgesic medication dosages were increased to relieve the symptoms of pain, and the routine physiotherapy session was withheld. Another examination done half an hour later revealed severe pain on passive stretching. Peripheral pulses were still present as before. A clinical diagnosis of compartment syndrome of calf was made. An urgent fasciotomy of the left calf was performed with full recovery.
Compartment syndrome of calf led to an urgent fasciotomy using a two-incision technique with decompression of all four compartments. Compartment pressures were not measured for this urgent condition. Intraoperatively, muscle bulging out was prominent without any wound hematoma or vascular injury. The incised wounds were kept open and regularly dressed for two consecutive days with assessment of the wound and muscle color, consistency, and contraction. Closure was performed 3 days after fasciotomy (Fig. 2A–C). An uneventful recovery was seen without any neurologic deficit with range of motion from 10 degrees of extension to 95 degrees of knee flexion at 3-month follow-up.

Discussion

Compartment syndrome is a result of increased pressure in a closed fascial space compromising the circulation to the nerves and muscles within the involved compartment. It can be due to either increased external pressure, or increase in content volume of compartment, or a decrease in volume of affected compartment. Any of these factors can compromise local tissue perfusion. Early signs and symptoms consist of pain disproportionate to the injury, which is exacerbated by passive stretching of the involved muscles, swelling, and coldness. Pulselessness may or may not manifest and presence of peripheral pulse cannot rule out compartment syndrome.

Compartment syndrome is an orthopedic emergency where clinical suspicion is of paramount importance, thus allowing early surgical treatment. Irreversible ischemic necrosis of muscles and nerves can cause significant morbidity in cases with missed or late diagnosis and late decompression. Neglected cases can have severe systemic complications such as myoglobinuria, renal failure, and even death. Compartment pressure measurement is helpful in unconscious

Fig. 1 (A and B) Anteroposterior and lateral view showing cemented total knee prosthesis in immediate postoperative period.

Fig. 2 (A, B, and C) Fasciotomy wound on day of closure.
Table 1  Review of literature of compartment syndrome following total knee arthroplasty

<table>
<thead>
<tr>
<th>Literature</th>
<th>Cases</th>
<th>Age</th>
<th>Gender</th>
<th>Surgery</th>
<th>CS site (no.)</th>
<th>Compart- ment pres- sure (mm Hg)</th>
<th>Tourniquet use (min)</th>
<th>Routine thrombo- phyaxis</th>
<th>Postop an- algesia</th>
<th>Surgery time (min)</th>
<th>Time to ter- mination of epidural</th>
<th>Time to symp- toms in- itiation</th>
<th>Peripheral pulses pre- sent</th>
<th>Nerve palsy</th>
<th>Time to fasciotomy</th>
<th>Outcome</th>
</tr>
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<tbody>
<tr>
<td>Smith et al14</td>
<td>1</td>
<td>66</td>
<td>M</td>
<td>TKA</td>
<td>Thigh</td>
<td>35</td>
<td>Yes (NA/75)</td>
<td>Yes</td>
<td>IM morphine</td>
<td>N/A</td>
<td>N/A</td>
<td>24h</td>
<td>Yes</td>
<td>No</td>
<td>CT</td>
<td>FR</td>
</tr>
<tr>
<td>Nadem et al17</td>
<td>3</td>
<td>69 (mean)</td>
<td>M</td>
<td>TKA</td>
<td>Thigh</td>
<td>Measured</td>
<td>N/A</td>
<td>Yes</td>
<td>Oral opioids</td>
<td>N/A</td>
<td>N/A</td>
<td>72 h</td>
<td>Yes</td>
<td>No</td>
<td>N/A</td>
<td>FR</td>
</tr>
<tr>
<td>Burki et al18</td>
<td>1</td>
<td>75</td>
<td>F</td>
<td>TKA</td>
<td>Calf</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>FR</td>
<td></td>
</tr>
<tr>
<td>Tang and Chu7</td>
<td>1</td>
<td>62</td>
<td>F</td>
<td>TKA</td>
<td>Calf</td>
<td>Measured</td>
<td>Yes (300)/100</td>
<td>N/A</td>
<td>CE</td>
<td>150</td>
<td>48 h</td>
<td>Silent</td>
<td>Yes</td>
<td>N/A</td>
<td>48 h</td>
<td>SMD</td>
</tr>
<tr>
<td>Pacheco et al13</td>
<td>2</td>
<td>59</td>
<td>2 M</td>
<td>TKA</td>
<td>B/L buttocks (1); I/L but- tock (1)</td>
<td>N/A</td>
<td>Yes (NA/112 and 110)</td>
<td>N/A</td>
<td>CE</td>
<td>135, 145</td>
<td>22 h, 43 h</td>
<td>29 h, 47.5 h</td>
<td>Yes</td>
<td>(1); no (1)</td>
<td>44 h</td>
<td>SD (1); SMD (1)</td>
</tr>
<tr>
<td>Haggi et al19</td>
<td>7</td>
<td>54.8 (mean)</td>
<td>3 M; 4 F</td>
<td>TKA; Rev. TKA</td>
<td>Calf (6); Thigh (1)</td>
<td>Measured</td>
<td>Yes 6/7 (350/77)</td>
<td>Yes (2); no (5)</td>
<td>CE, PCA</td>
<td>91.16 (mean)</td>
<td>29.3 h</td>
<td>N/A</td>
<td>Yes (3); no (2)</td>
<td>Yes (2); no (5)</td>
<td>56.5 h</td>
<td>MD (5); AMP (1); FR (1)</td>
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<tr>
<td>Hailer et al3</td>
<td>1</td>
<td>43</td>
<td>F</td>
<td>TKA</td>
<td>Calf</td>
<td>N/A</td>
<td>Yes (275/68)</td>
<td>Yes</td>
<td>CE</td>
<td>65</td>
<td>N/A</td>
<td>12 h</td>
<td>No</td>
<td>Yes</td>
<td>48 h</td>
<td>SMD</td>
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<tr>
<td>Kor et al20</td>
<td>1</td>
<td>44</td>
<td>F</td>
<td>UKA</td>
<td>Calf</td>
<td>N/A</td>
<td>Yes (300)/115</td>
<td>N/A</td>
<td>CE</td>
<td>130</td>
<td>12 h</td>
<td>12 h</td>
<td>No</td>
<td>Yes</td>
<td>22 h</td>
<td>FR</td>
</tr>
<tr>
<td>Kumar et al21</td>
<td>2</td>
<td>59 (mean)</td>
<td>1M; 1F</td>
<td>TKA</td>
<td>I/L buttocks</td>
<td>N/A</td>
<td>Yes (NA/80 and 110)</td>
<td>N/A</td>
<td>CE</td>
<td>132.5 (mean)</td>
<td>31.5 h (mean)</td>
<td>42.5 h</td>
<td>N/A</td>
<td>Yes (1); no (1)</td>
<td>48 h</td>
<td>FR (1); MD (1)</td>
</tr>
<tr>
<td>Lonner et al22</td>
<td>1</td>
<td>N/A</td>
<td>NA</td>
<td>B/L, Rev. TKA</td>
<td>Calf</td>
<td>N/A</td>
<td>Yes (NA/64)</td>
<td>N/A</td>
<td>CE</td>
<td>N/A</td>
<td>48 h</td>
<td>72 h</td>
<td>N/A</td>
<td>N/A</td>
<td>72 h</td>
<td>SO</td>
</tr>
<tr>
<td>Boon et al23</td>
<td>1</td>
<td>62</td>
<td>M</td>
<td>TKA</td>
<td>Thigh</td>
<td>Measured</td>
<td>Yes (350/68)</td>
<td>Yes</td>
<td>IM piritramide</td>
<td>63</td>
<td>N/A</td>
<td>N/A</td>
<td>Yes</td>
<td>No</td>
<td>N/A</td>
<td>FR</td>
</tr>
<tr>
<td>Vegari et al16</td>
<td>6</td>
<td>67 (mean)</td>
<td>1 M; 5 F</td>
<td>TKA (5); B/L TKA (1)</td>
<td>Calf</td>
<td>Measured</td>
<td>Yes (350/1325/1); X01 (1); 250 (173) (mean)</td>
<td>Yes</td>
<td>(4); no (2)</td>
<td>CE (3); NA (3)</td>
<td>104.34 (mean)</td>
<td>N/A</td>
<td>25 h (mean)</td>
<td>IV (5)</td>
<td>29.16 h (mean)</td>
<td>FR (1); MD (2); WC (2); AMP (1)</td>
</tr>
</tbody>
</table>

Our study | 1 | 67 | M | TKA | Calf | N/A | Yes (300/89) | Yes | Oral opioids | 89 | N/A | 48 h | Yes | No | 50 h | FR |

Abbreviations: AMP, amputation; B/L, bilateral; CE, continuous epidural; CS, compartment syndrome; CT, conservative treatment; F, female; FR, full recovery; h, hours; I/L, ipsilateral; ICP, intra-compartmental pressure; IM, intramuscular; M, male; MD, motor deficit; Min, minutes; N/A, not available; PCA, patient-controlled analgesia; Rev., revision; SD, sensory deficit; SMD, sensory and motor deficit; TKA, primary total knee arthroplasty; UKA, unicompartmental arthroplasty; WC, wound complications.
patients and in rare, clinically inconclusive scenarios and
where regional anesthesia is used. Although critical pressure
at which decompression is required remains controversial, 6
this measurement results in earlier decompression and less
dysfunction. 4 Fasciotomy is recommended when compart-
ment pressure exceeds 30 to 35 mm Hg. 1

A lot of factors are relevant in delaying early diagnosis of
compartment syndrome after a TKA. Epidural anesthesia
use can cause compartment syndrome. An absolute upper limit of safety of
3 hours and pressure for the thigh to be double the systolic
pressure exceeds 30 to 35 mm Hg. 1

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