CASE REPORT

Toxic shock syndrome post open reduction and Kirschner wire fixation of a humeral lateral condyle fracture

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SUMMARY

Use of Kirschner wires (K-wires) is the most common method of fracture stabilisation in lateral condyle fracture fixation in children. We report a case of toxic shock syndrome (TSS) following an open reduction and internal fixation using K-wires for a humeral lateral condyle fracture in a 5-year-old girl. TSS is a toxin-mediated multisystem illness. It typically presents with shock and it is most often attributed to toxin-producing strains of *Staphylococcus aureus* and *Streptococcus pyogenes*. It can lead to multiorgan failure and, ultimately, death. It is important to be aware of TSS, as it can present within any setting. Patients often have non-specific symptoms and their condition can worsen rapidly. TSS postorthopaedic surgery is rare; however, due to the serious nature of this disease, it is important to promptly recognise and diagnose TSS, and to ensure appropriate treatment is started without delay.

BACKGROUND

Lateral condyle fractures are common injuries in children and account for 15–20% of paediatric elbow fractures.¹ Displaced fractures often require open reduction and internal fixation. Use of Kirschner wires (K-wires) is the most common method of fracture stabilisation in lateral condyle fracture fixation in children.² Complications of K-wire usage include failure of fixation, wire breakage, infection and migration.³

Toxic shock syndrome (TSS) is a toxin-mediated multisystem illness. It typically presents with shock, and it is most often attributed to toxin-producing strains of *Staphylococcus aureus* and *Streptococcus pyogenes*. Patients present with non-specific coryzal symptoms. This is often accompanied by hypovolaemia. If there is a focus of infection, it is often superficial, such as a wound, burn or an embedded foreign body.⁴ TSS has potentially serious consequences. It can lead to multiorgan failure and, ultimately, death. We report a case of TSS following an open reduction and internal fixation using K-wires for a humeral lateral condyle fracture in a 5-year-old girl.

CASE PRESENTATION

A 5-year-old fit and healthy girl presented to fracture clinic with a lateral condyle fracture of her left humerus after falling from a zip wire. Her immunisations were all up to date. On examination, her elbow was moderately swollen. She was tender over her lateral condyle. She had reduced range of movement

of her elbow due to pain. She had no distal neurovascular deficit. Her radiographs confirmed a fracture of her left lateral condyle (figure 1). She was treated with an open reduction and K-wiring of her lateral condyle fracture under general anaesthesia. She had a dose of intravenous cefuroxime at induction and procedure was carried out under tourniquet control.

An anterolateral approach was used for open reduction. The fracture was reduced under direct vision and secured using two 2.0 mm K-wires (figure 2). The K-wires were left unburied. Closure was carried out in layers with 2.0 Vicryl to fat and 3.0 Monocryl to skin. The patient's wound was infiltrated with 0.25% chirocaine. A Mepore dressing was placed over the wound and alcohol-soaked gauze applied around the pin sites. The patient was placed in an above elbow backslab. She was prescribed two further doses of intravenous cefuroxime. She was seen in fracture clinic 1 week postoperatively and there were no issues at that time. Her plaster and dressings were changed. Her wounds were healthy. There was no sign of a rash and she was systemically well.

She presented 2 weeks after her operation to the emergency department with a 2-day history of diarrhoea and vomiting. She was feverish and had a non-itchy rash that started on her chest and spread to all four limbs. Her parents reported that she had increasing pain in her left elbow over the course of 2–3 days and reduced movements.

On examination, the patient was haemodynamically unstable with a blood pressure of 77/39 mm Hg and a heart rate of 146 bpm. Her respiratory rate was 24 breaths/min and she was saturating at 96% on room air. On arrival, her temperature was 39°C. She had a generalised blanching macular rash. Her left elbow had an erythematous macular rash around the K-wires and the incision. She had a serous discharge around the incision site and pain on flexion of her elbow. There was no distal neurovascular deficit and no lymphadenopathy. No other obvious focal signs of infection were identified. Her blood tests showed C reactive protein 343.2 mg/L and white cell count $14.92 \times 10^9/L$ on admission. She was resuscitated in the emergency department; however, her hypotension persisted despite vigorous fluid resuscitation and she was transferred to the paediatric high-dependency unit. She required inotropic support and was started on intravenous cefotaxime for sepsis.

She was taken to theatres for removal of both K-wires and washout of her left elbow. Her pin

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Figure 1 Initial radiographs showing a lateral condyle fracture of left distal humerus.

sites were erythematous and indurated. She had pus in her wound, which tracked to the pin sites. The infected skin edges were debrided and thoroughly washed out, and the wound was left open. Samples were sent to microbiology. Postoperatively, intravenous clindamycin and teicoplanin were added to her antibiotic regimen.

INVESTIGATIONS

Two sets of blood cultures sent on the patient's admission were negative. A throat swab showed upper respiratory tract flora. Swabs from the pin sites grew *S. aureus*. A diagnosis of staphylococcal TSS was confirmed by bacteriological report. Samples sent for bacteriology and serology tested positive for staphylococcal enterotoxin A, G, I, and TSS toxin 1 (TSST-1). The patient was treated with intravenous flucloxacillin as per sensitivities shown from her cultures. Three days postadmission, she was weaned off inotropic support. Inflammatory markers continued to improve with antibiotic treatment.

OUTCOME AND FOLLOW-UP

The patient's wound was explored 3 days post initial debridement. It remained clean but was left open to heal by secondary intention. The elbow was screened under image intensifier. There was no movement at the fracture site. An above elbow backslab was applied. She was discharged on oral antibiotics. Her fracture had united and she remained well at the last follow-up (figure 3).

DISCUSSION

TSS is an acute febrile, multiorgan, toxin-mediated illness.⁴ It was first described by Todd *et al*,³ and most cases are related to menses and tampon use.⁶ It is specifically caused by toxin-producing strains of *S. aureus* and *Streptococcus pyogenes*. The pathogenesis of TSS is the release of bacterial toxins, which act as superantigens, triggering an excessive immune response. It is potentially fatal and patients often present with shock.

Figure 2 Postoperative radiographs showing K-wire fixation of lateral condyle fracture.

Figure 3 Radiographs showing union of lateral condyle fracture.

Mortality rate is higher than meningococcal septicaemia; however, there is not an equal amount of awareness for TSS. There is new evidence that non-menstrual TSS may be more prevalent than menstrual-related TSS. Non-menstrual TSS may result from any primary staphylococcal infection and from colonisation of *S. aureus*, with the ability to produce toxins. TSS should be considered in all patients presenting with shock and positive cultures for *S. aureus*.⁴

Clinical features of TSS include a progressive illness with high fever and rapid-onset hypotension leading to multiorgan failure. Patients often present with fever, sore throat, gastrointestinal symptoms, myalgia, headache, malaise, diffuse rash, confusion, agitation, adult respiratory distress syndrome, disseminated intravascular coagulation and renal dysfunction.^{4 7} Only a small number of cases of TSS have been reported in the orthopaedic literature.⁶⁻⁹ Only a single case of TSS was reported in a study looking at the incidence of pin site infections in paediatric orthopaedic surgery over 17 years.⁸

A case of TSS has been described in a 14-year-old child post-percutaneous K-wiring of a closed metaphyseal fracture of the proximal humerus.⁶ The patient presented 2 weeks postsurgery with fever and shock. She had a diffuse macular papular rash. Interestingly, the pin sites did not appear to be clinically infected, but her shoulder was tender and painful on movement. It is unclear from the report whether the K-wires were buried or unburied. She was resuscitated and started on antibiotics. The K-wires were removed and the wounds were cleaned. The fracture was managed non-operatively after K-wire removal. She made a full recovery from TSS and had good functional recovery of her humeral fracture. Other cases have been described, by Herold *et al*,⁹ following open fixation for slipped upper femoral epiphysis in children.

TSS also occurs in adult orthopaedics. A case of TSS was reported in a 23-year-old woman with a distal humeral fracture.⁷ She was initially treated with skeletal traction for 11 days followed by definitive surgery with six K-wires and a tension band wire. All the wires were buried. She presented with symptoms 4 days after definitive surgery. Although she had symptoms of infection, she did not have any signs of wound infection. She also presented with high fever and a diffuse macular erythrodermatous rash. Her symptoms worsened and she was transferred to intensive care where she was intubated and ventilated. She developed disseminated intravascular coagulation from her sepsis. She was treated with antibiotics and her condition gradually improved. Her initial blood cultures were negative. Her diagnosis was eventually confirmed with a positive swab of the wound growing methicillin-resistant *S. aureus*. A wound debridement was carried out and pus was draining around the insertion site of the initial traction wire. The wound was thoroughly washed out and irrigation tubes were left in site to

perform continuous irrigation. Samples from the operation tested positive for TSST-1 and staphylococcal enterotoxin C. In this case, the wires were not removed by the authors as they wanted to preserve the alignment of the elbow joint. Other cases of TSS have been described in adults who had ligament repairs of the knee and lumbar laminectomy.^{10 11}

Removal of foreign body (wires, screws, plates) is an important part of the management of TSS. We removed the wires in our case and doing so in other cases also worked well.^{6 9} Removal of the source of infection is also a well-known principle in management of sepsis. Herold *et al* managed both their cases differently. The first case they treated had removal of metalwork as the patient's symptoms were not improving despite having washouts and medical management. The second case had the metalwork left in situ as the patient was responding to medical management. However, the authors reported a recurrence of TSS in the patient after removal of metalwork electively.

In our case, our wires were unburied. K-wires are commonly used in paediatric orthopaedics and smooth wires can predispose patients to infection due to their percutaneous placement through the skin. K-wire infections have been reported to be between 0.46% and 21%.⁸ Tosti *et al*⁸ looked at 1583 K-wires in 884 patients and reported only 12 K-wire infections. Of these, only one was diagnosed with TSS. All the K-wires were unburied in their study. One study looking at buried as well as

unburied K-wires in lateral condyle fractures found a higher rate of infection in the buried K-wire group.² It is difficult to say whether burying or not burying the K-wires has any impact on the development of infection or more specifically the development of TSS, but it should be considered.

It is important to be aware of TSS, as it can present within any setting. Patients often have non-specific symptoms and their condition can worsen rapidly. Their initial blood cultures are often negative and it is specifically the cultures from the pin sites or wound that provide definitive diagnosis. TSS postorthopaedic surgery is rare, however, due to the serious nature of this disease, it is important to promptly recognise and diagnose TSS and to ensure appropriate treatment is started without delay. The wound itself may not look infected, but we must have a high level of caution when dealing with a postoperative child presenting with sepsis. We would recommend prompt treatment consisting of removal of metalwork during the initial debridement and washout along with appropriate antibiotics in consultation with the microbiologist.

Contributors YC wrote the manuscript. VS edited the manuscript. NG was the responsible consultant and edited the manuscript.

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Learning points

- Toxic shock syndrome (TSS) should be in the differential of a postoperative child presenting with sepsis. Patients often have non-specific symptoms and their condition can worsen rapidly.
- In TSS, the initial blood cultures are often negative and it is specifically the cultures from the pin sites or wound that provide definitive diagnosis.
- TSS postorthopaedic surgery is rare, however, due to the serious nature of this disease, it is important to promptly recognise and diagnose TSS, and to ensure appropriate treatment is started without delay.
- Prompt treatment consists of removal of metalwork, washout and debridement of the wound, and appropriate antibiotics, as guided by the microbiologist.

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