Orthopaedic Management of a Multiply Injured Child in Developing Countries: Relevance of Damage Control Surgery. A Case Report and Literature Review

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Abstract

The optimal treatment of major fractures in children with blunt multiple injuries continues to be discussed. The authors report the case of a 12 year old girl with multiple injuries after a traffic road accident. Long bone fractures benefited from an early definitive stabilization after initial resuscitation within the first 24 hours. No meaningful complication occurred. The fracture patterns are presented, diagnosis pitfalls outlined, and the surgical management in our context discussed according to the principles of damage control surgery.

Key words: Child; damage control orthopedic; developing countries; polytrauma

Introduction

The subject of polytrauma is one that will interest most trauma surgeons as the principles of fracture management continue to be of crucial importance[1,2]. Many orthopedic patients who have sustained multiple injuries benefit from the early total care of major bone fractures.

The impact of early total care on the immune response that occurs in polytraumatized patients, in addition to that caused by the primary insult has been clearly demonstrated. Damage control orthopedics (DCO) has evolved as a new approach to minimize this impact[1,3]. We present a case of polytrauma in a child to highlight the diagnosis pitfalls, the peculiarity of lesions encountered, and to discuss the orthopedic management with special attention to the concept of DCO in our context.

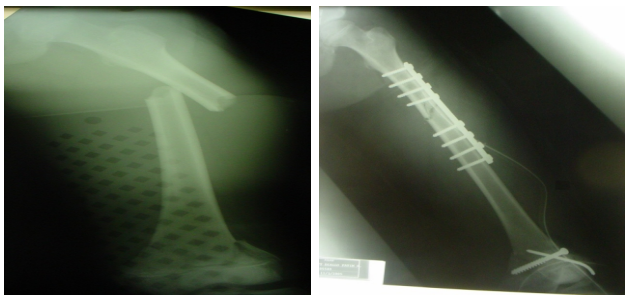
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Case report

A 12-year-old girl was admitted through accident and emergency department to the orthopedic unit of a private clinic with polytrauma following a traffic road accident where she was a passenger in a car that had collided with another. She was transported to the clinic by ambulance soon after the injury. She lost consciousness for a few minutes but regained it fully. On initial examination, the patient was fully conscious but hemodynamically unstable. The injury severity score was 53.

After resuscitation in the intensive care unit, both clinical and radiological investigations

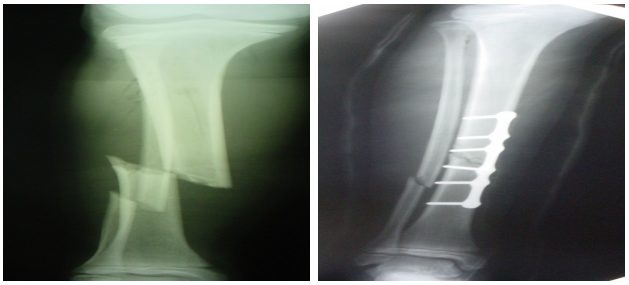
Fig. 1: Lipsilateral fractures of the shaft and Salter-Harris type II of the distal end of the left femur



a) Perspective X-ray b) Postoperative X-ray

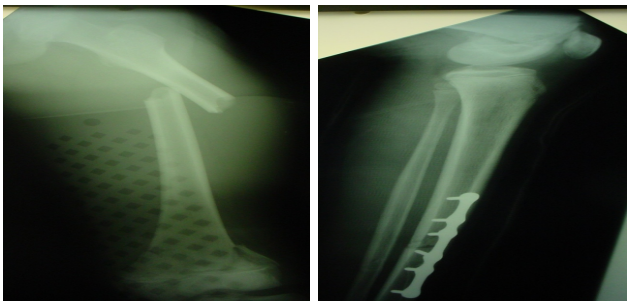
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Fig. 2: Shaft fracture of both tibia and fibula of the right leg.



a) Preoperative X-ray b) Postoperative X-ray

Fig. 3: Salter-Harris type II fracture of the distal end of the right femur



a) Preoperative X-ray b) Postoperative X-ray

revealed maxillofacial fractures, a closed fracture of the proximal third of the left femoral shaft in combination with an ipsilateral closed Salter-Harris type II fracture of the distal end of the femur (Figure 1a), and an open Gustilo type I fracture of both bones of the right leg (Figure 2a). There was no injury of the chest or of the abdomen.

Besides the maxillofacial injury, fractures of long bones were managed operatively in emergency under general anesthesia once her hemodynamic status was deemed stable. Femoral diaphyseal fracture was opened and plated (Figure 1b).

Distal femoral fracture was treated by closed reduction and percutaneous screw and pin fixation (Figure 1b). Open tibial fracture benefited from wound debridement and internal fixation with plate (Figure 2b). Both lower limbs were immobilized with two above knee plaster casts. Postoperative radiographs of the right knee showed a Salter-Harris type II fracture of the distal end of the femur (Figure 3a) that was misdiagnosed at admission. Surgical treatment for this misdiagnosed fracture was performed seven days after the injury. Attempt at closed reduction had failed. Therefore, open reduction and internal fixation with K-wires were undertaken (Figure 3b). Maxillofacial injury was managed surgically. No complication was encountered postoperatively. She was discharged from hospital three weeks after the injury.

Discussion

Main advantages of early total fracture stabilization in multiply injured patients are reduction of pain, early mobilization, and the associated reduction in thromboembolic complications. However patients with very high injury severity scores who benefit from this procedure are considered to be at high risk of deterioration after extensive surgery. Even with excellent rescue conditions, an unacceptably high number of systemic complications is observed3. More and more, multiple long bone fractures in the setting of polytrauma are managed according to the principles of DCO[1]. Damage control focuses on control of hemorrhage, management of soft-tissue injury, and achievement of provisional fracture stability, while avoiding additional insults to the patient. Thus, DCO appears to be an adequate alternative for patients at high risk of developing posttraumatic systemic complications such as adult respiratory distress syndrome and multiple organ failure. Minimally invasive surgical implants such as external fixator are used initially[1,3].

This method affords a rapid tool of gaining fracture stability, causes negligible blood loss, and postpones the additional biological adverse effects caused by prolonged surgical procedures. Surgeons treating pediatric trauma need to be familiar with its use.

Debates concern mainly the femur. Indeed, the femur is a special entity in the treatment of patient with multiple trauma, as this bone represents the most frequently injured long bone[4]. Although children are anatomically and physiologically different from adults in many respects, the principles of this concept are the same in both

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groups[5]. The consensus of opinion remains that stabilization of long bone fractures should be undertaken as soon as the child's condition allows and that unnecessary delay is detrimental[6].

After assessment and resuscitation definitive or at least temporarily stable fixation of closed fractures in the primary period (i.e. 1 to 72 hours after the injury) is recommended[2].

In our patient, a timely subsequent definitive stabilization of long bones fractures was carried out after an early appropriate resuscitation. Patient's hemodynamic status was deemed stable after initial resuscitation and intraoperatively. The patterns of fracture were favorable to an immediate definite stabilization and the surgical implants available allowed us to perform this early total care. However, she was quite fortunate to have sustained no complications after this surgical procedure performed in one step considering the severity of the initial trauma and prolonged anesthesia. Given the unstable hemodynamic condition, DCO performed in three steps could be an alternative to the early total care pathway[7,8]. But is this new concept in the management of the multiply injured patient indicated in our patient? External fixator available in our context is contraindicated by the ipsilateral distal femoral fracture. A conventional femoral plate that offers excellent control of proximal shaft fracture which can be difficult to manage with other surgical methods was therefore used. This device allows the ipsilateral distal femoral fracture to be fixed concurrently. Plate osteosynthesis has also been shown to be successful in treating femoral fractures in children who have multiple injuries[9-10].

The fact that external fixator is temporary in the first stage of DCO approach[11] gives rise to the problem of its replacement after the second stage involving resuscitation of patients and optimization of their condition.

In the third stage consisting of definitive fracture fixation, surgical options available in patients aged 12 years are twofold, namely the elastic stable intramedullary pinning (ESIP) and plate osteosynthesis. Arguments in favor of plating technique have been already discussed. Availability of pins in any operating room in developing countries makes the technique of EISP useful in the context of a multiply injured child. Metaphyseal fracture as evidenced by our case is a contra-indication to this procedure which simplifies the nursing care. In our opinion, EISP is a more demanding technique than the plate osteosynthesis, and it requires a specially trained surgical team. Open fractures should be treated according to the same principles as those practised in the adult population[6].

Open tibial fracture had been treated in the same manner as if it had occurred as isolated injury. Our preferred surgical method while treating tibial fracture in children is by plate technique as it works well for the majority of tibial fractures. Moreover, weight-bearing cannot be considered in our patient whose both lower limbs are involved until fracture healing. With relatively quick application of widely available and familiar equipment, the transcutaneous fixation technique supplemented with a cast[12] could be an attractive alternative to external fixation in most open tibial fractures in children in our environment. Distal femoral fractures since they were displaced and had occurred in the event of polytrauma were managed operatively[13,14]. Misdiagnosing a fracture about the knee in our patient lends further weight to the old axiom stressing the examination of joint above and below a shaft fracture. Points making this report unusual are twofold. Firstly, the occurrence of a bilateral symmetric distal femoral physeal fracture is uncommon.

Secondly, the location of fractures on both lower limbs is akin to that in the bucket-handle type fracture commonly described in pelvic disruptions where the anterior fracture is on the opposite side to the posterior lesion. We would stress the importance of a careful physical evaluation and radiological examination of both knees following trauma to the contralateral femoral and tibial shafts as a physeal fracture can be easily missed.

This case report outlines the importance of a

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careful examination of all extremities and axial areas in this setting of a patient sustaining multiple trauma. The priorities in resuscitation of a multiply injured child are the same as those of an adult. In other words lessons learnt from damage control surgery in adult are transferable to pediatric population. Definitive fracture stabilization was performed in our patient after an early appropriate resuscitation uneventfully. However in our environment, the principles of damage control orthopedic surgery can be applied to children who have sustained multiple fractures of long bones provided there remains no local contraindication and equipment and experience are available.

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