

# A study of vascular injuries in pediatric supracondylar humeral fractures

Ritabh Kumar, Vivek Trikha and Rajesh Malhotra

Department of Orthopaedics, All India Institute of Medical Sciences, New Delhi, India

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## ABSTRACT

194 children with supracondylar fractures of the humerus were reviewed. Of the 49 children with Gartland grade III displacement, signs of vascular compromise were clinically suspected in 5 cases. Immediate open reduction, internal fixation and exploration were performed. Four children had a satisfactory outcome. One child required amputation. A careful clinical evaluation for vascular injury and an aggressive surgical approach is suggested, when indicated.

**Key words:** humerus, supracondylar fracture, vascular insult, clinical evaluation, surgery

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## INTRODUCTION

Supracondylar fracture of the humerus is the commonest upper extremity fracture in children associated with complications.<sup>4</sup> The overall incidence of vascular complications is reported to be upto 12%.<sup>9</sup> It is imperative that the early signs of vascular compromise be looked for and treated aggressively to prevent severe disabling sequels. The purpose of this study was to determine the incidence and outcome of supracondylar fractures of the humerus with signs of ischaemia

## MATERIALS AND METHODS

From January 1996 to June 1999, 194 children with supracondylar fractures of humerus were treated. The age, sex, mechanism of injury, duration from the time of injury, type of injury and neurovascular status were recorded. Signs of vascular compromise — weak or absent radial pulse, decreased or absent capillary refill, cold extremities, failure to record arterial oxygen saturation and pain on passive stretch of the wrist or fingers, were carefully looked for.

In cases with suspected vascular compromise, primary open reduction, internal fixation and exploration of the neurovascular structures were performed by the anteromedial approach. A vascular surgery consultation was obtained in all these cases. Prophylactic antibiotics, Ceftriaxone (50 mg/kg) and Gentamycin (1 mg/kg) were administered intravenously 1/2 hour prior to induction and continued for 48 hours after surgery. The fracture was reduced and stabilized with cross Kirschner wires followed by the vascular procedure. Heparin in a bolus dose was administered during the surgery and continued postoperatively for 5 days under control of a coagulation profile.

The desired outcome was a well-reduced fracture in proper alignment with a viable and warm functional extremity. Assessment at final outcome included clinical measurement of elbow range of motion and carrying angle of both elbows using a goniometer. The neurovascular status was noted.

## RESULTS

Of the 194 children with supracondylar fracture of the humerus, 49 patients (25%) had Gartland grade III displacement (Table 1). Signs of vascular compromise were suspected in five of the 49 cases (10%) and all of these were extension type fractures. Treatment decision was based solely on clinical examination.

**Table 1**  
Gartland's classification for extension type supracondylar humerus fracture

Fracture type	Description
I	Non-displaced
II	Minimal to moderately displaced: partially intact posterior cortex
III	Severely displaced: no cortical contact

Two patients had associated preoperative anterior interosseous nerve palsy, and on exploration the brachial artery was found completely lacerated with thrombosis and the median nerve was stretched over the proximal fragment (Table 2). The contused arterial segment was excised and repaired with reverse saphenous vein graft. In the other two cases, the artery was caught in a spike of the proximal fragment. After release, the vessel spasm was relieved with 1% xylocaine spray. A rent in the vessel wall was detected in one case on restoration of the arterial flow that was repaired with 6 'O'prolene. All four patients postoperatively had a palpable radial pulse. The nerve palsy recovered spontaneously within 12 weeks. Extension was restricted in two cases.

One child was referred to our institute with signs of gangrene. Seven days had elapsed from the time of injury and an above-elbow amputation was done in two stages.

## DISCUSSION

Supracondylar fracture of the humerus in children, when associated with vascular compromise, constitutes a true orthopaedic emergency. The swelling associated with this fracture and the difficulty of examining a crying and frightened child may delay early detection of ischaemic signs.<sup>5</sup> This delay can lead to disastrous consequences like Volkmann's contracture, gangrene and even amputation.<sup>7</sup> Ecchymosis in the antecubital fossa, consistent with buttonholing of the brachialis muscle and posterolateral displacement on radiography, points towards the potential of neurovascular injury and demands special attention.<sup>3,10</sup>

The use of arteriography in cases of vascular injury is controversial. Freidman and Jupiter<sup>3</sup> suggested that it could be used to localize and define the nature of a suspected vascular injury. Shaw et al.<sup>8</sup>, however, favoured exploration without proceeding to angiography. Copley et al.<sup>2</sup> showed that no further information is obtained from angiography to help define or locate the vascular injury. The lesion is associated in all instances with the fracture anatomically. In this study, angiography was not performed, because the lesions are readily identifiable on exploration and we believe that it is an avoidable delay. Furthermore, the facility of performing angiography at odd hours is not feasible in most institutes of a developing nation.

**Table 2**  
Clinical details of the patients

SNo	Preop			Perop			Postop	
	Age (yrs)	Sex	Delay (hours)	Displacement	Nerve injury		Range of Motion	Cubitus Varus
1	10	M	2	PM	AIN Palsy	BA tear	10-140	*
2	13	M	2	PM	AIN Palsy	BA tear	15-140	*
3	10	M	3	PL	-	Spasm	0-140	-
4	3	M	2	PM	-	Spasm+rent	0-140	-
5	7	F	168	PL		Amputation		

PM-posteromedial, PL-posterolateral, AIN-anterior interosseous nerve, BA-brachial artery.

\* cannot be commented upon due to extension loss.

By the time the classic five P's (pain, pulselessness, parasthesias, paralysis and pallor) appear, tissue ischaemia is well established and irreversible. However, they may be noted early and can be helpful in guiding the management of vascular injury.<sup>2</sup> The findings on examining the radial pulse are difficult to interpret. The absence of a pulse is not necessarily a danger sign and its presence not a guarantee that ischaemia will be avoided.<sup>1</sup> The entire clinical examination must therefore be carefully considered before deciding about the vascular status of the child's arm. Complete substance tear or penetration of the brachialis is essential for the vessel to be injured. Closed manipulation then cannot be expected to be successful and the return of a palpable pulse does not guarantee that ischemia will be avoided.

Taking into consideration the above criteria, four patients had suspect vascular status and were immediately explored. Fixation of the fragments prior to the vascular procedure is technically simpler, helps stabilize the vascular repair and prevents damage to the anastomosed bypass graft.

Two children required bypass grafts for complete tear of the brachial artery. Both these cases had anterior interosseous nerve (AIN) palsy that recovered within 12 weeks. This experience is similar to that of Garbuz et al.<sup>4</sup> where 60% of patients with absent radial pulse had neurological injury, most commonly to the anterior interosseous nerve.

Arterial spasm has a similar clinical presentation as that of true vascular injury. In the present study two children had arterial spasm, which improved with release of the entrapped artery followed by Xylocaine spray. Wray<sup>11</sup> tried local application of papaverine and pre or intraoperative stellate ganglion block with similar results. On restoration of the arterial flow a rent was detected in one case that was repaired directly. None of the patients developed compartment syndrome or required a forearm fasciotomy. The patient with a seven-day-old injury had signs of wet gangrene on presentation (Fig.1) and required an above elbow amputation.

The temporal relation between injury and treatment is important. Four of the 5 cases presented



**Figure 1** Seven-day-old supracondylar fracture with gas in the soft tissues.

within 6 hours of injury and were immediately operated upon. They had an excellent functional outcome. In the case having only vascular spasm, immediate surgery with exploration did not cause any additional morbidity, with the patient having normal vascular status and normal range of elbow motion postoperatively (Table 2). Ottolenghi<sup>6</sup> reported similar results, with all the cases of Volkmann's ischaemia occurring where exploration was delayed beyond 24 hours after injury. This is convincing evidence that prompt exploration can markedly decrease the incidence of the dreaded vascular complications.

## CONCLUSION

In cases with suspected vascular compromise following supracondylar fracture of the humerus, immediate exploration should be performed. With early stabilization of the fracture and repair of the brachial artery, long-term vascular sequelae can be prevented. Despite advances in technology, clinical examination still remains the most valuable tool for assessing vascular insufficiency.

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