Ultrasound and radiological features of supracondylar humerus fractures in children

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INTRODUCTION: It has been reported that brachial artery injuries occur in 12-15% of supracondylar fractures of the humerus in children. However, the presence of collateral circulation, and few cases require deployment during emergency surgery. The management and evaluation of such a Pink Pulseless Hand (PPH) is still a matter of debate. Preoperative ultrasound （US） evaluation of the vessels and nerves in pediatric supracondylar humerus fractures may be useful in assessing the need for treatment of the vessels. In this study, we report on the X-ray and US features of supracondylar humerus fractures in children.

METHODS:

The subjects were 40 children diagnosed and treated for supracondylar fractures of the humerus at our hospital. The patients were evaluated by X-ray, blood flow, neurological evaluation, and examination for PPH. First, the Wilkins-modified Gartland classification was used in the preoperative X-rays. Next, the preoperative fracture site was evaluated by US. Periosteum, brachialis muscle, blood vessels and blood flow were evaluated. US classification was as follows: US-Type 1: Fracture without rupture of the periosteum. US-Type2: Partial damage to the periosteum. Type3a: Partial damage to the brachialis muscle. US-Type3a-c: Complete injury of the brachialis muscle. US-Type3b: Humerus displaced laterally and in contact with the radial nerve. US-Type3b: humerus displaced laterally and in contact with the radial nerve. US-Type 3c: (Compression), the humerus is in contact with the brachial artery and the blood flow is interrupted. (Return of pulse after reduction). US-Type4:(Kinking), The brachial artery is entrapped at the fracture site. No blood flow despite reduction. The US classification are shown in Figure 1.The Wilkins-modified Gartland classification was compared with the US classification. This study was reviewed and approved by the ethics committee of our institution.

RESULTS SECTION: There were 29 boys and 11 girls. The average age of the patients was 5.4 years (3-11 years). Wilkins-modified Gartland classification by X-ray was Type 1 in 3cases, 10 cases with Type 2A, 4 cases with Type 2B, and 22 cases with Type 3. PPH was present in 6 cases. US classification was US-Type 1 in 3 cases, US-Type2 was 9 cases, US-Type3a was15 cases, US-Type3a-c was 6cases, US-Type3b was 1case, US-Type3c was 2cases, and Type4 was 4cases. All cases of PPH were classified as type 3-c or 4. The Wilkins-modified Gartland classification and the US classification are shown in Figure 2.

DISCUSSION: In pediatric patients with supracondylar fractures of the humerus, two out of six cases of PPH were found to be Kinking on US, and two out of six cases of pulse were improved by reduction. Wilkins-modified Gartland classification Type 3 was observed in 22 cases, which were classified into 5 categories from Type 3a to Type 4 according to the tear of the brachialis muscle, blood vessels and blood flow. Type 3c and Type 4 are indicated for emergency surgery, and Type 3c can be treated by percutaneous insertion of steel wire even in PPH. US-type 4 requires an open exploration.

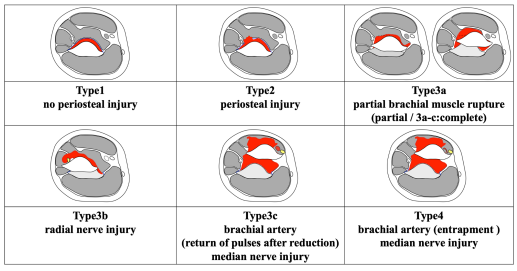
In the Wilkins-modified Gartland classification Type 2A, the anterior periosteum was thought to be damaged. However, the US showed that the periosteum in Type 2A was not completely torn, and most of the periosteum remained intact.

Significance/Clinical Relevance:

US evaluation of supracondylar fractures of the humerus in children helps to determine and decide which cases require emergency surgery.

IMAGES AND TABLES:

Ultrasound classification of supracondylar humerus fractures in children



Wilkins-modified Gartland classification and Ultrasound classification

	type1	type2	type3a	type3a-c	type3b	type3c	type4
1	3						
2A		9	1				
2B			4				
3			10	6	1	2	4