

or thrombosis, prompt arteriography permits proper diagnosis and treatment. Restoration of blood flow may be vital for the proper growth and development of a child's extremity.

### Summary

Peripheral arterial injuries in infants and children occur more frequently than generally recognized. Arterial interruption may lead to ischemia and frank gangrene or fistula and aneurysm formation. Three groups of cases have been presented which illustrate peculiar vascular problems in a pediatric age group. They are:

- (1) Trauma to an extremity, particularly from falls through glass doors and supracondylar fractures;
- (2) Retrograde arteriotomy for diagnostic catheterization;
- (3) Needling of an extremity for injections or diagnostic sampling.

Particular care and attention to details can minimize the complications which can result from these diagnostic and therapeutic procedures. For example, improved technic has reduced the incidence of thrombosis following arteriotomy for cardiac catheterization from 28% to 8%. Several serious complications have been documented in this report. If there is any doubt about arterial injury, intravenous arteriography will usually clarify questionable

clinical manifestations. If there is arterial interruption or thrombosis, exploration and re-establishment of blood flow are of vital importance in young children.

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### DISCUSSION

DR. ROBERT P. KELLY, JR. (Atlanta): This is a familiar problem to the orthopedist, and we believe this injury occurs more often than is recognized. My first encounter with this was not with a child but with the 18-year-old son of a physician who had dislocated his elbow about 18 hours earlier. There was no severance, but there was thrombosis at the bifurcation of the brachial artery. The following morning after excision there was little temperature difference in the boy's hands and good function.

A number of papers have reported good results with children who had complete interruption of the brachial artery in connection with supracondylar fractures. This is attributed to the rich collateral system around the elbow. We observed these children and studied their ability to extend their fingers voluntarily. If they protested of pain when an attempt was made to extend the fingers passively, we knew something had to be done. Orthopedically, many of them will do well without repair, but certainly some will need the intervention of vascular surgery.

DR. MARK M. RAVITCH (Chicago): This is a particularly important paper because of its demonstration of the substantial hazards of our advanced diagnostic technic. We have come to adopt these technics rather casually sometimes and they are not always placed in the hands of experienced vascular surgeons.

I point out that I am absolutely confident that none of these injuries were produced by Dr. Haller. As a matter of fact, he did not see most of these patients until late.

There are two other dreadful circumstances in which unnecessary injuries occur to children in the course of diagnostic maneuvers. One is the simple attempt to obtain a blood sample from the femoral vein of a newborn infant or tiny baby.

This frequently happens in a depleted child who has had diarrhea, who has hemoconcentration and may have sepsis, and therefore have peripheral vasoconstriction, lowered cardiac output, slowed circulation. Neither the artery nor the vein is very large, they are not very far apart, and it is not rare for thrombosis and loss of limb to result from this circumstance; and it is a dreadful situation.

The second circumstance (and again of interest to the orthopedist) results from the technic commonly adopted by pediatricians of going in perpendicularly to the thigh for femoral arterial puncture, and the instruction is: "Proceed until you hit bone, and draw back."

The result has been (as we have seen, perhaps, over the last 5 or 6 years in half a dozen cases) septic arthritis of the hip, with resorption and destruction of the head, again because these are all sick infants, very often with sepsis, and the skin is never as clean as it should be. Perhaps this has something to do with the understanding of sterile technic.

There is a feeling that just putting a needle through the skin does not require any very great type of preparation; whereas in fact the care which is taken as far as asepsis is concerned should be just as great as that which was discussed by Dr. Altmeier and Dr. Deryl Hart. If we could only persuade our associates to remember about Lister, I think a great deal of harm would be prevented.

DR. OSCAR P. HAMPTON, JR. (St. Louis): I support the concept advanced by Dr. Haller which

is in all orthopedic training programs now regarding supracondylar fractures of the humerus. That is, if the circulation does not return with a palpable pulse immediately after reduction, to forget "spasm," and to consider that the artery has been interrupted.

I would like to point out to Dr. Haller that orthopedic surgeons learned about spasm from the general surgical literature.

CHAIRMAN WILSON: It should also be emphasized that when we are talking about these concurrent orthopedic and general surgical accidents, that this same thing is occurring not infrequently in the lower extremities. Our chief resident used a vein to repair the popliteal artery over a period of approximately 1 month in two young football players who suffered fractures of the lower femur with disruption of the popliteal artery.

DR. J. ALEX HALLER, JR. (Closing): We would like to thank all of the discussants for emphasizing other aspects of this problem.

I was delighted to hear from Dr. Kelly and Dr. Hampton that arterial injuries are a worry to orthopedic surgeons and that brachial artery injuries are especially troublesome ones.

We have found that in a young child it may be extremely difficult to use altered function as a sign of muscle ischemia. As many of you know, the practice of pediatrics is not dissimilar to veterinary medicine, and some children are very difficult to evaluate by the usual symptoms and signs. It was for this reason that we became interested in a more objective test which might be helpful in evaluating arterial injuries in supracondylar fractures.

Dr. Wilson, in regard to lower extremity fractures, we have certainly seen these injuries, but did not include them in our discussion because they occur primarily in older children and young adults. I think we have all seen fractures of the tibial plateau with popliteal arterial injuries.

Finally, I appreciate Dr. Ravitch's comments, because he has emphasized that there are complications associated with fairly straightforward, simple diagnostic procedures. We must all be aware of these if we are going to carry out a large number of these diagnostic studies.