This is an important review of lower limb ischemia complications treated by a high volume paediatric cardiothoracic centre, which accurately reflects real world experience in acute largely iatrogenic arterial injuries. The particular focus of this single centre review is on complications arising from catheterization of the femoral artery in these critically ill children. In most paediatric intensive care units pre-term, neonates and children will require therapeutic and monitoring arterial and venous cannulation; this can be achieved using umbilical arterial and venous access in the pre-term and neonates, but more commonly femoral arterial and venous brachial access in infants and older children.

Acute ischaemia in the vast majority of cases relates to catheter induced injury. Most commonly these are disruption of the
endothelium leading to thrombosis, intimal flaps and dissection. The occlusive effect is further compounded by the presence of the catheter, which in smaller children further compromises flow. Arterial sheaths of course can have a similar partial or complete occlusive effects depending on relative dimensions. The logical and most important first step in management of these children must therefore be immediate removal of the catheter or sheath. In the majority of these children removal of the catheter or sheath is possible, but in a minority of typically very ill children where no other access site is feasible and vascular access essential, a difficult decision regarding life over limb has to be made.

A secondary pathology, which must be considered in these children, is hypercoagulability. This clinical scenario must be considered particularly in ill neonates unable to feed and who become clinically dehydrated. A further important clinical factor for raised haematocrit and risk of thrombosis, is the polycythaemia often present in children with Down’s syndrome aggravated by dehydration. Because of their associated septal defects, these children will present frequently to paediatric cardiothoracic surgeons.

It therefore follows that in parallel to prompt removal of the catheter or sheath, paediatric haematological assessment is vitally important. This is both to diagnose and correct polycythaemia but also to assess for and treat the underlying abnormalities of coagulation often present in the pre-term and term infants. Typically the fibrinolytic system is activated (raised tPA and PAI 1 levels) which in thrombotic and hemorrhagic situations may predispose to disseminated intravascular coagulopathy and hypo-fibrinogenemia. Expert paediatric haematological input is vitally important when thrombosis is being considered.

After prompt removal of the catheter or sheath, immediate anticoagulation with fractionated heparin is of vital importance as is clearly documented in the outcomes of this group’s experience. Most commonly this combined treatment will result in a marked improvement of arterial perfusion in the affected limb often as rapidly as within 2 to 4 hours. Over 80% of children will have significant improvement simply with removal of the offending catheter or sheath and prompt heparinisation. Fractionated heparin can be used in therapeutic doses, but unfractionated heparin has the added advantage of a very short half-life should urgent surgical intervention be required.

In the minority of patients where Heparin administration has not resulted in significant improvement of lower limb ischaemia, intra-arterial or systemic thrombolysis usually with rtPA should be considered. Delivered in a multi-disciplinary scenario of paediatric intensive care with input from haematology and meticulous vascular monitoring, thrombolysis in infants and children is documented to be effective and safe. In children who have undergone major cardiothoracic surgery, clearly thrombolytic therapy carries increased risk and once again, the difficult decision between preservation of life over limb will have to be made.

Careful clinical assessment is essential in management of these children. Effective care protocols are essential, emphasizing the need to assess rigorously for critical lower limb ischaemia and its signs, often subtle in pre-term and neonate children.

Monitoring of the status of arterial perfusion is essential in the first treatment phase after removal of the catheter and starting intravenous heparin. In the minority of children where there is no improvement after 6 hours with on-going critical ischaemia, thrombolysis may be used; once again careful clinical monitoring with effective care protocols are of vital importance. In the very small minority where removal of the catheter, heparinisation and thrombolysis have not significantly improved perfusion, and where the affected limb is judged to remain potentially viable, then surgical intervention should be considered. Balloon embolectomy is infrequently successful but open thrombectomy with “milking” thrombus out of the artery can be. Support from surgeons with micro-vascular skills (usually plastic surgeons) is useful in this fortunately rare scenario.

Finally, duplex assessment is a diagnostic and monitoring tool of excellence in these children. Not infrequently, there is significantly improved arterial perfusion by collateral flow but no return of pulses, leading to a common clinical dilemma with regard to further intervention. Where there is evidence of significant clinical and duplex flow improvement, absent pulses will be accepted; however the possibility of adverse late ischaemic effects on limb growth should be highlighted in the future care plans of these children. In deficient limb growth, most frequently the chronic occlusion involves the external iliac artery. Late arterial reconstruction using autologous or prosthetic bypass in a child rather than an infant becomes technically more successful.

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