

Iatrogenic Arterial Injuries in Neonates Secondary To Venepuncture – Presentation Management and Outcome

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ABSTRACT

Objective: To share collective operative experience in management of iatrogenic arterial injuries secondary to venepuncture in terms of demographics, clinical presentation, treatment and outcome; along with review of current relevant literature.

Materials & Methods: A prospective review of database at tertiary care military hospitals of all iatrogenic paediatric arterial injuries from March 2006 to March 2016 was performed. The data was analysed in terms of demographics, presentation, treatment and outcome.

Results: A total of 28 patients were referred from various hospitals with iatrogenic arterial injuries during venepuncture. The mean age was $13 \pm SD 4$ days and weight was $2.6 \pm SD 0.8$ Kgs. Of the 28; 71.4% (n=20) had acute limb ischemia (ALI), 21.4% (n=6) dry gangrene and 7.1% (n=2) had pseudo-aneurysm. All patients with ALI underwent thrombo-embolectomy, amputations were done for dry gangrene and pseudo-aneurysms were resected with reverse venous bypass grafting. Mean follow up of 12 months was uneventful.

Conclusion: Iatrogenic neonatal arterial injuries secondary to venepuncture are rare but may cause limb and even life threatening complications. Early diagnosis and surgical intervention using microsurgical techniques is limb saving and prevents long term complications.

Key words: Arterial, iatrogenic, injury, neonates, venepuncture.

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INTRODUCTION

The term iatrogenic derived from Greek words “iatros” and “gennan” which means “physician” and “to produce” respectively. Thus the term iatrogenic refers to consequences of a medical action when a high risk procedure is performed in spite of having a low risk option. Paediatric vascular injuries are rare. The reported incidence of paediatric injuries treated in major trauma centre in US is five per year¹. Iatrogenic vascular injuries constitutes approximately 33% of such vascular injuries². 80% of the iatrogenic arterial injuries occur in neonates especially with low birth weight³. The common causes of iatrogenic arterial injuries includes catheterization, venepuncture and arterial blood sampling. The arterial puncture is followed by vascular spasm and occlusion if vessel due to subsequent thrombosis^{4,5}. The incidence of such thrombotic vascular

injuries range from 1-25% in neonates^{4,5}. The presenting symptoms are variable depending upon the time of presentation varying from features of acute limb ischemia to long term complications such as arteriovenous fistulas, pseudo-aneurysms and limb growth retardation⁶.

Such injuries often go unnoticed or present late to vascular surgeons in our setup. This study was conducted to document experience of managing such patients in terms of their clinical presentation, treatment offered and outcome.

MATERIALS & METHODS

The data of all the patients with iatrogenic vascular injuries managed from February 2006 to March 2016 at various “Combined Military Hospitals” namely Lahore, Gujranwala, Kharian, Quetta and Peshawar were analysed. The records were reviewed for demography, surgical intervention and outcome.

After initial evaluation and assessment, all patients received an intravenous bolus dose of 50 units per kilogram of unfractionated heparin in neonates and 75 units per kilogram in infants followed by a continuous

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infusion of heparin at rate of 25 units per kilogram per hour.

Patients were operated under General Anesthesia with full heparinization and antibiotic prophylaxis. Retrograde embolectomy if needed was performed using 3 Fr Fogarty Catheter. Per-operatively vessels were flushed with heparinized saline. Postoperatively, heparin infusion in a dose of 25 units per kilogram per hour was continued to maintain the partial thromboplastin time (PTT) two times above its normal limit of 35–42 seconds. Anticoagulation was continued for one week after the surgery. Regular monthly follow up for six months was done.

Data was entered into statistical package for social sciences (SPSS) version 21. The numerical outcome like age and hospital stay was calculated as mean and standard deviation. Gender was recorded as frequency and percentage.

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008. Informed consent was obtained from all patients for being included in the study.

RESULTS

A total of 28 patients were managed during the study period. The mean age was $13 \pm SD 4$ days (range 1–75 days). In terms of weight, mean weight was $2.6 \pm SD 0.8$ Kgs (Range 1.7 – 3.6 Kgs). There were 12 baby boys and 16 baby girls with male to female ratio of 0.75:1 (Table 1).

Table : Baseline demographics and clinical presentation of patients

Baseline characteristics	
No. of patients (n)	28
Male [n (%)]	12 (42.8%)
Female [n (%)]	16 (57.1%)
Mean Weight (in Kgs)	$2.6 \pm SD 0.8$ (Range 1.7 – 3.6).
Mean Age (in days)	$13 \pm SD 4$ (range 1-75)
Clinical presentation	
Acute limb ischemia [n (%)]	20 (71.4%)
Pain [n/20 (%)]	20/20 (100%)
Pallor [n/20 (%)]	15/20 (75%)
Paralysis [n/20 (%)]	8/20 (40%)
Loss of pulse [n/20 (%)]	8/20 (40%)
Dry Gangrene [% (n)]	21.4% (6)
Pseudo-aneurysm [% (n)]	7.1% (n=2)

In terms of presentation, 71.4% (n=20) patients had

acute limb ischemia with no impending tissue loss or gangrene; 21.4% (n=6) had gangrene and 7.1% (n=2) had pseudo-aneurysm. Out of a total of 28 patients; 35.7% (n=10) had injury to the upper limb and 64.2% (n=18) suffered injury to the lower limb. In those who had upper limb injuries, 6 patients had injury to brachial artery and 4 patients had injury to radial artery; while it was femoral artery in all patients with lower limb injury.

The injury was clinically diagnosed in 71.4% (n=20) patients who presented with features of acute limb ischemia. In terms of timing of presentation; 12 presented within 6 hours of venipuncture, 6 presented between 6–12 hours and 2 presented between 12–24 hours after the suspected injury. Dry gangrene was the presenting feature in 21.4% (n=6) patients. Of these; 2 presented within one week and 4 presented within one month of injury. The rest of the 7.1% (n=2) babies presented with pulsatile swelling at the site of venipuncture; one in cubital fossa and other in the inguinal area. Patient with brachial artery pseudo-aneurysm in cubital fossa presented 4 months after the injury while with femoral artery pseudo-aneurysm presented 9 months after the injury.

The diagnosis was clinically evident in all cases, however Duplex scan was done in patients with acute limb ischemia and pseudo-aneurysm to confirm the clinical findings. CT Angiogram was not done in any case.

All patients with acute limb ischemia underwent thrombectomy and retrograde embolectomy. Re exploration was needed only in 2 cases where embolectomy was performed again. No patient required fasciotomy and all had an uneventful recovery. Patients with dry gangrene ended up with amputations. There were 3 below knee, 1 above knee and 2 below elbow amputations. Resection of aneurysm with reverse venous bypass graft was done in two cases of pseudo-aneurysm. All patients had uneventful hospital recovery. Mean hospital stay was $9 \pm SD 1$ day (Range 8–13).

DISCUSSION

Trauma is the leading cause of death in young children of 1 to 14 years age. In such age group, vascular injuries constitute about 3–6% and more than half of them are iatrogenic. Iatrogenic arterial injuries have high prevalence in neonates especially in low birth weight neonates⁷. It is postulated that such injuries constitute 80% of iatrogenic injuries in this age group⁸. The most common causes of iatrogenic arterial injuries are

invasive arterial cannulation, arterial blood sampling and inadvertent arterial puncture during venepuncture³. In our study all 28 neonates sustained inadvertent arterial injury during venepuncture of neighbouring veins for cannulation and blood sampling.

The usual sequence is arterial puncture followed by spasm and thrombotic occlusion. In neonates the vasospasm is intense and thus leads to early thrombosis when compared with adults⁹. We also noted spasm of the artery at the site of injury as well as distal to injury site in 60% (n=12) patients who had acute limb ischemia. It is worth noting that all these patients were those who were diagnosed and treated within 6 hours of the injury. The documented incidence of inadvertent arterial thrombosis in neonates ranges from 1% to 25%^{4,5}. On surgical exploration of our 20 patients who had acute limb ischemia as presenting symptom, we noted intra-arterial thrombosis in 45 % (n=9) cases.

Clinically patient may present with wide array of symptoms including features of acute limb ischemia, gangrene, pulsatile swelling due to pseudo-aneurysm and limb growth retardation; depending upon how much time has passed since the original vascular insult⁶. Acute limb ischemia may presents with classical features of six "Ps"^{10,11}. Presence of pulse is difficult to assess in neonates due to small size vessels and intense vasospasms⁹. Maleux et al found that pulses are present in 25 % of the patients with arterial injuries¹². We found absent pulses clinically in 40%(n=8) cases who had acute limb ischemia, however duplex scan did confirm loss of pulses only on 15% (n=3) cases only, the other 25% had Doppler signal however it was reduced flow when compared to other side.

Historically, operative treatment in neonates has been avoided due to vast array of causes namely smaller vessel size, unavailability of expertise and lack of microvascular instruments. Hence such injuries has been treated conservatively with thrombolytics and anticoagulants. Such conservative treatment results in higher amputation rates and long terms sequels like limb discrepancies and pseudo-aneurysms^{12,13}. In our series 28.5% (n=8) patients presented with complications which include 21.5 % (n=6) with dry gangrene and 7% (n=2) with pseudo-aneurysms. Unfortunately all these patients received conservative treatment only by the attending physician and none was referred in time to vascular surgeon for consultation.

There are three types of iatrogenic vascular injuries^{4,14}. Type 1 is limb and life threatening and should be aggressively approached with immediate surgical

intervention. Type 2 are those in which limb is not threatened and detailed duplex studies are recommended first. Type 3 are suspected vascular injuries and they should also be investigated in detail by duplex and angiogram if required. In our series all 20 patients with acute limb ischemia were in category 1 hence urgent surgical intervention was done. Andraska et al postulated that early surgical intervention not only saves the limb but also prevents long term complications and should be the treatment of choice in limb and life threatening injuries⁴. We also preferred an aggressive surgical approach in all the patients who presented well in time, hence the amputation rate in our patients with acute limb ischemia stood at zero and no long term complication was noted in any of these patient.

CONCLUSION

Inadvertent arterial injuries in neonates are rare. Early diagnosis and aggressive surgical intervention using microsurgical techniques is recommended to prevent limb loss and long term complications. Use of anticoagulants and thrombolytics as sole treatment should be discouraged and such treatment to be continued only while the patient is awaiting urgent referral / transfer to a vascular team.

Conflict of Interest: All authors declare that they have no conflict of interest.

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