



ORIGINAL RESEARCH PAPER

Surgery

PEDIATRIC VASCULAR INJURIES - 6 YEARS ANALYSIS

KEY WORDS: Iatrogenic, polytrauma, ischemic, hemorrhagic, reperfusion.

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ABSTRACT	AIM To analyze the incidence, pattern, and mode of pediatric vascular injuries. To analyze the outcomes of various medical/surgical procedures following Pediatric Vascular injuries
	MATERIALS AND METHODS This is a retrospective cum prospective study. Patients ≤ 15 years of age treated for vascular injuries from January 2009 to March 2015 were analyzed. Patients who presented with ischemic / hemorrhagic complications as a result of iatrogenic and non-iatrogenic trauma were identified and analyzed.
	RESULT Annual incidence of pediatric vascular injuries has been increasing over the years. 75% of pediatric vascular injuries are traumatic and the rest iatrogenic. Traumatic injuries are more common in 11 – 15 years age group. 63.2% of iatrogenic injuries were seen in girls. 87.7% of Traumatic injuries occurred in boys. 60% of injuries were arterial in nature. Upper limb is most commonly involved in traumatic injuries. Supracondylar # of humerus with brachial artery injury was the most common cause of non-iatrogenic vascular injury. There was a 7.9% amputation rate. Mortality rate was 10.5%. Most common cause of death was polytrauma followed by reperfusion injury.
	CONCLUSIONS Significant proportion of the pediatric vascular injuries in children is due to iatrogenic cause, which is largely preventable. Image guided interventions will decrease the incidence of iatrogenic injuries.

INTRODUCTION

In the era of urbanization, road traffic accidents are the major cause of trauma in general and pediatric vascular injuries in particular. Due to the development of high speed vehicles and lack of safety features for children and non-adherence to speed limit and other traffic rules, high velocity injuries are increasing day by day. Children in particular boys due to their adventurous nature are more prone for traumatic vascular injury.

With the improvement of critical care and the interventional procedures such as central venous pressure monitoring, total parenteral nutrition, invasive BP monitoring and minimally invasive procedures for the treatment of congenital cardiac anomalies e.g. PDA closure, the incidence of iatrogenic vascular injuries is on the raise.

Pediatric vascular injuries are unique in that the vessels are thin and have a propensity for spasm. The growth of the child has to be addressed while repairing the vessel. If the vascularity of the limb is compromised this would lead to limb length discrepancy. There is no comprehensive data with respect to pediatric vascular injuries from India

MATERIALS AND METHODS

This is a retrospective cum prospective study.

INCLUSION CRITERIA

Patients ≤ 15 years of age treated for vascular injuries from January 2009 to March 2015 were analyzed. Patients who presented with ischemic / hemorrhagic complications as a result of iatrogenic and non-iatrogenic trauma were identified and analyzed.

EXCLUSION CRITERIA

Patients who presented with traumatic amputations and those who presented with isolated injury to the superficial veins were excluded from the study.

All the patients who presented with traumatic injuries were evaluated by a multidisciplinary team comprising of vascular, orthopedic and plastic surgeons. If necessary, neurosurgeon opinion was also sought. Thorough clinical examination including the pulse status, pulse deficit, blood pressure, presence of open wound and contamination was done. Hand held Doppler examination was done, ankle brachial index was calculated, presence of thump noted. Blood samples were collected and sent for total blood count, renal parameter and blood grouping and typing.

X rays of the injured part and other regions suspected to have been injured were taken. In patients presenting with shock, the injuries were reassessed after resuscitating the patient.

All patients presenting with signs and symptoms of distal ischemia were given a loading dose of Inj. Heparin 80units/Kg.

In case of on table iatrogenic injuries, a thorough inspection of the operative field was done to identify the type of vascular injury and to rule out other visceral injuries.

In patients presenting with iatrogenic vascular injuries due to accidental intra-arterial injection, in addition to loading dose, Inj. Heparin was given at the rate of 18units/Kg/hr infusion or 75units/Kg 6th hourly. These patients were started on T. Aspirin 75mg ½ OD.

Table 1. Various Types of Vascular Injuries and Potential

Future Complications

Injury Type	Natural History	Complications
PENETRATING OR IATROGENIC		
Laceration	Pseudoaneurysm or thrombosis	Ischemia, rupture, embolization
Contusion	Stenosis, thrombosis	Ischemia, embolization
Arteriovenous fistula	Increase in size and flow	"Steal" syndromes, pseudoaneurysm
BLUNT		
Intimal dissection or thrombosis (<25%)	Spontaneous resolution	None unless progression
Intimal dissection or thrombosis (>25%)	Pseudoaneurysm, thrombosis	Rupture, ischemia
Pseudoaneurysm	Increase in size	Rupture, embolization
Thrombosis	Occlusion, recanalization	Ischemia, stenosis
Arteriovenous fistula	Increase in size and flow	"Steal" syndromes, pseudoaneurysm
Transection	Thrombosis, pseudoaneurysm	Ischemia, compartment syndrome

Table 2. Management of vascular injuries

Medical management	
Anti coagulation with heparin	In all ischemic type of injuries intravenous Inj.heparin (unfractionated) @ the dose of 80units/Kg body weight maintenance dose of 18units /hr/Kg body weight infusion or 80units/kg every 6 hourly
antiplatelets	Post successful bypass patients T.Aspirin 37.5 mg OD in child > 2yrs/ 15kgs and 75mg OD in children 10years/30 kgs for period of 6 months.
steroids	Chemical arteritis Inj.Dexamethasone 4mg i.v twice daily was given for three days.
Surgical management	
Ligation of the injured vessel	life saving in the hemodynamically unstable patients. risk of life outweighs that of the limb. superficial system of veins, non axial arteries in adequate collateral supply, injury to an isolated forearm or tibial arteries can be safely dealt with by simple ligation and yet the limb can be salvaged
Primary repair	Since the vessels in children are very thin, in injuries involving more than 1/3 of the circumference of the artery primary repair is deferred and a venous patch closure is recommended.
Thrombectomy and patch closure	The contused portion of the artery is excised and the defect in the artery is closed with a venous patch
Interposition graft	injuries involving irregular lacerations, complete transection of the arteries or long segment of contusion thrombosis synthetic grafts are to be avoided in children.

RESULTS :

Iatrogenic injuries accounted for 19 cases (25%), which is largely preventable.

Fig.1

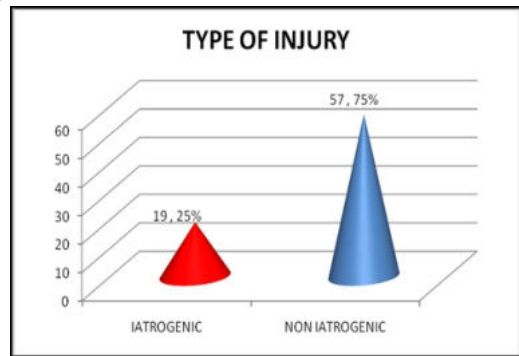
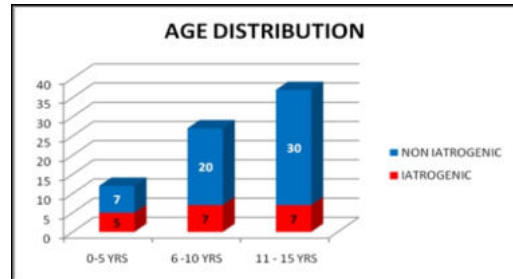


Fig.2



Incidence of iatrogenic vascular injuries is more in younger age group.

Fig.3

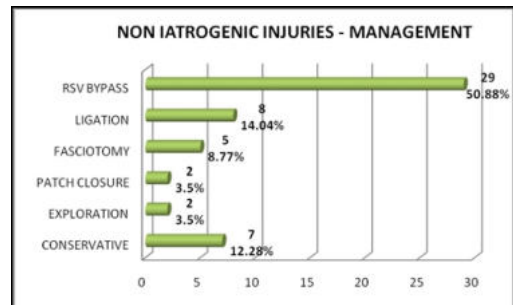


Fig.4

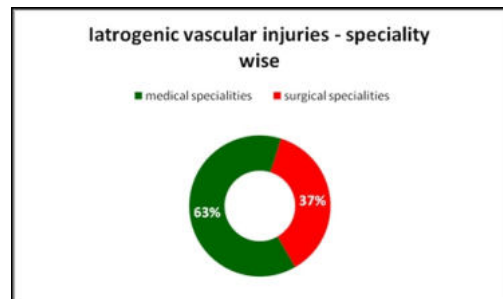


Fig.5

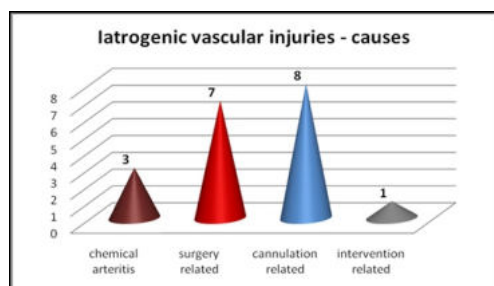


Fig.6

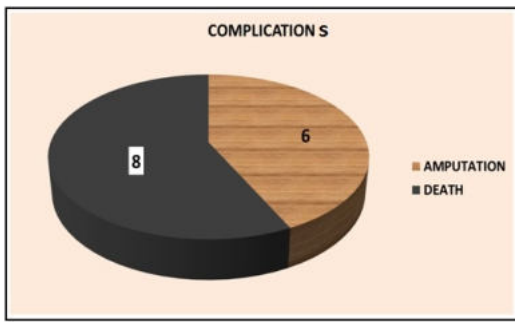


Fig.7: Nature of Injury

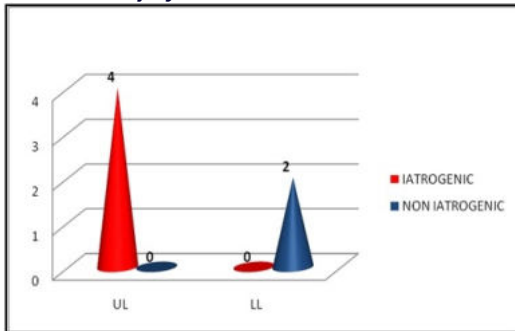
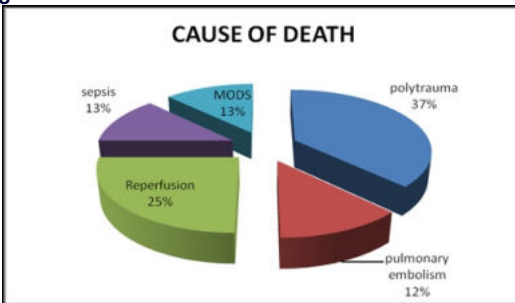


Fig.8



DISCUSSION

There are a limited number of studies from other parts of the world.

We have attempted to compare our study with that of few of the studies available in recent times.

Table 3: Study comparison

Study	Madras Medical College	A	B	C
Duration of study	6 YRS	13 YRS	12 YRS	6 YRS
No of patients	76	138	103	42
Age group	<15y	<18y	<18y	NA
Sex	M- 75%	NA	M 74%	M-64%
Nature of injury	Penetrating 75%	Penetrating 57.8%	Penetrating 68%	Penetrating 55%
Conservative	6.8%A,	NA	9.7%	26% A
Mortality	10.5%	10.1%	9.7%	NA
Amputation	7.9%	2.6%	10.7%	NA

- A Pediatric Vascular Injuries: acute management and early outcomes J Trauma 2011 Apr;70(4):823-8 Corneille MG et al¹
- B Pediatric Vascular injuries: patterns of injury, morbidity and mortality J Pediatric Surgery 2007 Jan;42(1):178-82 Klinkner DB et al²
- C Pediatric Peripheral Vascular Injuries: A Review of Our Experience Journal of Surgical Research volume 153 issue

1,pages 162-1166, May 1, 2009 Sohail R Shah et al³

In the study by Corneille MG et al, the duration of study was 13 years and the total number of cases analyzed was 138. It is a comprehensive study analyzing the various types of vascular significant injuries in children comprising both iatrogenic and non-iatrogenic injuries. In our study the duration of study was 5 years and 3 months only, yet we had a sizeable number of cases 76 to analyse. In the study by Klinkner DB et al, the duration of study was 12 years and the total number of cases was 102. In the study by Sohail R Shah et al, the duration of study was 6 years and the total number of cases was 42.

In the study by Corneille MG et al and Klinkner DB et al, the pediatric population was chosen as children less than 18 years, whereas in our study we have chosen the criteria as children ≤ 15 years of age. Yet, we have got 76 cases; this is probably due to our large population and our institution being one of the largest tertiary care centers with a 25 years old department.

We chose ≤15 years as the criteria for the following reasons

- 1) Epiphysis of the long bones around the elbow and knee joints start fusing around this age and hence the longterm effects of limb length discrepancy cannot be properly assessed with the growth of the child
- 2) In children above 15 years the physiologic response the trauma is similar to that of a young healthy adult
- 3) The size of the vessels in children above 15 years is nearly equal to that of the young adult

Comparing with other studies,

In our study the incidence of penetrating type of vascular injuries is 75%. In the studies by Corneille MG et al, Klinkner DB et al and Sohail R Shah et al, it is 57.8%, 68% and 55% respectively.

6.8% of the arterial injuries were treated conservatively and the limbs salvaged. In the studies by Klinkner DB et al and Sohail R Shah et al they reported successful conservative management of arterial injuries in 9.7% and 26% of the cases respectively.

Amputation in our study was 7.9%. In the studies by Corneille MG et al and Klinkner DB et al, it was 2.6% and 10.7% respectively. Corneille MG et al and Klinkner DB et al reported mortality rate of 10.1% and 9.7% respectively. The mortality rate in our study is 10.5%.

PREVENTION

Decreased transport time and improved prehospital care in case of trauma patients have led to some of the patients with major vascular injuries reaching the hospital alive.

Early identification and referral can go a long way in reducing the morbidity and mortality.

Better road engineering, incorporation of safety norms for children in automobiles, strict traffic rules can go a long way in preventing major vascular injuries in children.

Pediatric cannulation / IV drug administration should be done by experienced staff with utmost care.

Interventional procedures done under image guidance (fluoroscopy/ USG) can prevent iatrogenic vascular injuries.

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