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Intraosseous Route with Epidural Needle for Emergency Intraoperative Resuscitation and Reversal in Pediatric Emergency Surgery

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Abstract: *Intravenous line is the lifeline for anaesthesiologists. Intravenous cannulation poses a great challenge in infants and in hypovolumic patients. Intraosseous route can be a easiest way to administer fluids and drugs in such situations. Very few case reports are available regarding the use of intraosseous route for the purpose of anaesthesia. Here we are reporting a case of a pediatric emergency surgery conducted in the early hours with only an intraosseous line for purpose of anaesthesia.*
Keywords: *Pediatric emergency, Intraosseous, Resuscitation*

I. Case Summary:

A 10 months old female child was brought to the hospital at 11 pm with history of swelling in the right groin from 2 months, history of pain at the site of swelling with increase in size and two bouts of vomiting from one day. Child was diagnosed to have obstructed inguinal hernia, posted for emergency hernia repair.

Child weighed 12 kilos, airway and systemic examination were normal. Child showed features suggestive of moderate dehydration. Only three thin peripheral veins were visible and were marked. Preoperative investigations including serum electrolytes were within normal limits. Child was nil per oral for 6 hours. Intravenous(IV) line was secured in right dorsum of hand with 24G IV cannula and IV fluid (isolyte P) was connected. Preexisting fluid deficit was calculated as 600ml and 300 ml was infused over 1st hour and was taken up for emergency surgery as child continued to vomit. Child was premedicated with Inj. Atropine 0.3mg. Rapid sequence induction was done with Inj. Propofol 30mg and Inj. Succinylcholine 15mg. Intubated with 4.0 mm ID uncuffed endotracheal tube and secured after bilateral air entry was confirmed, maintained on IPPV with Jackson-Rees breathing circuit using Inj. Atracurium as a muscle relaxant and halothane was used intermittently. Analgesia was given by Inj. Fentanyl 25mcg and paracetamol rectal suppository. The Remaining calculated IV fluid (300ml) was infused intraoperatively. After surgical exploration of the site, bowels were found hyperemic maintaining motility. The urine output was adequate. Surgery lasted for 1 hour. Incision site was infiltrated with local anaesthetic for postoperative analgesia.

Just before reversal of neuromuscular blockade and extubation, intravenous line got distorted and was completely displaced from vein. Intravenous line was required for emergency drug administration, post operative antibiotics and fluid management. Meanwhile, child started to breath spontaneously and had to be maintained only with halothane. A perplexing situation arises regarding extubation without IV line or to establish one IV line and later extubate, in order to counter any complication that may arise during extubation or in the post-extubation period. IV line could not be secured as veins were very thin and had short course. Multiple attempts were made by two anaesthesiologists but was unsuccessful. During these attempts, child continued to dehydrate. Halothane further worsened the situation by causing hypotension, vasodilatation and bradycardia. Intramuscular atropine was administered to treat bradycardia. Central venous cannulation was not possible as pediatric central venous set was not available. Venesection was tried by surgeons at three sites but was not successful as veins were very thin even to accommodate 24G cannula. Fluids were flushed through Ryle's tube in order to prevent dehydration. Intraosseous route was the last resort available. Bone marrow puncture needle was not available and hence 18G Tuohy's epidural needle was used. Under strict asepsis bone marrow puncture was done over the right tibial shin, needle was left in place and fixed with sterile dressing. Normal saline was rapidly infused through the epidural needle. Peripheral intravenous line could not be secured in spite of repeated attempts for two hours. Child recovered completely from anaesthesia and was extubated with only available intraosseous route for drug administration. Child was monitored in pediatric ICU for 12 hours. Post operative IV fluids and antibiotics were administered through intraosseous route only. After 12 hours, child was well hydrated. Once again peripheral line access was tried by two senior experienced anaesthesiologists, but was unsuccessful. Intraosseous line was left for 24 hours and removed. Child was put on oral antibiotics and paracetamol rectal suppositories for 5 days. Child recovered completely and was discharged on 8th day without any complications. After discharge, follow up was done for one month and there were no complications related to surgery, anaesthesia or to intraosseous line site.

II. Discussion:

Securing an intravenous line in an infant is the most challenging part in pediatric anaesthesia. Various methods have been described since ages and this aspect is still a challenge to the anaesthesiologist irrespective of their experience in their field. Problems faced in infants are due to poor visibility of veins, thin walled and under developed course of veins. Further, the difficulty is increased if the infant is dehydrated, dark colored and obese.

It is critical to establish an intravenous access rapidly in severely dehydrated children for fluid infusion. This is often not possible when the veins are not visible or palpable due to peripheral vascular collapse. Percutaneous cannulation of large veins (femoral/subclavian) is difficult and venous cutdown is time consuming [1]. Hence there is a need for a rapid, effective and safe alternative to intravenous route for fluid resuscitation.

Drinker *et al* and Doan in 1922 demonstrated the adequacy of the bone marrow for fluid infusion in experimental animals[2,3]. The intraosseous route utilizes the rich vascular network of long bones for transport of fluids and drugs from the medullary cavity to the circulation. After years of neglect, the use of this route is showing resurgence for emergency drug [5] and fluid therapy [6].

In anaesthesia, intravenous route is traditionally used for rapid fluid infusion. There is paucity of literature on the efficacy of intraosseous route and its use in anaesthesia. I R Selby and James used intraosseous route for induction of anaesthesia in a pediatric emergency case [7]. They used this route to administer induction agents, atropine, muscle relaxants and IV fluids[10]. They concluded that intraosseous route is a rapid, safe and effective route for the emergency induction of anaesthesia.

Any 13G to 20G needle with a stylet can be used for medullary puncture. The most common sites used for the insertion of the intraosseous needles are the anterior surface of the tibia, **2-3** cm below the tibial tuberosity, the medial surface of the tibia **3** cm above the medial malleolus, or the femur **3** cm above the lateral condyle[7,8]. Intraosseous route can be used to administer fluids, drugs and blood can be drawn for cross-matching too[10]. However this route can deliver fluids at the rate of 50ml/min [8]. The drugs that have been administered by this route include sodium bicarbonate, atropine, adrenaline, dopamine, dobutamine, diazepam and antibiotics [7,8,9].

Intraosseous line is associated with cellulitis, osteomyelitis, bone marrow depression with prolonged use and in lack of asepsis. Injury to epiphyseal plate may occur if puncture is made close to epiphysis[1,7]. Fat embolism has been reported in animals but not in humans, however should be watched for.

The technique has been used in many different circumstances, including cardiac arrest in children, shock, trauma, seizures, near drowning, and in severe burns[1,4,7,8]. It is suitable for use up to the age of **6** years, after which the bones become too hard, although cannula have recently been developed which are suitable for adults[1]. This technique can be easily learnt and studies show that its less time consuming than securing peripheral line in cases of shock and dehydration[1].

III. Conclusion:

We conclude with few lessons to share. Firstly, pediatric case should be started with at least two I.V. lines. Secondly, intravenous line should be properly secured with splints. Thirdly, intraosseous route to be kept in mind as an alternate route for emergency resuscitation. All those involved in the management of such children should be familiar with the technique in order to use it quickly and safely when required.

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