

## Interosseous cannulation, a life saving vascular access in resuscitation of an infant in cardiac arrest

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### ABSTRACT

We present a case of 2 months old critically ill child who developed cardiac arrest while securing central venous access under ultra-sonographic technique. Successful resuscitation by administering fluid and drugs through prompt establishment of intra osseous access saved the life of an infant.

**Key words:** Cardiac arrest, intra osseous route, pediatric emergency, resuscitation

### INTRODUCTION

Securing Intravenous access is a challenge in pediatric anesthesia. The situation can be worse if it is a case of a critically ill, obese, chubby and dehydrated infant. While securing intravenous (I.V.) access, peripheral lines, central venous (CVP) lines, umbilical lines, scalp vein cannulation and venesection are considered, but intraosseous (I.O.) line is usually not a frequently considered option. Contrary to the belief it is much easier, effective and has much less complications as compared to others. Drinker et al and Doan in 1922 demonstrated for the first time the adequacy of bone marrow for fluid infusion in an experimental animal<sup>1</sup> After years of neglect the use of this route is now revisited for emergency drugs and fluid therapy.<sup>2</sup> Following case report highlights the importance of I.O. cannulation in saving life of a dying infant.

### CASE REPORT

A 2 months old female baby, 3 Kg. in weight, underwent a primary repair for intestinal perforation 4 days back. patient was referred to department of Anaesthesiology for central venous cannulation due to several failed attempts of IV cannulation and right saphenous vein venesection in the paediatric intensive care unit. Patient was crying, irritable, dehydrated and general condition was poor.

It was decided to put central venous line under ultrasound guidance in the operation theatre. Patient was given 10mg of ketamine intramuscular in the anterolateral aspect of left

thigh. The routine monitors attached to the patient revealed SPO<sub>2</sub> of 97-98 % and H.R. of 150/min (sinus rhythm, regular) on electrocardiography. The cleaning and draping of right and left supraclavicular region was done after positioning the patient ten degree head down. CVP catheter of 5 F diameter inserted. Right internal jugular vein (IJV) cannulation under ultrasound guidance was tried. Right internal jugular vein (IJV) was successfully punctured with the needle but guide wire could not be passed due to collapsed lumen of vein. After two attempts for right IJV, left I.J.V. was attempted under ultrasound guidance. The position of tip of needle inside left I.J.V. was confirmed by ultrasound but guide wire could not be passed due to the same reason again, meanwhile the patient deteriorated due to loss of blood and because of unavailability of venous access. On examination peripheral skin became cold, brachial and femoral pulse could not be felt, heart rate and SPO<sub>2</sub> were not recordable.

On auscultation no heart sounds were heard. Realizing that patient was in cardiac arrest immediately C.P.R. was started as per 2015 AHA guidelines. Patient's trachea was

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intubated with a 3.0 mm I.D. E.T.T. with initiation of bag mask ventilation and oxygen enriched tidal breaths. For venous access, intra-osseous route was established at proximal tibia as the last option to get vascular access. After sterilizing the proximal tibia, a 38mm long and 0.80mm bore wide needle was inserted at the flat surface of bone 1 cm distal and slightly medial to the tibial tuberosity. Around 40 ml of normal saline was injected via intraosseous (I.O.) route immediately along with 2 shots of 30µg epinephrine (1:10000) (I.O.). Patient got revived after 2 cycles of C.P.R. On ultrasonography, right I.J.V. lumen got significantly inflated after intraosseous injection of normal saline. C.V.P. line in right I.J.V. now could be easily placed and fluid transfusion was started. Cardiac monitor showed HR – 130/min, BP – 90/60, RR – 30/min, Pulse volume – good, muscle tone adequate and the color of skin became pink. Baby became active.

Patient was shifted to paediatric ICU and put on mechanical ventilation with SIMV and PSV mode. ABG was done which showed (metabolic acidosis PH-6.9 with low serum calcium levels. Metabolic acidosis and electrolyte imbalances were corrected in consultation with pediatrician in the paediatric ICU. Next day patient was weaned off the mechanical ventilatory support and finally extubated. After extubation, the vitals were : HR – 130/min, R/R – 20/min, SPO<sub>2</sub> – 100% on oxygen face mask. Child was conscious, crying, opening eyes with active limb movements.

**DISCUSSION**

In this patient, timely decision of securing intra osseous route which is usually not thought of, proved to be a life saving intervention. Intraosseous route (I.O.) often an underutilized technique can be utilized in the desperate situation where securing other route of intravenous access fails. Historically, its use was recommended only in younger children, however new guidelines supports it in all age groups. It needs less skill than putting a central line, umbilical line and even scalp line, in addition it has fewer serious complications than central lines and can be performed much faster than central or peripheral line when vascular collapse is present. The bone marrow consists of a network of vessels that empties into the central vein and functions as non collapsible vein during hypovolemia and shock. Any intravenous fluid blood products and routine resuscitation drugs can be administered through intraosseous route. This route allows medications and fluids to enter the circulation within seconds and also to obtain even blood sample.

One recent study where 31 month old child suffering from severe epistaxis for 12 hrs, admitted in critical condition was successfully resuscitated by transfusing fluid and blood by intraosseous route .<sup>3</sup>

In another study comparing the effectiveness of I.O. access in relation to I.V. access for infusion of anesthetic agent (midazolam, ketamine, and fentanyl) and fluids during hemodynamic studies, it was found that the puncture time was significantly smaller in I.O. group (3.6 min) than in I.V. group (9.6 min). The result shows superiority for I.O. infusion as compared to I.V. infusion.<sup>4</sup>

I.R Selby and James used intraosseous route for induction of anesthesia in a pediatric emergency case. They used i.o route to administer induction agent atropine, muscle relaxant and fluids.<sup>5</sup>

Intraosseous route can be used to draw blood besides for fluids and drug.<sup>7</sup> The drugs like sodium bicarbonate, dobutamine, atropine, adrenaline, dopamine, diazepam and antibiotics have been administered by this route .<sup>7</sup>

This route has been used in many different circumstances including cardiac arrest in children, shock, trauma, and seizures, near drowning and severe burns.<sup>5,6</sup>

I.O. route has been used successfully in fatally wounded soldiers in the battle field.<sup>7</sup>

Many a times an appropriate size IJV cannula may not be available in emergency situation as happened in this case. The correct recommended sizes of IJV cannula for infants and neonates as per recommendation by general hospital, Canada are depicted in table below.<sup>8</sup>

Weight (kg)	CENTRAL LINE					
	Internal Jugular		Subclavian		Femoral	
	Diameter (Fr)	Length (cm)	Diameter (Fr)	Length (cm)	Diameter (Fr)	Length (cm)
<5.0	4	5	4	8	4	8
5-10	4-5	5-8	4-5	8-12	4-5	8-12
10-20	5	8	5	12	5	12
20-30	5	8	5	12	5	12

**COMPLICATIONS WHICH ONE CAN COME ACROSS FOLLOWING IO ACCESS ARE**

(a) Extravasation of fluid. (b) Compartment syndrome. If hypertonic fluid like soda bicarbonate, dopamine or calcium chloride are given. They may lead to necrosis

of muscles. (c) Infection and Osteomyelitis are relatively rare complications. (d) Growth plate injuries may also occur rarely. IO needle must be removed within 3-4 hours normally but may be maintained for 72-96 hours if required. Alternative insertion sites such as distal tibia, distal femur and proximal humerus can be utilized.

However, this may be absolute contraindication for IO access if fracture of tibia or other bones exist. Relative contraindication could be cellulitis, inferior vena caval injury, osteogenesis imperfecta and osteoporosis. There is need to train health care providers in this novel techniques with high success rate and low complication rate and above all a life saving procedure as proved in this case.

## CONCLUSION

Intra osseous route is a very important and can be lifesaving technique during emergency situation. Health personnel must utilize it readily without hesitancy instead of lingering on with repeated failed attempts of conventional

I.V. access techniques and wasting precious time during emergency situations.

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