Rapid sequence induction via an intraosseous needle

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The use of the intraosseous (IO) route for drug administration has been widely reported in the pre-hospital and military trauma setting, for use in paediatric patients and for use in the cardiac arrest scenario for rapid access. We wish to highlight its use for rapid sequence induction (RSI) in the adult population in a case of difficult intravenous access.

A patient presented to our hospital as a stand-by call to the Emergency Department resuscitation area. He was peri-arrest with cardiogenic shock. He was cyanosed with unrecordable oxygen saturations and blood pressure but was very combative. Intubation to facilitate oxygenation was required urgently due to his rapidly deteriorating condition. Multiple attempts at securing intravenous access had been unsuccessful. An EZ-IO™ (Prometheus Medical Ltd, Hereford, UK) Intraosseous Vascular Access System was inserted in his right proximal tibia. Rapid sequence induction was performed using fentanyl 200 µg, ketamine 100 mg and suxamethonium 100 mg. No fasciculations were observed. We waited 30 s and attempted direct laryngoscopy, which obtained a Grade I Cormack-Lehane View. Intubation was secured at first attempt. The induction process felt very similar in nature and speed to a standard intravenous induction. Post intubation, rapid intravenous access was secured in the right external jugular and then a femoral central line sited.

The intraosseous route for drug administration has been used for many years. Studies comparing the pharmacokinetic data of intraosseous versus central venous drug delivery have primarily been undertaken in animals. One study has compared intraosseous versus intravenous rocuronium in anaesthetised swine.¹ They compared electromyographic data obtained following tibial intraosseous administration to that of peripheral intravenous administration and demonstrated no statistically significant difference in the onset time between the two groups. They also demonstrated that the duration of paralysis with the intraosseous route was longer than with the intravenous. They concluded that rocuronium could be administered via the intraosseous route in the same doses as when using the intravenous route. With regard to human studies, a prospective, randomised crossover study has compared the delivery of intraosseous to intravenous morphine² in adults and demonstrated that there was no statistically significant

difference in the majority of the pharmacokinetic data including the maximum plasma concentration, time to maximum concentration and area under plasma concentration time curve.

The majority of reports of using intraosseous for RSI have come from military and trauma experience. A recent observational study has been published in the *Emergency Medicine Journal*³ looking at whether RSI via IO was comparable to the intravenous route in terms of grade of view and number of attempts at intubation. The study demonstrated that in the 34 patients who received RSI via IO for trauma they had a 97% first pass intubation rate and that 91% of patients had a Grade I Cormack-Lehane view. They were unable to compare this directly to RSI via the intravenous route, as intraosseous access is often the preferred route of access in a military trauma setting. A further military study retrospectively reviewed 830 adult trauma cases and found that 1014 IO devices were inserted over a 60-month period.⁴ They demonstrated that the devices were used to infuse anaesthetic induction drugs, analgesia, tranexamic acid, blood and blood products, and intravenous fluids. Of the 1205 times that the IO route was used to infuse drugs, anaesthetic induction agents were the most common drug given, being used for this purpose in 61.8% of cases. With regard to complications, there were no serious complications reported and 14 minor complications that included failure to correctly place IO device, failure to infuse drug, or fracture of needle. This is similar to a Danish study that looked at complications associated with intraosseous access.⁵ They showed that serious complications such as compartment syndrome or osteomyelitis are very rare and that problems such as difficulty penetrating periosteum, difficulty aspirating bone marrow and difficulties injecting or infusing fluids or drugs are more common.

One of the concerns with the use of the intraosseous route in awake patients is the side effects of pain on insertion and pain on injection. Reports⁶ have

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demonstrated that insertion is less painful than one might expect and can be minimised by infiltration of local anaesthetic down to the periosteum prior to insertion or the use of anxiolytics or inhaled nitrous oxide. Injection is known to be more painful than insertion and is thought to be related to the difference in innervation of the skin and periosteum as compared to the medullary space. Flushing the line with lidocaine prior to commencing injection can help to reduce this. Several patients in the case study from which the above information was taken commented that they preferred intraosseous access to multiple failed attempts at establishing intravenous access.

This case highlighted to us that the use of the intraosseous route for rapid sequence intubation is useful in cases of difficult intravenous access. Access can be secured rapidly with a lower complication rate than central venous catheterisation. Rapid intubating conditions can be achieved which are comparable to those achieved using intravenous anaesthetic drugs.

Patient consent

Published with written consent from the patient.

Declaration of Conflicting Interests

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