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## CASE REPORT

### An intraosseous blood transfusion in a critically ill child



#### *Une transfusion sanguine par voie intraosseuse chez un enfant gravement malade*

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**Introduction:** An intraosseous infusion (IO) is a safe and simple method to administer fluid in an emergency situation and can be used to gain rapid vascular access in a critically ill child. Fluids and drugs can be infused as well as blood boluses, but very few cases describe the infusion of blood products.

**Case Report:** In this case study we report of a successful transfusion of fluid and blood by IO to a 31 months old child, who had suffered severe epistaxis for 12 hours. The child was unconscious at time of admission and the hemoglobin (Hb) level was measured to 3.6 g/dl. Through an IO in the proximal tibia, 300 ml of fluid was first infused, followed by 200 ml of blood.

**Discussion:** We conclude that IO should be placed without delay when venous access is not rapidly obtained.

**Introduction:** Une perfusion par voie intraosseuse (PI) est une méthode sûre et simple d'administrer un fluide dans une situation d'urgence et peut être utilisée pour obtenir un accès vasculaire rapide chez un enfant gravement malade. Les fluides et les médicaments peuvent être administrés par perfusion ainsi que des bolus sanguins, mais peu de cas décrivent la perfusion de produits sanguins.

**Rapport de cas:** Dans cette étude de cas, nous rapportons le cas d'une transfusion réussie de fluide et de sang par PI à un enfant de 31 mois, qui a souffert d'une épistaxis sévère pendant 12 heures. L'enfant était inconscient au moment de l'admission et le niveau d'hémoglobine (Hb) a été mesuré à 3.6 g/dl. Grâce à une PI dans le tibia proximal, 300 ml de fluide ont d'abord été perfusés, suivis de 200 ml de sang.

**Discussion:** Nous concluons en affirmant qu'une PI doit être réalisée sur-le-champ lorsqu'un accès veineux n'est pas rapidement obtenu.

#### African relevance

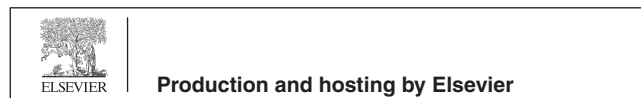
- Several conditions including bleeding, trauma and severe anaemia due to malaria can cause circulatory shock requiring both IV fluids and an urgent blood transfusion.
- An 18 gauge needle, alcoholic swabs and a syringe are the only necessary equipment which are possible to also use in smaller hospitals.
- Establishing an intraosseous access is a technique that can be easily taught and therefore can be widely used.

#### Introduction

Establishing a peripheral intravenous venous access (IV) is a common task in an emergency centre, but in paediatric patients several attempts are often required to successfully insert the IV.<sup>1</sup> In the circulatory unstable child the rapid placement of a vascular access is crucial for the patient's survival. The intraosseous (IO) needle has been shown to be easier to place successfully than the IV, and can therefore be an important alternative in emergency cases.<sup>2,3</sup> It was widely used in World War II,<sup>4</sup> and then re-emerged as an option for fluid and drug resuscitation in the critically ill child in the 1980's, following the famous editorial by JP Orłowski "My kingdom for an intravenous line".<sup>5</sup> Several different sites can be used for IO insertion, the most common one used in children is the anteromedial surface of the proximal tibia. The technique of insertion can easily be taught. The goal is to remove the IO needle within 3–4 h, but as soon as an IV access is established it should be removed. The risk of infection increases after 72–96 h.<sup>6–8</sup>

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This is a case report of a 31 month old child presenting with hypovolemic shock and anaemia due to severe epistaxis, who received an IO blood transfusion through an 18 gauge hypodermic needle.

### Case report

A 2 year and 7 month old child of sub-Saharan African descent was brought to Mpongwe Mission Hospital in Zambia in an emergency condition due to epistaxis and fatigue. The child started nose bleeding 12 h earlier, but the parents were unable to get to the hospital due to unavailability of transport. At time of admission the child was not actively bleeding, but was unconscious, presenting with peripheral coldness and extremely pale skin. One of the most skilled clinical officers attempted to establish an IV access. He tried to access the peripheral veins, vena jugularis externa and finally vena femoralis, but after 2–3 min the child's heart beat was almost inaudible. At this moment we decided to perform an intraosseous infusion in the tibia using an 18 gauge needle. At insertion, we immediately entered the bone marrow. We managed to withdraw blood for urgent haemoglobin estimation, grouping and cross-matching from the femoral venal puncture. The Haemoglobin level was 3.6 g/dl, the white blood count was  $23.3 \times 10^9/L$  and the platelet count was  $178 \times 10^9/L$ . Three hundred ml of Ringers Lactate was infused during one hour, during which the child showed signs of improvement by crying, responding to pain and regaining peripheral warmth. After one hour, we received blood from the laboratory and as we still only had access to the bone marrow, we decided to transfuse the blood through the IO. However, due to the high pressure in the bone marrow the blood could not be rapidly infused. Therefore, we decided to infuse directly into the bone marrow using a syringe. After injecting a few ml of blood, the child started bleeding from the nose again. We inserted nasal packs soaked with adrenaline, simultaneously as one of us drew blood from a receiver and one of us injected the blood into the bone marrow. After approximately 90 min the child was sitting up, drinking coke. Due to the fact that the situation had been very urgent, completely sterile conditions were not achieved. As a preventative measure, the child received one dose of intraosseous antibiotics (cloxacillin). The child's condition kept on improving throughout the day and night. There were no signs of fever or pain from the injection site the following day, the child had recovered well, and was discharged. Since we estimated that the blood loss was bigger than the supply, and the child had a poor nutritional status, we prescribed 5 mg of folic acid daily for one month and 50 mg of ferrous sulphate three times daily for one month. At the return visit one week later, the haemoglobin level was 6.0 g/dl. Three months later, the haemoglobin level was 9.4 g/dl and the child was doing well.

### Discussion

The bone marrow consists of a network of vessels that empties into a central vein and functions as a non-collapsible vein during hypovolemia or shock. Any intravenous fluid, blood products or routine resuscitation drugs can be administered through the IO route. Complications for short term use are

relatively rare compared to the advantages for a child who needs rapid administration of blood or fluid. The most common complication is extravasation of fluid, but that is often associated with too much movement during insertion, which we avoided by holding the leg straight throughout the procedure. Bone marrow and fat emboli in the venous circulation and the lungs due to the open blood vessels in the medullary cavity, presence of disrupted bone marrow and increased intramedullary pressure have been described, but so far no paediatric cases have been reported.<sup>9</sup> One case of intravascular air after intraosseous infusion was observed in a 4-month-old boy who died from Sudden Infant Death Syndrome (SIDS); this complication can be avoided by ensuring that intraosseous needles are never disconnected.<sup>10</sup> Another rare, but serious risk is that of compartment syndrome. This can be minimized by using a proper technique, ensuring the needle remains in the marrow and does not pass through the other cortex as well as only making one attempt at insertion per bone. Extravasation of hypertonic or specific medications can result in necrosis of the muscle. Infection and osteomyelitis are rare complications but can occur if an aseptic technique is not followed during insertion.<sup>11,12</sup> In our case we could not ensure complete sterility at the insertion of the IO, which is why we administered one dose of prophylactic cloxacillin.<sup>13</sup> Injuries to the growth plate are a possible complication correlated with incorrect placement of the needle. Fiser et al and Claudet et al performed prospective studies to evaluate the effect of IO on tibial growth. They performed radiographic follow-up examinations after IO treatment, 16.2 months and 29.2 months, respectively, that showed no tibia discrepancy between the two legs, indicating no long term effect on tibial growth.<sup>14,15</sup> In our case an experienced paediatric haematologist performed the IO at the anteromedial surface of the proximal tibia, and future risks for growth plate injuries should be minimal.

Several studies have demonstrated the value of IO administration of emergency medications when establishing an IV access is difficult. However, to our knowledge, only one recent study has demonstrated an IO blood transfusion successfully, in a 5 month old female with a severe traumatic brain injury.<sup>16</sup> That intraosseous blood transfusion was given at a trauma centre to a younger child with a traumatic haemorrhagic shock. In our case, the child was given the transfusion at a smaller mission hospital without access to advanced technology such as a battery-powered IO driver, as in the above described case.

In summary our patient was admitted unconscious to the Mission hospital, where the cannulation of both a peripheral and central vein failed due to vascular circulation collapse. The primary infusion of Ringer lactate stabilized the circulation, but there was still no possibility to infuse the blood through the veins. Intraosseous blood transfusion was therefore the only option in this very urgent situation. We conclude that performing an intraosseous blood transfusion should be the immediate intervention in life-threatening situations like this one.

### Conflicts of interest

The authors declare no conflict of interest.

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