

**Research Article** 

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# Intraosseous access in the management of paediatric emergencies: a report from Gabriel Toure hospital

#### Abstract

When access to peripheral veins is delayed or impossible, intraosseous access must be rapidly considered. The aim of our study was to determine the epidemiological, clinical and therapeutic characteristics of children who have benefited from intraosseous access, as well as the practical details of its implementation.

**Materials and methods:** It was a prospective study, on the assessment of aspects of intraosseous access in the management of pediatric emergencies. Children under 15 years of age who received this procedure were included. The study was performed over a 14-month period from March 2018 to April 2019 at the pediatric emergencies of Gabriel Touré hospital.

**Results:** Twenty-two patients were included. The sex ratio was 2.14. The mean age was 9 months (2 months-36 months). Dehydration complicated by shock represented 45.5% of treated diseases. All intraosseous access points were placed in the proximal tibia. Manual insertion was used in all cases. The most frequent early complication was deperfusion (13.6%). Difficulty with peripheral venous access was the main indication (77.3%). The procedure was performed by a physician in 91% of cases, with a success rate of 86.4%. Vascular filling was the most common treatment used by this route, accounting for 82% of cases.

**Conclusion:** Intraosseous device insertion has saved children in life-threatening emergencies. The main factors limiting the insertion of the intraosseous device in our study were high cost of devices and lack of appropriate training about veins access in case of pediatric emergencies.

Keywords: intraosseous access, emergencies, children, Mali

## Introduction

In emergency medicine, the intraosseous route is the first choice, due to its efficacy and low cost. It is not always easy to set up this procedure in certain emergency cases: "more a patient needs a venous route, harder it is to find", said Turkel in 1983. If peripheral venous access is delayed or impossible, an intraosseous line should be rapidly considered.<sup>1-3</sup> In terms of plasma concentrations of the drugs injected, the efficacy of the intraosseous route is similar to that of the central venous route.<sup>4</sup> In states of hypovolemic shock, veins frequently collapse, which makes it more difficult to obtain rapid peripheral venous access. Fast access to the infusion route has a direct impact on the patient's prognosis, particularly in the context of cardiorespiratory arrest. Intraosseous infusion can be used as an alternative to the peripheral venous route in paediatric emergencies. It uses the vast intramedullary venous circuit as a vector to deliver the necessary therapeutics to the systemic circulation. First described in the 1920s and widely used during the Second World War, intraosseous perfusion has been gradually regaining interest since the 1990s, first in pediatric practice and then in adults. The success rate for intrabone access in cardiorespiratory arrest is over 83%. Despite its recognized indications and high success rate, the use of an intraosseous route remains a rarely performed procedure.5 This finding is probably linked to non-compliance with recommendations, when there is a mismatch between the formal indication for an intraosseous access in the cardiorespiratory arrest situation and clinical practice. In clinical practice, physicians suggest the intraosseous route after 10 minutes of successive failures to insert peripheral venous catheters. In Mali, there is no reported study on the use of intraosseous routes in pediatrics. This study aimed to determine the epidemiological, clinical, therapeutic

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Traoré F,' Maiga B,' Sacko K,' Maiga D,' Coulibaly Y A,' Traoré K,' Diarra M,<sup>2</sup> Toure D,3 Konaté D,' Sidibé LN,' Diall H,' Coulibaly O,' Togo P,' Cissé ME,' Doumbia AK,' Simaga T,' Diakité AA,' Dicko-Traoré F,' Togo B,' Sylla M'

<sup>1</sup>Pediatric department, CHU Gabriel Toure, Bamako-Mali <sup>2</sup>Secondary hospital, pediatric unit, CSREF kalabancoro Bamako-Mali

<sup>3</sup>Secondary hospital, pediatric unit, CSREF Mopti -Mali

**Correspondence:** Traore Fousseyni, Pediatric department, CHU Gabriel Toure, Bamako-Mali, Mali, Tel +0022366748262, Email drfousseynitraore@gmail.com

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and outcome features of children who received an intraosseous route, as well as the practical details of intraosseous procedure.

#### Patient and methods

It was a 14-month prospective, descriptive, analytic and monocentric study from March 2018 to April 2019. The study was performed in the pediatric emergency department of CHU Gabriel Touré in Bamako. Children aged less than 15 years were included, who received the intraosseous route. Data were collected from hospitalization files on individual questionnaire forms. The analysis of collected data has been performed on Epi info software version 3.5.3. Quantitative variables were shown as averages with their ranges. Qualitative variables were expressed as percentages. The relationship between qualitative variables was estimated using Pearson's Chi2 test and Fisher's exact test. The test is significant if the p-value is less than 0.05.

**Ethical considerations**: upon admission, patients' parents or legal guardians approved their enrolment in a clinical research project. The national ethics committee has approved the research protocol.

#### Results

The intraosseous route was performed in 22 patients. The mean age of the patients was  $9.23 \pm 8.141$  months (2 months-36 months). The most common age group was 1-6 months, representing 45.5% of cases. The sex ratio (M/F) was 2.14. The main reasons for consultation (Table 1) were diarrhea plus vomiting (81.85%) and respiratory distress (13.6%). The patients' diagnoses are represented in Table 2 severe dehydration complicated by hypovolemic shock (45.5%),

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meningitis (13.6%) and pneumonia (13.6%). The indications for the intraosseous route were difficulty in accessing the peripheral venous route (77.3%) and hypovolemic shock (22.7%). Thirty-two attempts to place an intraosseous route in 22 children were recorded, i.e. around 1.5 attempts per child, with a success rate of 59%. All intraosseous routes were inserted at the proximal end of the tibia. The only type used was the manually inserted intraosseous device. Intraosseous procedures were performed by a physician (90.9%), with a success rate of 86.4%. The main treatments received via the intraosseous route were saline solutions, antibiotics (78.94%) and blood products (Figure 1). Early complications were subcutaneous deperfusion (13.6%) and extravasation (9.1%).

#### Table I Reasons of visit

Reasons	Number	Percentage
Diarrhea and vomiting	18	81,85
Respiratory distress	3	13,6
Pallor	I	4,55
Total	22	100

Table 2 Patient diagnosis

Diagnosis	Number	Percentage
Severe dehydration	10	45,5
Meningitis	3	13,6
Pneumonia	3	13,6
Severe sepsis	2	9,1
Heart disease	I	4,5
Hemorrhagic shock	I	4,5
Severe malaria	2	9,1
Total	22	100,0



Figure I Treatment administered via intraosseous route.

#### Discussion

The relative small size of the sample limits the strength of the statistical tests. Children under 24 months of age represented the 90% of patients. In Glasser's study, 85% of patients were young infants.<sup>6</sup> In our study, severe dehydration complicated by shock was the most frequent diagnosis (45.5%), followed by meningitis and pneumonia. These results differed from those of Aleksandra C-M et al, where shock was the most frequent diagnosis at 61.1%.<sup>7</sup> Cardiorespiratory arrest and hypovolemic shock accounted for 75% and 18% respectively in the study performed by Vicens F.<sup>8</sup> Regarding operational aspects of intraosseous access, the indications requiring insertion were difficulties in accessing a peripheral venous access (77.3%) and shock (22.7%). Intraosseous access is currently recommended as the first vascular access for children in cardiorespiratory arrest, in decompensated

shock and in all emergency situations where a peripheral venous route cannot be established in less than 60 seconds. It is also indicated when it is necessary to infuse solutions at sufficient velocity in emergency situations.<sup>9,10</sup> Insertion should be completed within 5 minutes. Several authors have reported that the use of an intraosseous route reduces the time required to obtain a vessel access in children in cardiorespiratory arrest. In terms of indications, our results differ from those of Aleksandra C-M et al, who found the following indications: shock (61%) and cardiorespiratory arrest (27.7%).7 In Vicens F.'s study, the intraosseous route was more widely used in cardiorespiratory arrest (75%) and shock (18.2%). The success rate of intraosseous access in cardio respiratory arrest is higher (83%) than other vascular routes such as saphenous vein denudation (81%), sub-clavian catheterization (77%) or peripheral venous access (17%).<sup>10</sup> Our success rate was relatively low (59%) compared with the literature. This rate is similar to that reported by Aleksandra C-M et al, who reported 1.5 attempts per child and a 57% success rate per attempt. Rouvière M et al with 1.3 attempts per patient and 77% success rate per attempt.<sup>11</sup> In our study, a manually inserted intraosseous device was used in 100% of cases, with a success rate of 86.4%. Anderson, Seigler and Pfister reported success rates of 87%, 77% and 86% respectively.<sup>12-14</sup> Vicens F et al used the motorized EZ-IO device in 100% of cases. Regardless of the device used, the success rate remains high. All intraosseous routes were inserted in the proximal tibia. This result agrees with that of Aleksandra C-M et al. In the Vicens F et al. study, almost all intraosseous access were inserted at the proximal tibial site, in 97.72% of cases. The proximal tibia is the site with the highest success rate for the intraosseous route compared with other sites.<sup>15</sup> In our study, the majority of procedures were performed by a physician (90.9%), followed by residents (9.1%). Insertion of the intraosseous device is a medical procedure, requiring a certain level of training. In the majority of European studies, insertion is performed by physicians, while in American studies, it is mostly performed by paramedical staff.<sup>16,17</sup> In our study, 86.4% of devices inserted were fully functional, with 13.6% failures. Vicens F. and Aleksandra C-M had 93.2% and 77.7% functional intraosseous routes. Lack of experience or training could explain our insertion failures. The main treatments administered by this route were normal filling solutions in 78.94% of cases. In the study reported by Vicens F et al, the main treatments administered intraosseously were catecholamines (68.4%) and filling products (60.5%). According to the data available in the literature, the main therapeutic agents administered are catecholamines, filling solutions and anesthetics.<sup>18</sup> Except anti-cancer drugs, any drug that can be administered by the venous route can be administered by the intraosseous route at the same dosage. A wide range of treatments administered by this route is currently available in the literature. We identified two minor complications: deperfusion and subcutaneous extravasation, accounting for 13.6% and 9.1% of cases respectively. In this study, complications were minor. These results are similar to those reported in the literature, which indicate a low incidence of severe complications (less than 1%).19-21

#### Conclusion

Intraosseous perfusion is a relatively ancient technique which has gained in importance in recent decades. It currently offers numerous advantages. Intraosseous infusion is a proven and lifesaving alternative to conventional peripheral venous infusion in life-threatening emergencies. As a result, it has been integrated into the latest international recommendations for the management of cardiorespiratory arrest in pediatrics, as the first choice for access to blood vessels.

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## **Ethical considerations**

This study was conducted in accordance with the Helsinki statement. In order to preserve confidentiality, an identification code was assigned to each patient.

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None.

### **Conflicts of interest**

The authors declare no conflict of interest in relation to this article.

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