

Use of the intraosseous route in resuscitation in a neonate

Dear Sir,

Intraosseous route is an alternative way of obtaining vascular access [1]. We report the case of a neonate who is still alive due to this technique.

A female aged 10 days was admitted to our institution with a 24-h history of decreased fluid intake, abnormal skin coloration and hypothermia. Her familiar and personal history was not relevant.

On admission she presented a poor peripheral perfusion, absence of palpable pulses, acidotic breathing pattern, pallor and marked hypotonia. Cardiac murmur and fine crackles were heard at auscultation. Hepatomegaly (3 cm below costal margin) was noted. Laboratory data revealed leukocytosis with a preponderance of immature forms, consumption coagulopathy and severe metabolic acidosis (pH = 6.98; bicarbonate = 5 mmol/l; base excess = -24.5 mmol/l). Attempts to cannulate peripheral or central veins (subclavian, femoral and jugular) failed, in spite of being an usual procedure performed at our service [2]; therefore an intraosseous needle was inserted into the right tibia. Fluids and drugs administration were initiated. During endotracheal intubation she suffered a cardiac arrest, recovering within a few minutes after the standard cardiopulmonary resuscitation techniques, including epinephrine administration through the intraosseous line, was initiated. Another intraosseous line was then placed into the left tibia for perfusion of dopamine. Both intraosseous needles were inserted into the medial surface of each tibia, 2 cm above the medial malleolus. The needles were fixed with a U-shaped splint device made by bending a tongue depressor into three parts, which were joined with strap.

Throughout the first 8 h of stay the only available route for fluid and drugs administration was the intraosseous one. A total of 240 ml fluids (sodium bicarbonate, human albumin, packed red cells, fresh frozen plasma and glucose solution), antibiotics (ampicillin, gentamicin), vitamin K and pancuronium were administered through these two lines.

After this period a venous central line cannulation became possible and both intraosseous lines were removed. There were no complications related to placement, use, or maintenance of the intraosseous route.

Patient's condition stabilized, and inotropic therapy could be discontinued within 48 h. Cultures were negatives. When shock remitted a differential pressure between brachial and femoral vessels was noted; persistent cardiomegaly was evident on chest X-ray. Aorta coarctation was diagnosed and the patient underwent cardiac surgery on day 15 after admission. At present she is at home in good condition.

It is well known the difficulty in obtaining intravascular access in critically ill pediatric patients [3]. We recommend the intraosseous route as a fast, safe and effective technique in life-threatening situations for infants and children, including the neonatal period.

Yours faithfully,

R. Martino Alba, M. J. Ruiz Lopez and J. Casado Flores

References

- Spivey WH (1987) Intraosseous infusions. *J Pediatr* 111:639–643
- Casado Flores J, Valdivielso Serna A, Pérez Jurado L, Pozo Román J, Monleón Luque M, García Pérez J, Ruiz Beltrán A, García Teresa MA (1991) Subclavian vein catheterization in critically ill children: analysis of 322 cannulations. *Intensive Care Med* 17:350–354
- Rossetti V, Thompson BM, Aprahamian C, Darin JC, Mateer JR (1984) Difficulty and delay in intravascular access in pediatric arrests. *Ann Emerg Med* 13:405–409

J. Casado Flores, Servicio de Cuidados Intensivos Pediátricos, Avda. Menéndez Pelayo, 65, E-28009 Madrid, Spain

Letter to the editor

Dear Sir,

Dr. K. L. Yang has recently confirmed that the ratio of breathing frequency to tidal volume (f/V_T) and that of inspiratory pressure per breath to maximal inspiratory pressure ($P_I/P_{I,max}$) are reliable indices of the ability to extubate, the final step of the "weaning" process [1]. I write asking Dr. Yang to clarify a few points and to make two comments on his very informative work. Figure 1 in the paper is a tracing of 16 breaths over 20 s which shows a progressive increase in subatmospheric (negative) pressure with the airway completely occluded. To what extent does the pressure obtained by this method represent true maximal voluntary inspiratory capability? Could that pressure not be the result of increased neuromuscular drive due to 16 consecutive unsatiated breaths? The method used to measure $P_{I,max}$ by Dr. Yang differs from that used in other recent reports and cited later in this letter. In the results section we are informed that the two ratios, separately and together are very reliable. How was the reported numeric value of the combination of the two ratios derived? I wonder if an odds ratio and on ROC analysis would add statistical strength to the overall analysis.

The paper is, in effect, the natural extension of his previous work with Dr. M. Tobin [2]. Indeed, the ratios of mean f to mean V_T in four other reports [3–6] also clearly distinguish between the failure and success groups (see Table 1). The data from Yang's study and that from three other prospective studies [7–9] are given in the table. All four publications agree that the frequency:tidal volume ratio is a reasonably reliable index with a high degree of sensitivity and specificity. The same is true of the $P_I/P_{I,max}$ ratio as shown in the table which gives the data from Yang's report and that from the studies by other investigators [4, 7, 8]. However, there are large differences in the group means between the studies such that it is impossible to identify an approximate universal threshold value (cut-off point) with any degree of certainty, depriving us of a normal or expected value for either ratio, particularly when one takes the reported scatter into account. Although it is incorrect to compare different patient samples, there is an apparent difference between medical and surgical patients, in the sense that the latter had lower values (see Table).

The second comment relates to the clinical application of the information provided. Given that (a) the work of breathing is a critical determinant of the ability to discontinue ventilatory support or to reduce the ventilator's contribution to total ventilation and that (b) work is proportional to the square of tidal volume (V_T)² but only twice frequency ($2 \times f$), it makes intuitive sense to use the more mathematically stringent ratio of f/V_T rather than the looser product of the two, minute volume. The clinician needs a simple, sensitive and non-invasive index of whether any changes made in the ventilator settings or other therapeutic steps were the correct ones and also needs to simply and quickly determine improvement or worsening in his/her patients' ventilatory status.