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Prediction of the distance from the skin to the lumbar epidural space in ex-premature infants

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Regional anesthesia such as caudal epidural or intervertebral epidural anesthesia can offer excellent postoperative analgesia without respiratory depression to infants and children [1]. We have been providing intraoperative (combined with light general anesthesia) and postoperative pain relief with intervertebral epidural anesthesia in children for several years [2–4]. Based on this experience, we have reported a formula to predict the distance from the skin to the lumbar epidural space in infants and children [5]. The formula was derived from the data of infants and children who were born at full-term. Currently, more infants who were born prematurely (so-called ex-premature infants) undergo surgery. We measured the distance in ex-premature infants and tested the applicability of our formula. In addition, the applicability of the formula reported by Busoni [6] to ex-premature infants was also tested.

Our formula is based on body weight [5], and the Busoni formula is based on age [6]:

Formula based on weight [5]: $D = (W + 10) \times 0.8$,
Formula based on age [6]: $D = (\text{age in years} \times 2) + 10$,

where D is the distance (mm) from the skin to the lumbar epidural space (L2/3 or L3/4) and W is body weight (kg).

After institutional approval and informed parental consent, we measured the distance from the skin to the lumbar epidural space (L3/4) in 41 ex-premature infants undergoing inguinal hernia surgery. The mean birth weight was 1.3 ± 0.5 kg (mean ± SD) and the mean body weight at operation was 8.2 ± 3.2 kg. Epidural anesthesia (midline approach) was performed under general anesthesia, and the epidural space was identified by the micro-drip infusion technique [7]. The depth was marked on the pediatric epidural needle [8] and measured later. The measured depth and the predicted depth calculated by the two formulas were compared (Figs. 1 and 2).

The predicted depth based on weight correlated well ($r = 0.900$) to the measured depth. There were no significant differences between the measured depth and the predicted depth based on body weight ($P > 0.05$, Student's paired t-test). However, the predicted depth based on age differed from the measured depth ($P < 0.001$, Student's paired t-test).

Based on the data of 341 cases of pediatric lumbar epidural anesthesia, Kosaka et al. [9] reported the distance from the skin to the lumbar epidural space and suggested a good correlation between the distance and the age or the body weight of patients. Dalens and Chrysostome [10] illustrated graphically the distance from the skin to the epidural space according to the patient's weight in sacral intervertebral, lumbar, and thoracic epidural anesthesia. They also found that the distance was correlated with the patient's age and weight. However, these authors [9,10] did not provide a formula to predict the distance.

For several years after birth, these ex-premature infants are usually smaller in size for their age, so the formula based on age [6] is not suitable for predicting the distance in ex-premature infants.

In conclusion, our previously reported formula to predict the distance from the skin to the lumbar epidural space based on body weight [5] is applicable to predicting the distance in ex-premature infants. We hope that the use of this simple formula will contribute to greater safety and a better success rate in lumbar epidural anesthesia in ex-premature infants.

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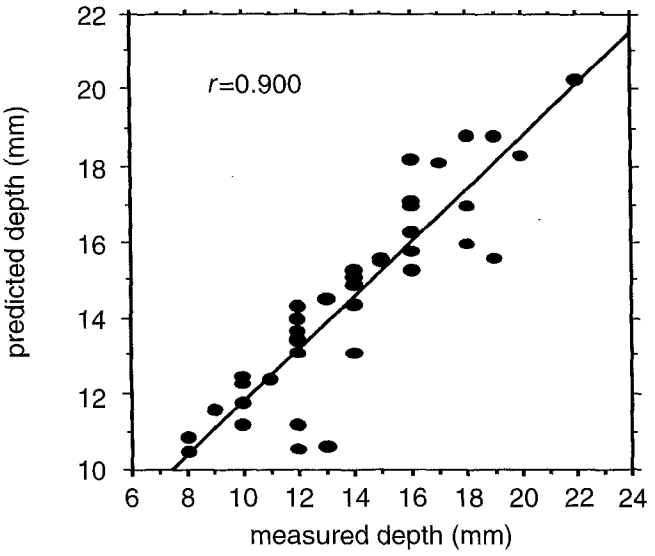

Fig. 1. Correlation between the measured depth from the skin to the lumbar epidural space in ex-premature infants and the predicted depth derived from the formula based on weight. $y = 0.694x + 4.897$; $r^2 = 0.811$; $P < 0.001$

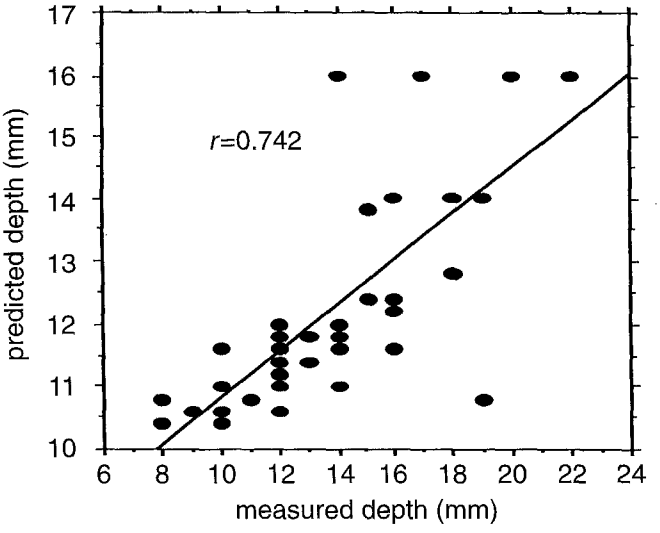

Fig. 2. Correlation between the measured depth from the skin to the lumbar epidural space in ex-premature infants and the predicted depth derived from the formula based on age. $y = 0.372x + 7.101$; $r^2 = 0.551$; $P < 0.001$

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