

## Distance from the Skin to the Epidural Space at the First Lumbar Interspace in a Japanese Obstetric Population

Kazuhisa SHIROYAMA\*, Hiromichi IZUMI, Takashi KUBO\*\* and Ryuji NAKAMURA

*Department of Anesthesia, Akane Foundation Tsuchiya General Hospital, 3-30 Nakashima, Naka-ku, Hiroshima 730-8655, Japan*

*\*Present address: Department of Anesthesia, National Hospital Kure Medical Center*

*\*\*Present address: Department of Anesthesia, Chugoku Rosai General Hospital*

### ABSTRACT

We prospectively examined the distance from the skin to the epidural space (SE distance) in 95 Japanese parturient women who underwent epidural anesthesia at the L1-2 interspace, and studied the correlation between various physical factors and SE distance. The same anesthesiologist inserted the epidural tubing with the patient in the right lateral decubitus position. An epidural needle was introduced into the skin vertically via the midline approach. The epidural space was located using the loss-of-resistance technique. SE distance was measured to the nearest 0.5 cm using centimeter markings on the shaft of the epidural needle. The median value of SE distance was 3.5 cm, with a range of 2.5 to 6.5 cm, and in 80% of cases SE distances were 3 to 4 cm. The correlation of body weight with SE distance was the highest of the physical factors ( $r^2 = 0.800$ ,  $p = 0.0001$ ), and a simple regression equation was formulated to aid in predicting SE distance: "SE distance (cm) =  $0.05 \times$  body weight (kg) + 0.36". This formula will be a useful clinical guide for administering epidural anesthesia in Japanese parturient women. In conclusion, the SE distance in most Japanese parturient women is between 3 and 4 cm at the L1-2 interspace and this value is most closely correlated with their body weight.

**Key words:** *Distance, Epidural space, Lumbar interspace, Obstetric*

Lumbar epidural anesthesia is the most commonly used anesthesia in cesarean sections. Since most obstetric patients undergoing the operation are young, inadvertent dural punctures are a potential cause of postdural puncture headaches<sup>3,9</sup>. A more precise estimate of the distance from the skin to the epidural space (SE distance) would aid in reducing the risk of inadvertent dural punctures during epidural procedures.

Although there have been several studies of SE distance in obstetric populations, in most the distance at the L3-4 interspace was examined<sup>6-8,10</sup>. The distance at L1-2 has rarely been examined. At our institution, spinal anesthesia at the L2-4 interspaces and epidural anesthesia at the T12-L2 interspaces are usually employed for cesarean sections. In the present study, we examined SE distances at the L1-2 interspace during epidural intubation in a Japanese obstetric popu-

lation, and compared them with those in other reports. Measured SE distances in our study were shorter than those in previous reports. Furthermore, we examined the correlation between physical factors and SE distance and devised a practical formula for predicting the SE distance.

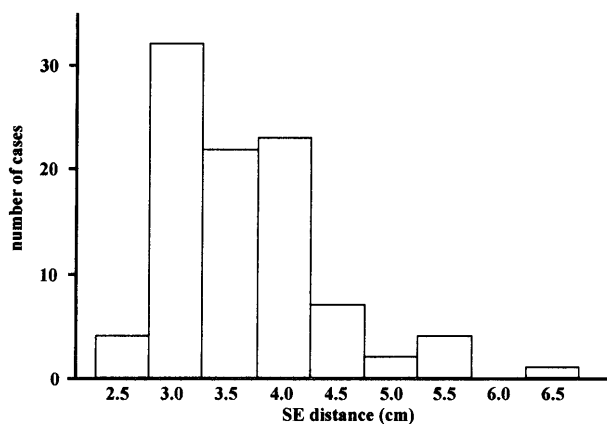
### MATERIALS AND METHODS

Ninety-five parturient women who underwent cesarean section at our institution between January 2000 and March 2003 were studied prospectively. Age, height, current weight, and prepregnant weight were obtained from their case records. Body mass index (BMI) was calculated as weight (kg)/height<sup>2</sup> (m<sup>2</sup>). The same anesthesiologist routinely administered the anesthesia for all the cesarean sections. All the parturient women had spinal anesthesia administered at the L3-4 interspace after epidural catheterization at the

L1–2 interspace while they were in the right lateral decubitus position. The vertebral interspace was estimated by taking a line connecting the highest points of the two iliac crests as corresponding to the L4 spinous process or the L4–5 interspace. A disposable epidural needle (B. Braun Co.) was introduced into the skin almost vertically via the midline approach at the L1–2 interspace. The epidural space was confirmed by using the loss-of-resistance technique. SE distance was measured to the nearest 0.5 cm using centimeter markings on the shaft of the epidural needle as in previous reports<sup>1,2,5,8</sup>. The median and range of the participants' height, current weight, prepregnant weight and BMI were calculated. The correlation between each physical factor and SE distance was analyzed using simple regression analysis. Pearson's correlation coefficients and a simple regression equation were obtained. Differences at  $p < 0.05$  were considered to be statistically significant.

### RESULTS

The parturient women's age, height, current weight, current BMI, prepregnant weight and the amount of weight gain were as follows: 30 (18–41) years old, 157 (147–170) cm, 63 (47–119) kg, 25.5

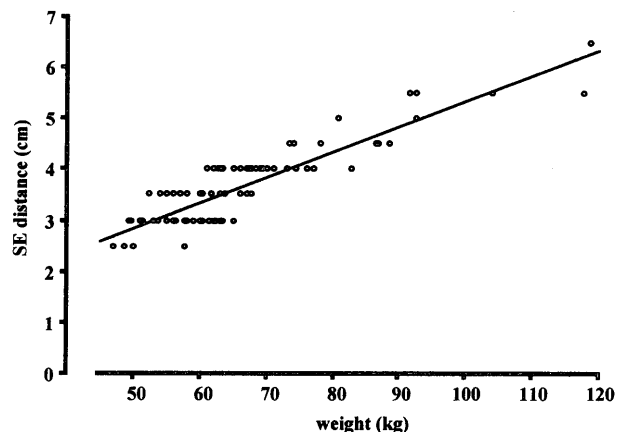


**Fig. 1.** Distribution of the distance from the skin to the epidural space (SE distance) at the L1-2 interspace.

The median of SE distance is 3.5 cm. The distance ranges from 2.5 to 6.5 cm, and in approximately 80% of cases is within 3 to 4 cm.

**Table 1.** Correlation between physical factors and the distance from the skin to the epidural space.

Physical factors	Correlation
Height	$r^2 = 0.074$ ( $p = 0.0078$ )
Current Weight	$r^2 = 0.800$ ( $p = 0.0001$ )
Body Mass Index	$r^2 = 0.765$ ( $p = 0.0001$ )
Prepregnant Weight	$r^2 = 0.761$ ( $p = 0.0001$ )
Weight Gain	$r^2 = 0.030$ ( $p = 0.1096$ )



**Fig. 2.** Correlation between body weight and the distance from the skin to the epidural space (SE distance).

Circles represent SE distance for each body weight. The solid line is the simple regression equation, that is, "SE distance =  $0.05 \times$  body weight (kg) + 0.36". The correlation between body weight and SE distance is statistically significant.

(19.5–43.5) kg/m<sup>2</sup>, 52 (37–115) kg, and 10 (2–20) kg, respectively. SE distance at the L1–2 interspace was 3.5 (2.5–6.5) cm (Fig. 1). The correlation between each of the physical factors excepting weight gain and SE distance was statistically significant (Table 1). Of all the physical factors, body weight had the highest correlation with SE distance (Fig. 2).

### DISCUSSION

The present study showed that SE distance at the L1–2 interspace while epidural anesthesia was being administered in the right lateral decubitus position ranged from 3 to 4 cm in the Japanese parturient women examined. Furthermore, of all the physical factors measured, SE distance most closely correlated with body weight, which can be expressed by the simple regression equation "SE distance (cm) =  $0.05 \times$  body weight (kg) + 0.36".

Previous reports<sup>4-7</sup> also showed that SE distance correlated positively with body weight. In the present study body weight ranged from 47 to 119 kg and the relationship between body weight and SE distance was higher than in previous reports. There are two possible reasons for the stronger correlation between body weight and SE distance in our study. Firstly, the same anesthesiologist performed the procedure in all patients. Secondly, the epidural puncture was technically easy in approximately 80 per cent of our patients because body weights were less than 70 kg. In obese women, the relationship between body weight and SE distance may be less reliable because epidural puncture is more difficult technically.

Palmer et al reported that the simple regression equation between body weight and SE distance was "SE distance (cm) =  $0.042 \times$  body weight (kg) + 1.67" (The original article expressed body weight in lb.)<sup>7)</sup>. In the present study there was a similar slope and a 1.31-cm smaller intercept on the Y-axis of the graph. Therefore, the SE distance obtained in our study was a little shorter than that obtained by Palmer. There are two possible reasons for this discrepancy. Firstly, SE distances in Caucasian women are significantly longer than those in Asian women<sup>5)</sup>. Secondly, the data in Palmer's report were obtained from measurements at the L3–4 interspace. SE distance is longer at the L3–4 interspace than at the L1–2 interspace<sup>2,4)</sup>. Our simple regression equation "SE distance =  $0.05 \times$  body weight (kg) + 0.36" has such a high correlation coefficient that the SE distance predicted by the use of this equation offers a useful clinical guide for administering epidural anesthesia to Japanese parturient women.

Hamza et al reported that SE distance is influenced by the woman's position when the epidural anesthesia is being administered<sup>1)</sup>. SE distance is significantly longer when the woman is in the left lateral decubitus position than in the sitting position. Therefore, anesthesiologists should be careful when administering an epidural puncture to a woman in the sitting position since the SE distance may be shorter than the SE distance value predicted by the new formula resulting from the present study.

In conclusion, the SE distances of most Japanese parturient women are 3 to 4 cm at the L1–2 interspace and the value can be predicted by the formula "SE distance (cm) =  $0.05 \times$  body weight (kg) + 0.36".

(Received June 12, 2003)

(Accepted July 8, 2003)

## REFERENCES

1. **Hamza, J., Smida, M., Benhamou, D. and Cohen, S.E.** 1995. Parturient's posture during epidural puncture affects the distance from skin to epidural space. *J. Clin. Anesth.* **7**: 1–4.
2. **Harrison, G.R. and Clowes, N.W.B.** 1985. The depth of the lumbar epidural space from the skin. *Anaesthesia* **40**: 685–687.
3. **Kuntz, K.M., Kokmen, E., Stevens, J.C., Miller, P., Offord, K.P. and Ho, M.M.** 1992. Post lumbar puncture headaches: experience in 501 consecutive procedures. *Neurology* **42**: 1884–1887.
4. **Matsumoto, J., Mitsuhashi, H., Matsumoto, S., Enzan, K. and Suzuki, M.** 1991. Skin-epidural distance in human lumbar region. *Masui* **40**: 250–257.
5. **Meiklejohn, B.H.** 1990. Distance from skin to the lumbar epidural space in an obstetric population. *Reg. Anesth.* **15**: 134–136.
6. **Oka, N., Hazano, S., Okada, T., Katoh, T. and Michiyabu, Y.** 1985. Distance from the skin to the lumbar epidural space in a parturient. *Masui* **34**: 1510–1514.
7. **Palmer, S., Abram, S.E., Maitra, A.M. and von Cokditz, J.H.** 1983. Distance from the skin to the lumbar epidural space in an obstetric population. *Anesth. Analg.* **62**: 944–946.
8. **Segal, S., Beach, M. and Eappen, S.** 1996. A multivariate model to predict the distance from the skin to the epidural space in an obstetric population. *Reg. Anesth.* **21**: 451–455.
9. **Vilming, S.T., Schrader, H. and Monstad, I.** 1989. The significance of age, sex, and cerebrospinal fluid pressure in post-lumbar-puncture headache. *Cephalalgia* **9**: 99–106.
10. **Watts, R.W.** 1993. The influence of obesity on the relationship between body mass index and the distance to the epidural space from the skin. *Anaesth. Intens. Care* **21**: 309–310.