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Original Contribution

Time-dependent changes in epidural catheter aspirate after injection of a local anesthetic☆

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Abstract

Study objective: A glucose check is used for investigation of a suspected accidental dural puncture in epidural anesthesia. However, glucose-positive clear fluid is sometimes aspirated from an epidural catheter in cases without clinical evidence of puncture. The goal of the study was to investigate time-dependent changes in the aspirate composition after injection of a local anesthetic into the epidural space.

Design: Observational study.

Setting: Operating rooms at Hamamatsu University Hospital.

Patients: The subjects were 30 patients (ASA I or II) undergoing surgery with combined epidural and general anesthesia.

Interventions: After epidural injection of local anesthetics, aspiration through the catheter was performed every 10 min until fluid could not be aspirated. pH, Na, K, Cl, Ca and glucose were measured in fluid samples using a blood gas analysis apparatus.

Main results: No patients had pain or clinical signs suggesting dural puncture throughout the perioperative period. Fluid aspiration was possible in 15 patients (50%) after 10 min and in 7, 3, 2 and 2 patients after 20, 30, 40 and 50 min, respectively. Glucose was detected in each aspirated fluid sample and gradually increased with time to become closer to the level in cerebrospinal fluid (CSF). Each electrolyte also changed to approach the level found in CSF.

Conclusions: A glucose check may increase the risk of a false-positive finding for accidental dural puncture with increasing time after local anesthetic injection. Conversely, detection of glucose at the time of epidural catheter placement may provide useful information for detection of accidental dural puncture.

1. Introduction

Epidural anesthesia is an effective perioperative technique, but has several risks, including the common complication of accidental dural puncture. The recommended techniques for detection of a puncture include fluid aspiration through the catheter before injection and injection of a small test dose. However, this approach does not identify all puncture cases and some reports recommend fractionated administration of local anesthetic [1,2].

Clear fluid aspirated from an epidural catheter during epidural anesthesia may be the injected local anesthetic or cerebrospinal fluid (CSF) and several methods have been described to distinguish between these two possibilities

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[3–9]. One common method is the so-called glucose check, which is based on the presence of glucose in CSF, but not in the anesthetic solution [3,5,7,10,11]. However, this method has a risk of a false-positive finding for accidental dural puncture. Waters et al. investigated the reliability of the glucose test using glucose oxidase paper every 30 min in healthy non-diabetic parturients after insertion of an epidural catheter, and found that 23 of 43 patients were positive for glucose at more than 30 min after the initial local anesthetic injection, despite none of the initial aspirate samples giving a positive result [10]. However, several types, doses and concentrations of local anesthetics were used as needed, the times required for a glucose-positive finding varied among the cases, and it was unclear how the composition of aspirate changed with time in the epidural space after the local anesthetic injection.

In our experience, clear fluid aspirate at 10 min can already give a positive result in a glucose check in some cases without clinical evidence of dural puncture, which provides misleading information suggesting accidental dural puncture. Changes in the composition of epidural aspirate after injection of local anesthetics are of interest to clinical anesthesiologists and an understanding of this phenomenon may be useful in identification of accidental dural puncture. Therefore, this study was performed to investigate time-dependent changes in fluid in the epidural space after local anesthetic injection, based on measurement of the composition of fluid aspirated via an epidural catheter. We hypothesized that this composition would gradually change and approach the composition of CSF in cases without clinical evidence of dural puncture.

2. Materials and methods

The study was performed with approval from the Hamamatsu University School of Medicine ethics committee and informed consent was obtained from all patients. The subjects were 30 patients (ASA I or II) undergoing surgery with combined epidural and general anesthesia. Before induction of general anesthesia, patients were turned to the left lateral position and the epidural space was identified using loss of resistance with a minimum volume of saline. An epidural catheter (B.Braun, Melsungen, Germany) was placed 4 to 5 cm into the epidural space through a 18-gauge epidural needle (B.Braun). After checking that fluid could not be aspirated from the catheter, 2 ml of 1% lidocaine was injected as a test dose. After checking for no signs of spinal block, general anesthesia was induced with 1–2 mg/kg propofol, 100 μg fentanyl and 0.05–0.2 μg/kg/min remifentanil. Tracheal intubation was facilitated using 0.6–0.7 mg/kg rocuronium. Anesthesia was maintained with 1.0–1.5% sevoflurane or propofol (target blood concentration 2.0–3.0 μg/ml) and 0.05–0.1 μg/kg/min remifentanil. After completion of general anesthesia, 10 ml of 1% lidocaine and 2 ml of fentanyl (100 μg) were injected via the epidural catheter. At 10 min after injection, 0.2 ml of fluid was aspirated from the catheter with a 1 ml syringe and discarded because this fluid was from the catheter, and not from the epidural space. A further 0.2 ml was aspirated and analyzed using a Radiometer ABL800 FLEX (Radiometer A/S, Bronshoj, Denmark) blood gas analysis apparatus for measurement of pH, Na, K, Cl, Ca and glucose. The same procedure was repeated every 10 min until 0.2 ml of fluid (0.4 ml including waste fluid) could not be aspirated. No additional dose of local anesthetics was given during this period. Vital signs were checked during surgery and the absence of motor and sensory disturbance of the lower extremities was confirmed after surgery. The presence of postdural puncture headache (PDPH), a distinctive symptom after dural puncture, was examined at 24 hours after surgery.

2.1. Statistical analysis

Data are expressed as means ± SD. Differences in age, height and weight between aspirated and non-aspirated patients were evaluated by Student t-test. Fluid aspirated at 0 min was considered to be local anesthetic. Non-aspirated cases were defined as those in which 0.4 ml of fluid, including waste fluid, could not be aspirated after 10 min. Changes in each composition variable from that of local anesthetic at each time point until 20 min were analyzed using repeated-measures one-way analysis of variance (ANOVA). If the ANOVA indicated significance, a Scheffe F-test for multiple comparisons was performed. $P < .05$ was considered to be statistically significant in all analyses.

3. Results

There were no difficulties with placement of the catheter into the epidural space in any patients and no clinical signs suggesting dural puncture throughout each perioperative period. A significant analgesic effect was obtained for all patients during and after surgery.

In 15 of 30 patients, fluid was aspirated from the epidural catheter at 10 min after injection of local anesthetic. The number of cases in which aspiration was possible decreased with time: 7, 3, 2 and 2 patients after 20, 30, 40 and 50 min, respectively. Fluid could not be aspirated at 60 min in all cases. All aspirated samples were clear fluid without blood contamination. There were no significant differences in background between cases in which fluid could and could not be aspirated (Table 1).

The average composition of fluids aspirated at 10-minute intervals are shown in Table 2 and individual changes are shown in Figure. The compositions of local anesthetics (10 ml of 1% lidocaine and 2 ml of fentanyl) and CSF analyzed with the same blood gas analysis apparatus are also shown in Table 2. The CSF data were obtained from three non-diabetic patients who were not subjects in this study and in whom a spinal-drainage catheter was inserted for thoracoabdominal or descending aortic replacement surgery. These