RESULTS

The results of measurements of oxygen consumption of three normal subjects breathing spontaneously and five postoperative patients on controlled respiration 24 hours post-thoracotomy are shown in Table 1. Both groups were supine and neither was in the basal metabolic state. The oxygen consumption in ml/min has been converted to l/m²/hour for comparison with the standard metabolic table values. The oxygen consumption values for the normal subjects are slightly higher than the standard values, probably because of their non-basal metabolic state. The patients' oxygen consumption measurements are both above and below the standard values; variables that affect these measurements include spontaneous muscular activity, body temperature, and levels of sedation and analgesia.

Because this apparatus is a high-pressure system when used with controlled respiration, leakage is the major source of error. Each of the patients in this study had an oroendotracheal airway which allowed a tight seal. Leakage in the apparatus was easily detected and checked, as described above. On repeated measurement of the same patients' oxygen consumption, deviation from the mean was found to lie within ±5 per cent.

DISCUSSION

The system described offers a simple, reliable means of measuring oxygen consumption in awake subjects with controlled respiration. Also, it may be used for measurements during anesthesia by filling it with the anesthetic mixture of gases when the subject has reached a stable plane of anesthesia.

The apparatus was found to be useful in evaluating patients for weaning from respirator-supported ventilation. The apparatus itself gives measurements of tidal volume, minute ventilation, oxygen consumption on controlled ventilation, vital capacity, and inspiratory force (by momentarily occluding the ventilator inlet tube with the outlet valve open) with spontaneous ventilation. By simultaneous measurements of arterial and central venous blood oxygen tensions, cardiac output and the A-aDO₂ may be measured.

REFERENCES


CASE REPORTS

Unexplained Failure of a Continuous Spinal Anesthetic

RICHARD B. WEISKOFF, M.D.

Occasionally anesthesiologists witness lack of adequate spinal anesthesia following administration of a single dose of local anesthetic through a needle which was thought to be properly placed into the subarachnoid space. Reports of lack of spinal anesthesia following administration of a local anesthetic through a catheter placed in the subarachnoid space are rare. This paper reports two such failures occurring on separate occasions in the same patient.
REPORT OF A CASE

A 48-year-old white man was admitted to the hospital with end-stage polycystic kidney disease. He had undergone repeated hemodialysis over the preceding two and a half years. Past medical history included hypertension for many years, congestive heart failure, and a cerebrovascular accident one year prior to admission. Medications which the patient was receiving included: alphamethyldopa, 250 mg, b.i.d.; diphenylhydantoin, 300 mg, b.i.d.; phenobarbital, 30 mg, t.i.d.; quinine, 65 mg, hs; and digoxin, 0.25 mg, q.d. Physical examination on the day prior to splenectomy and bilateral nephrectomy revealed a chronically ill man with left pleural effusion, bilateral rales, pericardial friction rub, gallop rhythm and partial aphasia. Serum electrolytes following dialysis on the evening prior to surgery were within normal limits.

The patient was premedicated with pentobarbital, 75 mg, and morphine sulfate, 7.5 mg, administered intramuscularly 90 minutes prior to subarachnoid block. Following preparation of the skin with benzalkonium chloride, 1:750, and skin infiltration with 0.5 per cent lidocaine, a 16 Tuohy needle was inserted without difficulty into the subarachnoid space at the L2–3 intervertebral space. Clear cerebrospinal fluid flowed freely. An epidural catheter (Portex disposable) could not be advanced cephalad into the subarachnoid space. The needle was rotated 180° and the catheter advanced caudad 3 cm without difficulty. Tetracaine, 16 mg, diluted to 4 ml with 10 per cent dextrose, was injected through the catheter in fractional doses over a 15-minute period. Over the next 25 minutes, there was no evidence of blockage of sensory, motor or sympathetic nerves. General anesthesia was then instituted. At the termination of the surgical operation, 90 minutes later, it was still possible to aspirate cerebrospinal fluid with ease from the catheter. The pH of the CSF at this time was 7.20. No evidence of subarachnoid anesthesia could be found.

Fourteen days later, on the day prior to renal homotransplantation, physical status and laboratory values were essentially unchanged. Hemodialysis was maintained at regular intervals prior to operation.

Premedication was as before. Following preparation of the skin with merthiolate and skin infiltration with 0.5 per cent lidocaine, a 16 Tuohy needle was placed in the subarachnoid space at the L2–3 interspace. Cerebrospinal fluid was clear and flowed freely. An epidural catheter (Portex disposable) was advanced 3–4 cm in a caudad direction and a paraesthesia was elicited in the right lower extremity. Clear cerebrospinal fluid of pH 7.22 was aspirated with ease from the catheter. Three ml of a mixture of tetracaine 4 mg/ml in 10 per cent dextrose in water were introduced through the catheter without apparent effect. Ten minutes later another two ml of this mixture were injected through the catheter. After a 20-minute wait, there was still no evidence of spinal anesthesia, despite the introduction of a total of 20 mg of tetracaine into the subarachnoid space. The patient could readily distinguish both light touch and pinprick. He had full range of motion in both lower extremities and there was no discernible change in skin color or temperature in the legs. The pH of the cerebrospinal fluid at this time was 7.03. General anesthesia was instituted. During both procedures muscular relaxation was poor and the use of systemic neuromuscular blockers was necessary. Two and a half hours later, the pH of the cerebrospinal fluid was 7.18. At the termination of the surgical operation, three hours later, cerebrospinal fluid could still be aspirated with ease. With the patient supine, as he had been for all previous injections, pantopaque, 1.5 ml, was injected through the catheter and an anterior posterior roentgenogram of the lumbar spine was made (fig. 1). This demonstrated that the catheter was in the subarachnoid space.

Several days later the patient's response to tetracaine was tested with intradermal injections of 0.1 ml of 0.2 per cent tetracaine and 0.1 ml of 0.02 per cent tetracaine. Both test doses provided good anesthesia.

![Fig. 1. Anteroposterior roentgenogram showing the epidural catheter within the subarachnoid space and pantopaque dispersed within the cerebrospinal fluid.](http://anesthesiology.pubs.asahq.org/pdfaccess.ashx?url=/data/journals/jasa/931584/...)}
DISCUSSION

Failure of a single-dose spinal anesthetic following a satisfactory spinal tap is not unusual. It is often attributed to movement of the needle after aspiration of cerebrospinal fluid, but before injection of the anesthetic, or to the level of the needle's being only partially within the subarachnoid space. These errors are not possible explanations when a catheter is positioned in the subarachnoid space such that cerebrospinal fluid can be aspirated from it at will.

Dripps, in a series of 506 continuous spinal anesthetics utilizing a catheter, reported 43 failures.1 Eighteen had no anesthesia at all, and in a few instances (exact number not indicated) fluid either could be withdrawn via the catheter or would drip from the catheter. Dripps speculated that this resulted from leakage of cerebrospinal fluid into the epidural space and placement of the catheter in that space. He also reported seven cases in which the first drug injected (tetracaine four times, procaine three times) produced no anesthesia, whereas injection of a second local anesthetic agent did produce anesthesia. It was speculated that the initial failures in the latter cases were due to drug resistance. Neither of these explanations is possible in the case reported here.

That the catheter was indeed within the subarachnoid space was amply demonstrated by the ease of aspiration and brisk flow of cerebrospinal fluid, the elicitation of a parasesthesia, and the radiographic study. The small deviation from normal of the pH of the cerebrospinal fluid is insufficient to explain this failure. Resistance of this individual to tetracaine was excluded by skin testing. Other uremic patients have had adequate spinal anesthesia at this institution. The reason for failure of tetracaine introduced into the subarachnoid space to provide anesthesia for this man on two separate occasions remains unexplained. Perhaps some of the failures of single-dose spinal anesthetic which we now attribute to the above-mentioned reasons result from the same unelucidated cause.

REFERENCE


Anesthetic Management for Surgical Separation of Thoracopagus Twins


Through 1967, 24 attempts to separate conjoined twins had been recorded.1-11 An excellent review of anesthetic management of conjoined twins has been published by Keats et al.12 We hope that our report will be of value to others who have to manage such cases, just as the experience of others was of tremendous help to us.

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REPORT OF A CASE

Female conjoined twins were born on January 12, 1969 to a para III woman (without antenatal observation). The labor was conducted by a village midwife (who was unaware of the twin pregnancy) without trauma to the mother or twins. Delivery was at full term, with cephalic presentation. The twins were admitted to All-India Institute of Medical Sciences Hospital on January 13, 1969, where they were studied.

Medical History. The twins were joined from xiphisternum to umbilicus, the circumference of their union being 21 cm (fig. 1). No other defects or abnormalities were seen. Their combined weight on admission was 4,750 g. Blood values were within normal limits. Roentgenograms showed separate hearts and gastrointestinal tracts. Twin

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