Comparing the results of available case reports in which the patients were anesthetized with various other methods with our experience, we come to the conclusion that ketamine is the anesthetic of choice for many procedures in patients with epidermolysis bullosa dystrophica.

REFERENCES

Total Spinal Anesthesia Following Intrathoracic Intercostal Nerve Blocks

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It has been shown1–4 that materials injected directly into a peripheral nerve can later be detected in the subarachnoid space and spinal cord. We are not aware of any report documenting an adverse central migration of local anesthetic deposited with known certainty into a peripheral nerve, except for reports of transverse myelitis following the use of Efocaine† for intercostal nerve block.5 The purpose of this communication is to report the occurrence of total spinal anesthesia resulting from the instillation of 0.75 per cent bupivacaine into six intercostal nerves under direct vision at the conclusion of an open thoracotomy while the patient was under general anesthesia.

REPORT OF A CASE

A previously healthy 32-year-old man was scheduled for a left lateral thoracotomy because of a one-day history of hemoptysis of bright red blood and a chest film that showed a large (8 cm) paramediastinal mass in the left chest. Additional history and physical examination were noncontributory, and results of all other laboratory studies were within normal limits.

Anesthesia during the first three and a half hours of operation, during which a left pneumonectomy was performed, was maintained with 1 per cent halothane in oxygen, pancuronium, 12 mg, iv, in six divided doses, and fentanyl, 0.3 mg, iv, in five divided doses. Throughout the operation blood pressure was 125–100/80–60 torr, pulse 95–115 beats/min, and CVP 8–9 cm H2O. Fluid replacement consisted of two liters of crystalloid and one unit of whole blood. Arterial blood gases were within normal limits.

Prior to closure of the chest, three ribs above and three below the incision were identified and each intercostal nerve bundle injected 1–2 cm lateral to the sympathetic chain with 3 ml 0.75 per cent bupivacaine containing 1:200,000 epinephrine.
Within three minutes the systemic pressure decreased from 125/80 torr to 65/30 torr and the pulse rate decreased from 114 to 98 beats/min. During the next five minutes a second unit of whole blood was rapidly infused and 5 mg ephedrine given iv, which restored the blood pressure to 95/30 torr and the pulse to 120 beats/min. Blood pressure and pulse remained stable during closure of the thorax, which was completed during the next hour. However, upon turning the patient from the right lateral decubitus to the supine position, the blood pressure decreased from 95/50 torr to 65/50 torr. This was treated with 10 mg ephedrine, iv, which restored systemic pressure to 95/50 torr.

In anticipation of an uncomplicated emergence from anesthesia, halothane was discontinued. Neuromuscular blockade was reversed by 2.5 mg neostigmine and 1.2 mg atropine, iv, and confirmed by well-sustained tetanus elicited by a nerve stimulator. Although the patient was still apneic, the trachea was extubated and ventilation by mask was begun in expectation of return of spontaneous ventilation. However, after 30 minutes and 0.4 mg naloxone, iv, the patient remained apneic, despite PaCO₂ 65 torr, pH 7.25, and PaO₂ 290 torr. Since one of us (J.S.) suspected total spinal anesthesia, it was elected to reintubate the patient's trachea and continue supportive treatment.

Two hours after the intercostal nerve injections, the patient remained unconscious, apneic, flaccid, without ankle, knee, or biceps tendon reflexes, and with dilated pupils. During the next two hours the following changes occurred in succession: tracheal tug, diaphragmatic movement, movement of the head, return of biceps tendon reflexes, flexion of the arms, detectable ankle reflexes, and return of responsiveness to command. Last, and most striking, was a clear-cut T₂ sensory level bilaterally elicited by pin prick when full consciousness returned. The patient was ventilated overnight, and his trachea was extubated the next day. He did well thereafter.

**DISCUSSION**

This case clearly demonstrates the occurrence of total spinal anesthesia subsequent to intercostal nerve blocks performed under direct vision in a patient under general anesthesia. The decreases in blood pressure and pulse, the persistent apnea, the failure to regain consciousness, the absence of reflexes, the dilated pupils, the temporal sequence of clinical recovery, and the clear-cut sensory level when the patient was awake all support this contention. Although the precise mechanism of this complication is not clear, there are several possibilities. First, it has long been recognized that there can be outward prolongation of the subarachnoid space along nerve roots. Postmortem examination has shown that these dural cuffs can extend as far as 8 cm past the intervertebral foramen. It is possible, then, that bupivacaine was introduced into one or more dural cuffs surrounding the intercostal nerves. A second possibility, suggested by previous studies by Moore and French, is that bupivacaine could have spread centrally into the spinal fluid via the perineural spaces. Last, although unlikely, bupivacaine could have been introduced directly into the subarachnoid space through an intervertebral foramen because of an unnoticed ill-placed angulation of the needle.

This report indicates a relative contraindication to the performance of intercostal nerve blocks near the spinal cord when the patient is under general anesthesia, when it is not possible to assess accurately the effect of the nerve blocks. As a consequence of this additional hazard, it may be safer to perform intercostal nerve blocks for postoperative analgesia when the patient is awake, and at a more peripheral point, as for example, more than 8 cm lateral to the intervertebral foramen. Finally, regardless of the exact mechanism, this case emphasizes the necessity of including spinal anesthesia in the differential diagnosis of postoperative cardiopulmonary and central nervous system depression when local anesthesia has been used in the vicinity of the spinal cord during general anesthesia.

**REFERENCES**

2. French JD, Strain WH, Jones GE: Mode of extension of contrast substance injected into peripheral nerves. J Neuropathol Exp Neurol 7:47–58, 1948