One-lung Ventilation for Thoracotomy Using a Hunsaker Jet Ventilation Tube

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ONE-lung ventilation (OLV) through a tracheostomy stoma is usually managed with bronchoscope-guided placement of either a Univent tube (Fuji Systems Co.), an endobronchial double lumen tube (DLT), a small endotracheal tube (left thoracotomy), or a bronchial blocker. This case report illustrates an alternative technique for OLV using a Hunsaker jet ventilation tube (Xomed Surgical Co., Florida) positioned down a tracheostomy.

Case Report

A 52-yr-old man was scheduled for left upper lobectomy for removal of a 2-cm lung nodule. Thirteen months before admission, the patient had radiotherapy to a stage III laryngeal carcinoma, followed by total laryngectomy, and radical neck dissection with closure using a pectoralis major muscle flap. Because of radiation-induced tracheal stenosis, a 36-mm soft silicon noncuffed laryngectomy tube (inner diameter, 12.5 mm) was placed through his stoma to dilate the stenosis. The surgeon then created a tracheoesophageal fistula and inserted a Blom-Singer 1.8cm Duckbill voice prosthesis through a defect cut into the back wall of the tracheostomy tube. The 5-mm proximal end of the voice prosthesis partly obstructed the tracheostomy tube superiorly (fig. 1). Removal of the laryngectomy tube would dislocate the voice prosthesis from the tracheoesophageal fistula, and the ENT surgeon requested that both be left in place during surgery if possible. The risk of aspiration was considered minimal with the voice prosthesis in place because it was located in the upper esophagus and was designed to act as a one-way valve for movement of air from trachea to esophagus when the tracheostomy is obstructed by a finger. Preoperative forced expiratory volume in 1 s (FEV1) was 74%, and forced vital capacity (FVC) was 91% of predicted.

The patient was premedicated with 0.3 mg of oral clonidine. After insertion of a thoracic epidural catheter (T5-T6) and intravenous and arterial catheters, the patient was preoxygenated and then heavily sedated with an infusion of propofol. Intravenous ketamine, 1 mg/kg, was given, and 3 ml of 4% lidocaine was instilled into the trachea. A Hunsaker jet ventilation tube† (Xomed Co., Jacksonville, FL) was inserted through the tracheostomy tube. To facilitate its insertion, the wings at the distal end of the tube were squeezed together. Using a pediatric bronchoscope, the entire length of the

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distal wings of the Hunsaker tube were inserted into the right main bronchus. The jet port of the catheter was positioned at the entrance of the right main bronchus (see fig 1). The proximal end of the Hunsaker tube was fed through the open port of a tracheostomy mask, which fitted snugly around the tracheostomy site. The swivel connector of the mask was connected to the anesthesia circuit and 100% oxygen, so that subsequent jet ventilation would entrain oxygen. The patient was given 50 μg of intravenous sufentanil and paralyzed with pancuronium. The Hunsaker tube was attached to the jet tubing of a Bird mark 2 ventilator connected to an H oxygen cylinder, and set at 60 psi to jet at 90 breath/min with an inspiratory-to-expiratory time ratio of 1:1. There was good visual expansion of the right side of the chest, and arterial blood gases taken after 5 min showed a PaO\textsubscript{2} of 376 mmHg and a PaCO\textsubscript{2} of 39 mmHg. Anesthesia was maintained with a propofol infusion and 15 ml of epidural 2% CO\textsubscript{2} lidocaine. The Hunsaker tube was taped to the side of the face; the patient was carefully positioned left side up, and the bronchoscope was reinserted to confirm the position of the Hunsaker tube. Thirty minutes after the incision, the left lung was fully collapsed. The surgeons stated that the rate of spontaneous lung collapse was the same as when using a DLT. Thoracotomy lasted 95 min; SaO\textsubscript{2} varied from 100% to 92%. Lateral decubitus blood gases showed PaO\textsubscript{2} at 469 mmHg and PaCO\textsubscript{2} at 28 mmHg (two-lung ventilation), decreasing to two values of PaO\textsubscript{2} at 65 and 69 mmHg (PaCO\textsubscript{2}, 26 mmHg) with OLV 30 and 50 min later (with lung collapse). Unfortunately biopsy of the tumor and aortopulmonary nodes showed small cell carcinoma, and lobectomy was cancelled. At chest closure, the Hunsaker tube was withdrawn into the trachea, with the distal wings above the carina (the jet port 5 cm above the carina). The Bird mark 2 ventilator was adjusted to a rate of 15 breath/min (jet inspiratory time, 2 s). This mode of ventilation caused rapid reflation of first that the left upper lobe, and then the left lower lobe. During chest closure, PaO\textsubscript{2} varied from 448 to 398 mmHg and PCO\textsubscript{2} was 37–39 mmHg. At the end of surgery, the patient was awake, and the Hunsaker tube was removed from the patient’s airway. Epidural meperidine was used for pain control, and the patient made an uneventful recovery from surgery.

Discussion

Jet ventilation catheters (often modified nasogastric tubes) are used for tracheal resection and reconstructive surgery, but they have not been used as an alternative to a DLT for lung resection. However, in 1981 El-Baz et al. successfully managed OLV in six patients undergoing sleeve pneumonectomy or tracheal resection, using a 2-mm inner diameter catheter passed through a standard endotracheal tube and then fed into the left main bronchus by the surgeon. The use of such jet ventilation catheters may be complicated by pneumothorax; the latter may be the result of the whip-like movement of the catheter with high frequency jet ventilation, causing tears in the tracheobronchial mucosa. Such excessive mobility of the catheter may also displace the tip of the catheter during surgery. Further, injury may occur because of the drying or cooling effect of a high jet of gas directed at the mucosal wall.

The Hunsaker tube was, originally designed for microlaryngoscopy. It has distal wings that center the high pressure jet in the tracheal or bronchial lumen 3 cm from the tip of the catheter. The wings limit the movement of the catheter and may prevent the jet from being directed against the mucosal surface. A side port allows monitoring of either end tidal CO\textsubscript{2} or tracheal pressures; an introducer aids its positioning, and as illustrated by this case, it can be inserted by the anesthetist and more reliably placed in position than a length of narrow tubing.

At present, Hunsaker jet ventilation tubes are a few centimeters too short (35 cm) to be used with conventional endotracheal tubes for OLV in adults. However, a longer version may prove to be ideal for tracheal resection and an alternative to a DLT for OLV. High frequency jet ventilation down a Hunsaker tube may be especially useful, as illustrated by this case report, when airway problems preclude the use of a DLT.

References

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CASE REPORTS


Radiographic Investigation of Unilateral Epidural Block after Single Injection

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WE report a case of unilateral epidural block developing after each of three attempts at single injection epidural block and discuss the cause of unilateral epidural block based on radiographic findings.

Case Report

A 53-yr-old woman, weighing 51 kg and 1.51 m tall, was admitted to our pain clinic for right low back pain. There were no abnormal findings on physical or neurologic examinations except for tenderness in the right lower lumbar paravertebral region. We treated her with single injection epidural block at the L5–S1 interspace using 5 ml of 1% mepivacaine once a week for three consecutive weeks. Each time, the patient complained of sensory and motor disturbance only on the left side. We confirmed unilateral epidural block with cold and pinprick tests. Radiography and magnetic resonance imaging of her lumbar spine did not provide any evidence of the cause of the unilateral epidural block. After obtaining informed consent, we conducted epidurography and computed tomographic (CT) epidurography by injecting nonionic radiographic contrast medium epidurally. After introducing a 22-gauge needle into the epidural space at the L5–S1 interspace in prone position under fluoroscopic control, we injected 4.5 ml of iopamidol mixed with 0.5 ml of 10% lidocaine. Posterior–anterior and lateral epidurography was carried out immedi-
ately after injection and transverse CT epidurography 10 min after injection. The injected contrast medium spread mainly to the left half of the L4–S1 epidural space and distributed mostly in the posterior epidural spaces (Fig. 1A, 1B). CT epidurography disclosed deformation of the dural sac, which showed a contracted inverted triangular shape with the summit pointing toward the laminal direction. Most of the epidurally injected contrast medium was confirmed to distribute to the left posterior part of the epidural space, whereas some also was seen in the right posterior and anterior parts of the epidural space (Fig. 1C). Analgesia developed only on the left side with extension to the L4–S2 dermatomes, as evaluated by pinprick test 25 min after the injection.

One hour after the first epidural injection, we again punctured her epidural space at same level under fluoroscopic control. This time, we intentionally directed the needle to the right side of the epidural space and injected 5 ml of iopamidol only. In contrast to the first epidurography, the second epidurography demonstrated exclusively right lateral distribution in relation to the median in the epidural space.

Discussion

According to the findings at epidurography and CT epidurography, it is most likely that in our case, the cause of the unilateral epidural block was a unilateral left-sided distribution of local anesthetics. Although a small volume of contrast medium was also seen on the right side, especially on CT epidurography, clinical analgesic effect appeared only on the left side. Presumably, the sensitivity of CT for contrast medium was high, but the concentration of local anesthetics was too small to produce a block.

The lumbar dura is anchored laterally and dorsomedially by each pair of spinal nerve roots and by dorsomedian connective tissue, which was noted by Blomberg et al. in their in vivo anatomic study using epiduroscopy.

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