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Pneumothorax Secondary to Ball-valve Obstruction during Jet Ventilation

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In 1967, Sanders introduced the jet injector, utilizing the Venturi principle to accomplish positive-pressure ventilation during bronchoscopy.[1] A more recent application of this injector is to provide ventilation and an unobstructed view of the surgical field during carbon dioxide laser microlaryngeal operations.[2] We report a case of pneumothorax accompanied by a pneumomediastinum and subcutaneous emphysema after jet ventilation during a CO_2 laser operation for vocal-cord papillomatosis.

REPORT OF A CASE

A 2½-year-old hispanic girl was admitted to the hospital with the diagnosis of recurrent juvenile laryngeal papillomas and respiratory distress. She was scheduled for direct laryngoscopy and CO_2 laser excision of laryngeal papillomas.

On physical examination, the child appeared well nourished well developed. She weighed 12.5 kg. Hoarseness with mild stridor were evident. Results of laboratory studies of blood and urine were essentially normal.

Premedication was not given. The patient was given ketamine, 50 mg, im, in the operating room. Anesthesia was induced with halothane, 2 per cent, nitrous oxide, 4 l/min, and oxygen, 2 l/min. Paralysis was achieved and maintained by use of intravenous infusion of succinylcholine, 0.2 per cent, and monitored with a peripheral nerve stimulator. After paralysis had been achieved, suspension laryngoscopy was performed by the surgeon.

A 14-gauge cannula attached to a Sanders jet injector was inserted within the lumen of the laryngoscope with the tip of the cannula extending just beyond the vocal cords. Ventilation was initiated using an intermittent jet of oxygen from a 50-psi wall source. After the first inspiration, the chest was noticed to remain fixed in the inspiratory position, and there was no discernible expiratory phase. Immediate laryngeal examination revealed prolapsed vocal cord papillomas forming a ball-valve obstruction of the airway. The obstruction was promptly relieved by partial removal of the tumor, and laser excision of the papillomas was accomplished uneventfully. The patient was transferred to the recovery room in a fully reactive state.

Approximately 15 min later, the patient was noticed to have crepitant subcutaneous emphysema of the neck, which rapidly spread to the upper anterior thorax. She was immediately returned to the operating room, where a 3.5-mm nasotracheal tube was inserted to secure an airway. Roentgenogram of the chest (fig. 1) revealed a right pneumothorax and a pneumomediastinum. During halothane–oxygen anesthesia, a chest tube was inserted. To relieve the subcutaneous emphysema, a small transverse incision on the skin was made above the manubrium, and a drain was inserted. The child was discharged from the hospital seven days later with complete resolution of the pneumothorax, pneumomediastinum, and subcutaneous emphysema.

DISCUSSION

The Sanders Injector utilizes a high-pressure oxygen jet and the Venturi principle. Smith has shown that the smaller the cannula attached to the jet ventilator, the greater the Venturi effect.[3] During jet ventilation, air is entrained from the oropharynx and is capable of drawing tumor tissue, blood, and other debris into the respiratory tract.[4] It has also been shown that jet ventilation in a narrowed airway can produce danger-

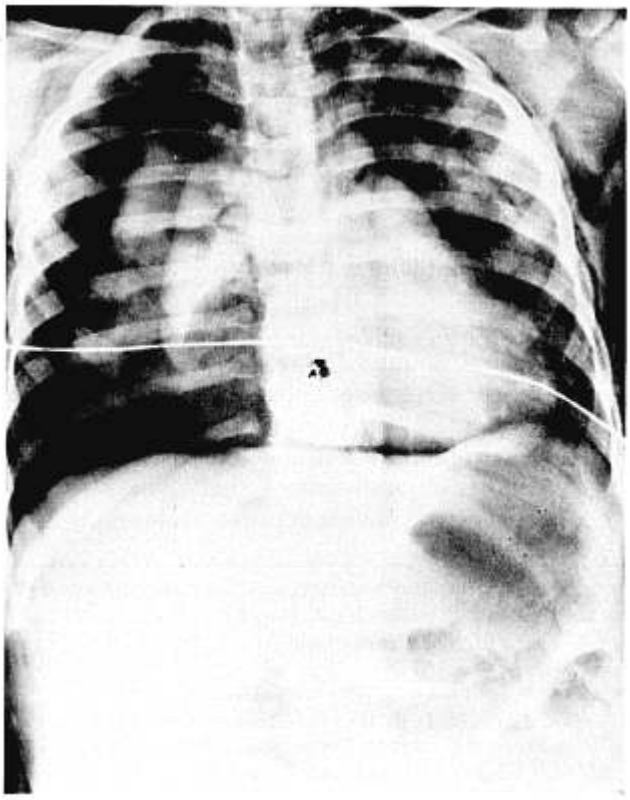

FIG. 1. Right pneumothorax and pneumomediastinum.

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ously high intratracheal pressures.[5] This high intratracheal pressure in the presence of a defect in the laryngotracheal mucosa may result in paratracheal fascial-plane dissection.

In our case the Venturi effect appeared to precipitate the prolapse of the large vocal-cord papilloma into the laryngeal inlet, forming a ball-valve obstruction during expiration. This narrowed or obstructed upper airway resulted in a high intratracheal pressure, initiating pneumothorax with mediastinal and subcutaneous emphysema. Abdominal distention has also been reported to occur following jet ventilation,[6] and a review of figure 1 reveals gastric dilatation, but its relevance here other than as an incidental finding is doubtful.

The use of the jet ventilator demands close observation and constant communication between surgeon and anesthesiologist. Any difficulty with ventilation should be promptly investigated.

A careful assessment of the laryngeal inlet must be undertaken prior to insertion of the jet cannula. In patients who have large vocal-cord lesions and a narrowed laryngeal airway, ventilation should be initiated at lower inflation pressures and increased as necessary to provide adequate ventilation. Norton *et al.*[2] have suggested initial endotracheal intubation and clearance of the airway in the anterior two thirds of the larynx prior to completing the remainder of the surgical procedure utilizing the jet injector. By providing an outlet for exhalation, the probability of a ball-valve obstruction is minimized.

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Reversal of Diazepam-induced Postanesthetic Somnolence with Physostigmine

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Diazepam is a popular intravenous induction agent and amnesic supplement during general anesthesia.[1,2] Prolonged postanesthetic somnolence is an occasional problem with diazepam, especially when large doses are used intraoperatively. Physostigmine is an effective antagonist to overdoses of anticholinesterase,[3] tricyclic antidepressants,[4,5] and phenothiazine[6] and Innovar-induced postoperative somnolence.[7] A recent report suggested that physostigmine was effective in reversing central nervous system depression occurring after administration of various combinations of diazepam and other central nervous system depressants.[8] This study was undertaken to evaluate the effectiveness of physostigmine as an antagonist to somnolence and disorientation after diazepam–nitrous oxide oxygen anesthesia in patients undergoing dilatation and curettage.

Methods

One hundred and eighteen women, ASA Class 1 or 2, scheduled for elective diagnostic dilatation and curettage and providing written informed consent at the preoperative visit were the experimental subjects Each patient was premedicated with diazepam, 10 mg, im, 60 min prior to the scheduled time of operation. An intravenous infusion was begun and routine monitoring (precordial stethoscope, blood pressure cuff, and electrocardiogram) initiated prior to anesthetic induction. Anesthetic induction was accomplished

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