J Anesth (1994) 8:490–492

Journal of
Anesthesia

Management of a patient with severe kyphoscoliosis and postoperative respiratory failure

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Key words: Scoliosis—Chronic restrictive pulmonary dysfunction—Pressure support ventilation

Introduction

It is well known that the pulmonary function of patients with severe scoliosis is disturbed due to reductions of total lung and vital capacities. Patients with less than 30% of percent vital capacity (%VC) were thought to be unable to undergo surgery because of postoperative cardiopulmonary dysfunction [1]. However, intraoperative monitoring and perioperative cardiopulmonary management are two examples of recent advances in general anesthetic techniques. These advances in general anesthesia have made it possible for patients with severe scoliosis, as well as high-risk patients, to undergo surgery [2]. The case reported herein provides additional evidence for successful surgical intervention and management of postoperative respiratory failure for a patient with severe kyphoscoliosis.

Case report

A 25-year-old woman with kyphoscoliosis was admitted to our hospital with complete obstruction of the intermediate bronchus by a thoracic vertebral body and an implanted instrument for correction of scoliosis. At the age of 17, she had received: (1) posterior spinal decompression, (2) Dwyer's instrumentation from T4 to T11 and from L3 to L4, (3) Leatherman's instrumentation from T2 to T9 at left side and posterior spine fusion from T1 to T11. The operation was scheduled for decompression and reopening of the obstructed bronchus.

On admission, her vital capacity (VC) was 630 ml (%VC was 24.3%), forced expiratory volume in 1 s ($FEV_{1.0}$) was 539 ml ($FEV_{1.0\%}$ was 85.5%) and maximum voluntary ventilation volume (MVV) was 24.5 l/min. $Paco_2$ was 55 mmHg and Pao_2 was 50 mmHg in room air. These findings and chest X-ray (Fig. 1) predicted that intra- and postoperative respiratory management, especially weaning from the postoperative mechanical ventilation, would be very difficult.

A lateral thoracotomy incision was used to enter into the right chest under 50% nitrous oxide and enflurane (0.5–1.0%) anesthesia supplemented with fentanyl. The operative procedures involved resection of the granulation at the compressed bronchial membranous portion, removing the Dwyer's screw and resection of the anterior half of the vertebral body, both of which compressed the bronchus. Vecuronium was used for muscle relaxation. Her lungs were ventilated manually during intrathoracic procedure and her $Paco_2$ and Pao_2 were kept at 45–50 mmHg and 100–200 mmHg, respectively. Bronchofiberscopy was done before, during, and after surgical procedure to confirm the compressed bronchus to be relieved. During bronchofiberscopy, 100% oxygen was administered and her Pao_2 kept above 100 mmHg.

Following the operation, her lungs were ventilated with continuous positive pressure ventilation with 5 cmH_2O PEEP in our intensive care unit. Tidal volume (V_T) of 250 ml and respiratory rate (RR) of 16 per min under F_IO_2 of 0.30 resulted in adequate oxygenation (Pao_2 = 110 mmHg) and ventilation ($Paco_2$ = 45 mmHg) on the day of surgery. On the 2nd postoperative day (day 2), we tried to wean the patient from the ventilator starting with the SIMV (synchronous intermittent mandatory ventilation) rate of 10/min. In this ventilatory setting, a V_T of 250 ml with PEEP of 5 cmH_2O was used under F_IO_2 of 0.30. She complained of a severe pain synchronizing with mandatory ventila-

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Received for publication on August 13, 1993; accepted on March 24, 1994

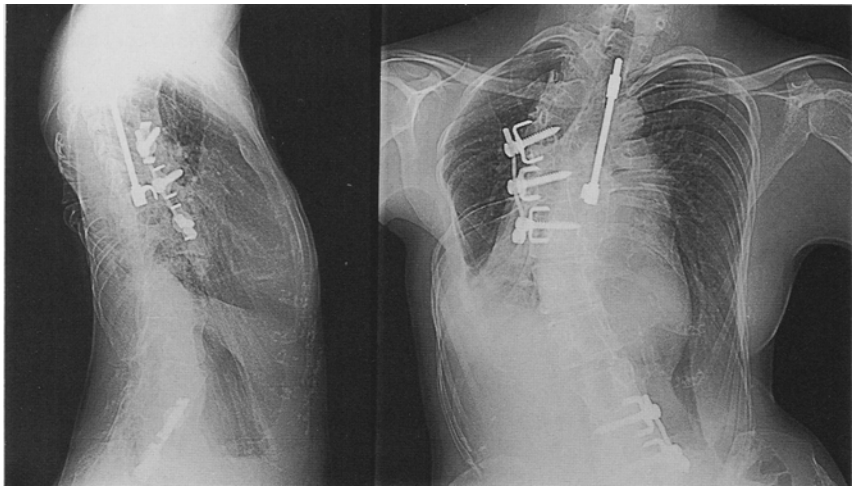

Fig. 1. Chest X-ray on admission. Significant spinal and thoracic deformity, and right middle and lower lobe atelectasis were seen. Cobb's angle was about 60 degrees

tion where the operation wound was located and was given pentazocine 0.5 mg/kg (i.m) every 3 h; the total dose of pentazocine administered was 150 mg in 30 h during SIMV. Due to the drug, her spontaneous breathing became much weaker. She suffered from severe hypercapnia, and was not allowed to decrease the rate of IMV. On day 3, we tried to decrease the rate of IMV, but failed again. Then, we switched to pressure support ventilation (PSV with Siemens Servo 900D Solna, Sweden) from SIMV. Pressure support of 20 cmH_2O with a trigger pressure of -3 cmH_2O was applied. At this ventilatory setting, her RR was 22–28 breath/min and her V_T was 150–300 ml. Peak negative pressure, when we gave pause to PSV, was -18 cmH_2O. Peak negative pressure was measured with a manometer as the maximum pressure below atmospheric that she can exert against a completely occluded endotracheal tube. Immediately after PSV, she became comfortable and intervals of analgesic administration became longer (6 h), total dose of administered pentazocine was 135 mg in 46 h during PSV. We then gradually decreased the support pressure by monitoring RR, heart rate, percutaneous O_2 saturation, and blood gas analysis. On day 5, she was separated from the ventilator with peak negative pressure of -40 cmH_2O and MVV of 14.4 l/min. After extubation of the endotracheal tube, her pH, Pa_{O_2}, and Pa_{CO_2}, were 7.37, 131 mmHg (F_{IO_2} = 0.40), and 63 mmHg, respectively. Her recovery thereafter was uneventful and she was discharged from the hospital about 2 months after surgery.

Discussion

Postoperative respiratory management in patients with severe scoliosis is generally considered difficult because of a reduction in lung volumes and a deterioration in lung and chest wall mechanics by thoracic surgery. Focusing on patients with ventilatory impairment after surgery, weaning from mechanical ventilatory support has generally been done based on the conventional criteria such as vital capacity and negative inspiratory pressure [3]. However, the ventilatory capacity and gas exchange function in our patient were marginal and did not satisfy those criteria. In addition, the indices of weaning in an acute deterioration of chronic respiratory failure have not yet been established. There were apprehensions in our case that long-term ventilatory support may cause inspiratory muscle atrophy and weaning failure based on the finding of Cohen et al. [4] that chronic inspiratory muscle atrophy may develop in patients with severe lung disease during long-term mechanical ventilatory support. Although weaning was started with SIMV immediately after surgery, she could not be successfully weaned from SIMV. Hurst et al. [5] reported that IMV might create a state of chronic fatigue and repeated weaning failure. In contrast, PSV is a newer mode of ventilatory support that has been reported to reduce the weaning time, decrease the work of breathing, and make the patient more comfortable [6–9] compared with other conventional techniques. PSV allows patients to continue to use their respiratory muscles without fatigue, and the amount of patient's respiratory work can be controlled by increasing and decreasing the support pressure [6–9]. Thus, we switched SIMV to PSV.

In this present case, the interval of administration of the analgesic was prolonged by changing to PSV. We do not know why PSV reduced the doses of the analgesic. However, we could not exclude the possibility that the pain from thoracotomy was becoming less with time. Stewart [10] reported that the requirements for sedation were reduced on PSV compared to conventional controlled ventilation. MacIntyre [6] reported that PSV

improves patient comfort, reduces the patient's ventilatory work, and provides a more balanced pressure and volume change following muscle work. These advantages for PSV could possibly allow successful weaning of our patient with severe respiratory impairment from ventilatory support.

In summary, the patient with severe postoperative respiratory failure was successfully weaned from the ventilatory support. PSV is one of the advantageous methods for weaning a patient suffering from severe postoperative respiratory failure.

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