ELSEVIER

Morbid Obesity and the Prone Position: A Case Report

Jay B. Brodsky, MD* Matthew Oldroyd, MD,† Howard N. Winfield, MD,‡ Paul M. Kozlowski, MD,§

Departments of Anesthesia and Urology, Stanford University School of Medicine, Stanford, CA

An improperly positioned prone patient can experience serious impairment of cardiopulmonary function. However, with appropriate preparation, even an extremely obese patient can safely tolerate the prone position.

Keywords: Body mass index; obesity: morbid; patient positioning: prone.

Case Report

A 37-year-old, 193 kg, 173 cm tall [body mass index (BMI) > 65 kg/m^2] woman was scheduled for percutaneous nephrolithotripsy. Her past medical history was significant for hypothyroidism controlled with thyroid supplements, nephrolithiasis, urinary tract infections, and osteoarthritis. There was no history of obstructive sleep apnea.

Preoperative physical examination revealed a Mallampati Class II view of the oropharynx, full range of motion of her head and neck, a thyromental distance of >5 finger breadths, and normal dentition. Vital signs, laboratory data, and ECG were each within normal limits.

After premedication with Bicitra, metoclopramide, and famotidine, the patient was brought to the operating room on a transport gurney. With the patient supine and breathing room air, a radial artery catheter was placed to allow arterial blood gas (ABG) sampling.

The patient was allowed to breath 100% O_2 by mask. Cricoid pressure was applied, and intravenous sodium thiopental (500 mg IV) and succinylcholine (140 mg IV) were administered. The patient's trachea was easily intubated with an 8.0 mm endotracheal tube (ETT) using a Macintosh #3 laryngoscope blade. Her lungs were ventilated with 100% O_2 and isoflurane, with a tidal volume of 1000 mL at a rate of 6/min with an I:E ratio of 1:2. The peak inspiratory pressure (PIP) was 30 cm H_2O.

Twelve people were needed to turn her prone onto two conventional operating tables that had been placed side by side. Extra large pelvic and shoulder bolsters were used (*Figure* 1*)*. Care was taken to position her over the bolsters to allow her abdomen to hang freely (*Figure* 2*)*. All pressure areas were padded.

In the prone position, the patient had bilateral equal breath sounds and equal chest excursion. Inspired O_2 concentration (F_iO_2) and ventilator settings were initially left unchanged, but the rate was increased from 6 to 8 breaths/min during the procedure because of mild hypoventilation. Her PIP remained at 30 cm H_2O with a tidal volume of 1000 mL. Several ABGs were obtained during the

*Professor of Anesthesia

†Resident in Anesthesia

‡Associate Professor of Urology

§Fellow in Urology

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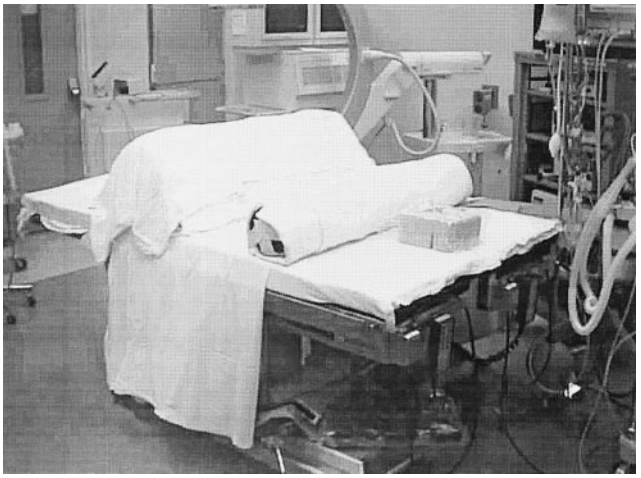

Figure 1. Two conventional operating room tables were placed together to accommodate this patient. Extra large pelvic and shoulder bolsters were needed to place the patient in the prone position.

procedure *(Table 1)*. She remained hemodynamically stable throughout the 3-hour operation. She had an uneventful emergence from anesthesia, and her trachea was then extubated.

Two and then three weeks later she returned for repeat endoscopic procedures. On both these occasions a "staircase" was built using lifts *(Figure 3)*. The patient climbed the staircase and positioned herself prone on the supports on the operating tables. She was then mildly sedated with midazolam (2 mg IV) and fentanyl (200 μg IV). After each of these procedures she turned and moved herself onto the gurney.

Figure 2. The patient was placed in the prone position. With her shoulders and pelvis supported by the large bolsters, her abdomen hung freely avoiding cardio-pulmonary problems.

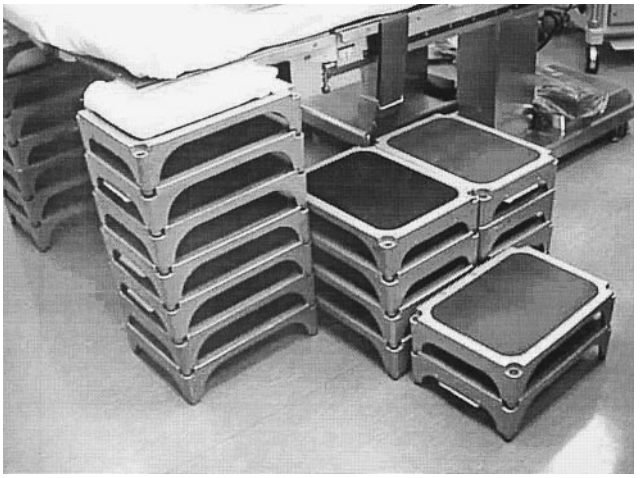

Figure 3. Surgical lifts were used to build a "staircase". The patient climbed and positioned herself prone on the operating tables.

Discussion

Obesity is associated with high intraabdominal pressure and decreased functional residual capacity, end-expiratory lung volume, and total lung capacity.[1] During general anesthesia with muscle paralysis, there is a further reduction of lung volumes that is directly related to increasing BMI.[2]

A patient who is improperly placed in the prone position can experience significant cardiopulmonary impairment. If the abdomen is compressed the diaphragm will be displaced and chest wall movement will be restricted.[3] Inferior vena caval compression will decrease venous return to the heart.[4] The patient may experience hypotension from decreased left ventricular volume due to the caval compression, and from the increased intrathoracic pressures generated during mechanical ventilation.[5]

Once anesthetized, morbidly obese patients are difficult to move to any position. Because ventilatory and hemodynamic compromise can occur in an improperly positioned prone patient, surgical procedures usually done in the prone position are often performed in the lateral decubitus position in morbidly obese patients.[6] They tolerate this position because their panniculus is displaced off the abdomen reducing intra-abdominal pressure and allowing greater diaphragmatic excursion during mechanical ventilation.[7]

In the prone position, if the abdomen is allowed to hang freely, respiratory mechanics, lung volumes, and oxygenation are improved in ventilated normal weight patients,[8–10] and in mild to moderately obese patients (average BMI = 34, range 30–46).[11] To date, there are no reports of patients as large as ours being ventilated in the prone position. Without changing tidal volume or F_iO_2, our patient's arterial O_2 tension (P_aO_2) increased from 363 mmHg (supine) to 448 mmHg (prone) during the procedure. We continued to ventilate her with a F_iO_2 of 1.0 despite the PaO_2 because of our concerns that if any problem occurred, she would desaturate very rapidly if

Table 1. Arterial Blood Gas Results During Procedure

	F_iO_2 (%)	pH	P_aCO_2 (mmHg)	P_aO_2 (mmHg)	Ventilatory Parameters
Preoperative (supine) (room air)	0.21	7.41	33	104	Spontaneous ventilation
Intraoperative Ventilated—supine	1.0	7.31	49	363	TV 1000, RR 6, I:E 1:2, PIP 30
Intraoperative Ventilated—prone #1	1.0	7.31	48	370	TV 1000, RR 6, I:E 1:2, PIP 30
Intraoperative Ventilated—prone #2	1.0	7.34	43	448	TV 1000, RR 8, I:E 1:2, PIP 30
Postoperative (supine)	Nasal O_2	7.39	39	69	Spontaneous ventilation

F_iO_2 = inspired oxygen concentration, P_aCO_2 = arterial carbon dioxide tension, P_aO_2 = arterial oxygen tension, TV = tidal volume (mL), RR = respiratory rate (breaths/min), I:E = inspiratory:expiratory ratio, PIP = peak inspiratory pressure (cm H_2O).

ventilated with a lower concentration of oxygen. Fortunately, there were no problems at all during the procedure. Because of mild carbon dioxide retention, the ventilator rate was increased from 6 to 8 breaths/min during the procedure.

Other management strategies must also be considered when planning an anesthetic for a prone morbidly obese patient. An operating room with sufficient space is required. Because the cystoscopy room where we usually perform lithotripsy procedures would not have been large enough, we chose a larger operating room. Two tables can be placed side-by-side to accommodate a very large sized or heavy patient.

Turning an extremely obese patient from supine to prone is labor intensive and requires coordination of the many assistants. It can help if the patient can turn himself. If a general anesthetic is required, an "awake" intubation can be performed and the patient can position himself before induction of anesthesia.[12] An awake intubation was a feasible alternative in this case, but it can be an unpleasant experience for the patient so we chose to establish the airway under general anesthesia in our patient. During her two subsequent procedures, we allowed her to position herself. This option does offer some benefits since an awake patient can identify those areas that require additional padding. Appropriate padding over pressure points can avoid injury.

In conclusion, this case demonstrates that, with proper preparation, even an extremely obese patient can safely tolerate the prone position.

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