

Unilateral pulmonary edema after laparoscopic nephrectomy

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Abstract

Unilateral-dependent pulmonary edema though reported in laparoscopic donor nephrectomies, has not been reported after laparoscopic non-donor nephrectomies. A 75-kg, 61-year-old man, a diagnosed case of right renal cell carcinoma was scheduled for laparoscopic nephrectomy. After establishing general anesthesia, the patient was positioned in the left-sided modified kidney (flank) position. During the 5.75-hour procedure, he was hemodynamically stable except for a transient drop in blood pressure immediately after positioning. Intra-abdominal pressure was maintained less than 15 mmHg throughout the procedure. Blood loss was approximately 50 mL and urine output was 100 mL in the first hour followed by a total of 20 mL in the next 4.75 hours. Total fluid received during the procedure included 1.5 L of Ringer's lactate and 1.0 L of 6% hydroxyethyl starch. After an uneventful procedure he developed respiratory distress in the postoperative period with a radiological evidence of dependent lung edema. Clinical and radiological improvement followed noninvasive ventilation, intravenous diuretics and oxygen therapy.

Key words: Dependent pulmonary edema, laparoscopic nephrectomy, unilateral pulmonary edema

Introduction

Laparoscopic nephrectomy has become increasingly popular for donor nephrectomies, since it is associated with lower morbidity and has the advantage that use of minimal access may promote kidney donation.^[1] We present a case of unilateral dependent pulmonary edema in an adult male patient who underwent laparoscopic nephrectomy for renal cell carcinoma. This entity is now increasingly being recognized as one of the complications unique to laparoscopic living donor nephrectomies.^[2,3] It is important that the anesthesiologists be aware of its possibility in any prolonged laparoscopic surgical procedures performed in lateral decubitus position.

Case Report

A 75-kg, 61-year-old man, a well-controlled hypertensive

was scheduled for laparoscopic nephrectomy for right renal cell carcinoma. General anesthesia was induced with intravenous (IV) fentanyl 150 mcg and propofol 200 mg, and thereafter maintained with isoflurane 2% in oxygen and air. His trachea was intubated after establishing muscle relaxation with IV vecuronium 8 mg and repeat doses of 1 mg were administered to maintain a train-of-four count of 0 to 1. Patient was mechanically ventilated with an initial setting of 600 ml of tidal volume and a respiratory rate of 12 per minute. He was positioned for surgery in the left modified kidney (flank) position. Intra-abdominal pressure (IAP) was maintained less than 15 mmHg during laparoscopy. Maximum peak airway pressure noticed during laparoscopy was 25 cm of H₂O. End-tidal carbon dioxide (ETCO₂) less than 40 mmHg was maintained by increasing the respiratory rate to 15 to 16 per minute. Urine output was 100 mL in the first hour followed by a total of 20 mL in the next 4.75 hours despite two fluid challenges with 250 mL of 6% hydroxyl-ethyl starch (HES). Throughout the procedure the systolic and diastolic noninvasive blood pressures were 90 to 100 mmHg and 50 to 60 mmHg, respectively. There was a transient drop to 78/40 mmHg immediately after positioning, which was treated with a bolus of IV mephentermine 6 mg. His heart rate ranged from 60 to 90 beats per minute. There was no episode of desaturation during the procedure. A total of 1.5 L of Ringer's lactate and 1.0 L of 6% HES were infused during the entire 5.75-hour procedure. Intraoperative blood loss was approximately 50 mL. After the procedure with the patient supine, neuromuscular blockade was reversed after noting four twitches on train-of-four count. The trachea was

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extubated when he was awake, breathing adequately with good cough reflex and having a sustained head lift. He was monitored in the postoperative room and administered oxygen supplementation 6 L/min by face mask.

Approximately 1 hour after tracheal extubation, he became anxious, complained of discomfort over the left chest and was tachypneic. The SpO₂ was 77% and coarse crepitations and rhonchi were heard over the left chest. Treatment was initiated by enhancing oxygen supplementation (by changing to a venturi mask set to deliver 0.6 FiO₂) and IV furosemide. Blood gas analysis at 0.6 FiO₂ revealed poor oxygenation with metabolic acidosis [pH: 7.288, pCO₂: 39.9 mmHg, pO₂: 47.7 mmHg, SaO₂: 80.1%, HCO₃⁻: 18.2(std), 18.5(calc), ABE: -7.3(calc), 6.9(std)]. ECG revealed sinus tachycardia with S₁Q₃T₃ pattern suggestive of right ventricular strain. A bedside echocardiogram showed normal biventricular systolic function. Troponin T level was not elevated at 12 hours after the episode. The chest X-ray revealed haziness of the entire left lung fields, more so in the mid and lower zones and haziness in the right perihilar area [Figure 1] suggestive

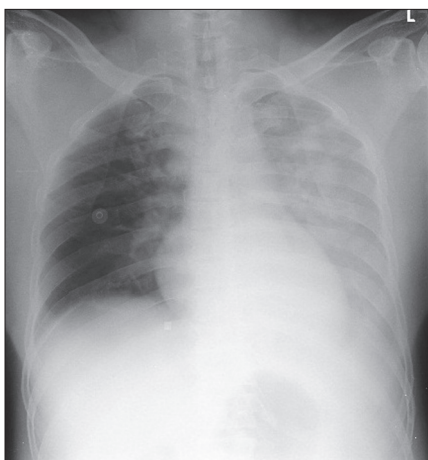


Figure 1: Left-sided dependent pulmonary edema

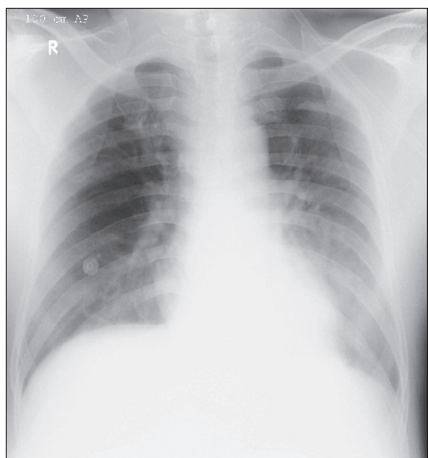


Figure 2: Resolving left-sided pulmonary edema

of dependent lung edema. He was shifted to the ICU and noninvasive ventilation (NIV) initiated in the propped up position. Clinical and radiological improvement [Figure 2] was noted after 12 hours and the NIV was discontinued. The rest of his hospital stay was unremarkable.

Discussion

Our patient demonstrated an uncommon complication of laparoscopic nephrectomy performed in left-lateral position which manifested as acute postoperative desaturation with radiological evidence of dependent pulmonary edema. The lateral decubitus position alters the physiology of pulmonary ventilation and perfusion. During lateral position with controlled ventilation, the dependent zones or the lower lung become hyperperfused and hypoventilated, whereas the nondependent or the upper lung become hypoperfused and hyperventilated. Hypoventilation of the dependent lung occurs due to upward displacement of the dependent hemidiaphragm under anesthesia and the mediastinal sagging.^[4] Ventilation of the dependent lung gets further worsened by carbon dioxide pneumoperitoneum and patient positioning maneuvers, including flexion of the operating table and elevation of the kidney rest.

Starling's equation states that the net fluid filtration at any point within a systemic or pulmonary circulation is largely dependent on capillary hydrostatic pressure.^[5] As the pulmonary capillary hydrostatic pressure was higher due to dependency, there was an increased propensity for fluid extravasation in the hyperperfused dependent lung.

Operations in which the patient is in the lateral decubitus position for 5 hours or more with high fluid requirements may be an independent risk factor for dependent pulmonary edema.^[2] Positive pressure ventilation could have masked the clinical manifestations of pulmonary edema during the intraoperative period. The possibility of re-expansion pulmonary edema was ruled out because it results from rapid re-expansion of a chronically collapsed lung.^[6]

London *et al.* recommended routine intraoperative volume expansion to reverse the changes in renal blood flow during prolonged CO₂ pneumoperitoneum to improve urine output.^[7] It has been suggested that optimizing intraoperative hydration by vigorous preloading may minimize the negative impact of pneumoperitoneum on renal perfusion as well as maintain urine production by the donor kidney.^[8] It is important to recognize the effect of prolonged pneumoperitoneum on urine output and avoid excessive intraoperative fluid administration in an attempt to stimulate urine production.^[9] Despite all the

evidence suggesting adverse effects of CO₂ pneumoperitoneum on renal blood flow and function, there have been no reports of permanent renal dysfunction after uncomplicated laparoscopic procedure. Lower volume fluid management strategies in laparoscopic donor nephrectomy do not appear to worsen recipient outcomes nor are they detrimental to the donors.^[10] Although in the case described, large volumes were not administered, mechanical effects of prolonged lateral decubitus position, pneumoperitoneum, ventilation-perfusion mismatch and Starling's forces summated to bring about this clinical condition.

This patient presented with unilateral dependent pulmonary edema following laparoscopic nephrectomy in lateral decubitus position for right renal cell carcinoma which manifested as acute postoperative desaturation. It is recommended that unilateral pulmonary edema be ruled out by radiological means, before tracheal extubation, whenever clinical evaluation indicates so. In case of pulmonary congestion or edema, it is prudent to ventilate the patient for few hours in the postoperative period. Should this happen after extubation, the management include oxygen therapy, ventilatory support, fluid restriction and diuretics.

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