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Restrictive Pattern Ventilatory Defect in a Case of Laparoscopic Robotic Hysterectomy

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INTRODUCTION
A 78 year-old female with large hiatus hernia who underwent a laparoscopic robotic hysterectomy developed a mechanical restrictive ventilatory defect secondary to subcutaneous emphysema, which was reflected by the rise of ETCO2 from 35 to 55mmHg.

CASE DESCRIPTION
A 78 year-old patient underwent laparoscopic & robot-assisted hysterectomy and bilateral salpingo-oophorectomy. Past medical history included hypertension, hyperlipidemia, hypothyroidism and large hiatus hernia. After a standard induction and endotracheal intubation, patient was positioned in a steep Trendelenburg position and pneumoperitoneum was created with inflation pressures up to a maximum of 15mmHg. Patient was maintained on pressure-controlled ventilation with peak airway pressures of 25mm Hg and with ETCO2 of around 35mm Hg.

Two hours after the start of pneumoperitoneum there was a gradual rise of the ETCO2 from 35mm Hg to a maximum of 36mm Hg. Ventilator parameters were adjusted continuously with an aim to keep the airway pressures below 35mm Hg and ETCO2 below 45mm Hg. Despite altering the ventilator settings to hyperventilate the patient, the ETCO2 continued to rise very gradually. Patient remained hemodynamically stable during the operation.

On examination patient had extensive swelling of the anterior chest wall, neck and face with crepitus sensation. On auscultation patient had bilateral equal breath sounds with ETT in optimal position. Also, the surgical port sites were assessed for any leaks and no leaks were found. The ETCO2 showed a dramatic return to pre-insufflation level on deflation of the pneumoperitoneum.

DISCUSSION
Laparoscopic gynecologic surgeries normally place a strain on pulmonary mechanics due to pneumoperitoneum and positioning. They reduce the FRC, TLC and pulmonary compliance, which is well known.

Various factors have been described in literature in the development of subcutaneous emphysema in robotic laparoscopic surgeries1. Besides the usual side effects of pneumoperitoneum in laparoscopic procedures1, the steep Trendelenburg position and extensive chest wall subcutaneous emphysema in our case caused the mechanical restrictive pattern secondary to the reduction in chest wall compliance.

Our patient also had a large hiatus hernia suggesting a significant defect in the under surface of the diaphragm. Despite keeping the insufflation pressures below 15mm Hg and increasing the ventilation parameters, ETCO2 continued to rise which could be due to escape of CO2 from the pneumoperitoneum cavity through the diaphragmatic defect communicating with chest wall and neck. As the insufflation was constant equal to breath, the constant escape of CO2 maintained the chest wall restrictive pattern despite increasing the ventilation dynamics.

CONCLUSIONS
The following may help minimize the development of ventilatory defect in patients having laparoscopic procedures:

1. Keep inflation pressure below 15mmHg.
2. Minimize the duration of surgery to less than 4 hours.
3. Use lower inflation pressures to maintain pneumoperitoneum on patients with large hiatus hernia.
4. Careful patient selection, thorough medical history avoiding elderly, frail and morbidly obese patients as they may not tolerate steep Trendelenburg positioning.
5. Using fewer than 4 insertion ports.
6. Patient visualization is limited therefore close communication with the surgical team is vital.

REFERENCES

DISCUSSION

<table>
<thead>
<tr>
<th>Actions to Initiate When Subcutaneous Emphysema Is Suspected or Noticed</th>
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<tbody>
<tr>
<td>Evaluate for a pneumothorax</td>
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<tr>
<td>Check end-tidal CO2 and arterial CO2</td>
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<tr>
<td>Increase ventilation rate and tidal volume</td>
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<tr>
<td>Increase oxygen to 100%</td>
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<tr>
<td>CO2 absorber in the circuit</td>
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<tr>
<td>Decreased LAP</td>
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<tr>
<td>Discontinue NO because it rapidly enters the area of tissue emphysema</td>
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<tr>
<td>Assess airway to ensure there is no compression before extubation</td>
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</tbody>
</table>

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