

## Case Report

# Indirect Electrothermal Coupling Bowel Injury — A Rare Complication of Laparoscopy

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In laparoscopic surgeries, indirect electrothermal injuries from capacitive coupling occur rarely. Capacitive coupling may release stray currents into neighbouring non-targeted tissues, even with intact instrument insulation. The degree of damage and the area affected are often underestimated. One such case of duodenal perforation occurred in a patient after laparoscopic myomectomy, performed to treat primary infertility. On the second postoperative day, she complained of abdominal pain and distension. She developed duodenal perforation even after strict adherence to the protocol and guidelines for laparoscopic myomectomy.

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Laparoscopy, a minimally invasive procedure has fewer postsurgical complications and hence widely practiced in Gynaecology. Electrosurgical advancements have further decreased the invasiveness of laparoscopic procedures in both, monopolar and bipolar modes. Monopolar generator is still preferred over bipolar tools for conventional laparoscopic surgery, due to its accessibility and favourable technical outcomes<sup>1</sup>. However, there are major safety concerns regarding electrothermal injury and nonspecific mechanical trauma caused by electrocautery<sup>2</sup>. Electrothermal injuries occur mainly due to insulation failure, direct and/or capacitive coupling<sup>3</sup>. Usually, these injuries go unrecognized during the surgery, as these are located beyond the laparoscopic visual field. The degree and area of damage to tissues is often underestimated. Unlike insulation failure and direct coupling that cause direct electrothermal damage; capacitive coupling releases stray current into non-targeted tissues in proximity to insulated metal objects and is rarely reported<sup>4</sup>. Such electrothermal injuries seem to be beyond the surgeon's control, since they are not completely understood, owing to their biophysical complexity<sup>5</sup>. Only seven such cases, causing fatal injuries such as gastrointestinal perforation and serious peritonitis, have been described. This report describes one such case of duodenal perforation due to capacitive coupling during laparoscopic myomectomy. We identified and highlighted the underlying risk factors of and possible preventative measures for capacitive coupling injuries in laparoscopic practice.

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### Editor's Comment :

- All Surgeons should be well informed of ergonomics of laparoscopic instruments.
- Electrosurgical units should always be checked before starting any surgery.
- Regular maintenance of electrical units should be done and documented.
- In case of any postoperative complications, though incidence is less, Coupling injuries should be there at back of mind to prevent the occurrence. As it can be life threatening.

### CASE REPORT

Our patient was a 38-year-old woman diagnosed with multiple large uterine fibroids on Ultrasonography (USG). Laparoscopic myomectomy was planned after voluntary consent, pre-operative work up and anaesthetic evaluation. In view of the large fibroids, patient was counselled about the need to convert to an open procedure. After induction, she was placed in Trendelenburg position, the laparoscope was introduced after adequate pneumoperitoneum and bowel loops retraction. We used a pulsatile monopolar current to make two separate incisions (7 cm and 4 cm) over the most prominent surface of fundal fibroid, with the entire working length of the instrument (Monopolar hook) in sight. Blunt and sharp dissection was used to enucleate fibroids. Continuous monopolar current was not used at any other point during the course of the surgery. The fibroid beds were sutured intracorporeally with Polyglactin suture. Haemostasis was achieved and specimens were retrieved by power morcellation. The procedure was uneventful and the instruments were removed through their respective ports under vision.

On postoperative day 2, the patient complained of abdominal pain, distension, pain in the right shoulder, and shortness of breath. On examination, she had tachycardia with a pulse of 124 beats/min, was hypotensive with a Systolic Blood Pressure of around 90 mm Hg, tachypnoeic with respiratory rate of 28 breaths/min. Her abdomen was distended and she had

decreased urine output. Laboratory reports showed, Haemoglobin-12 gm%, Serum creatinine-1.8 and Arterial Blood Gas analysis suggested metabolic acidosis. Her abdominal USG revealed moderate ascites which on tapping showed traces of bile pigments and bile salts.

The patient was taken for emergency abdominal exploration in view of clinical findings and investigations. On opening the abdominal cavity, 2–2.5 litres of bilious fluid was drained. The entire bowel was traced for any pathology (expecting direct instrument or cautery injury to the gastrointestinal tract), especially sigmoid colon, transverse colon, jejunum, ileum. On careful exploration, a perforation was identified in the second part of Duodenum (D2). It was closed primarily with Polyglactin with an omental patch above. After a thorough peritoneal lavage with a few litres of normal saline, the abdomen was closed in layers with two drains, one in Morrison's pouch and other a pelvic drain. The patient's vital parameters were thoroughly monitored. She recovered completely without any further complications.

### DISCUSSION

Indirect electrothermal burns from capacitance, to tubular organs such as the Ureter<sup>6</sup>, Bile duct<sup>1</sup> and small intestine<sup>7</sup>, due to the suspected stray capacitive current, have been occasionally reported in the past ten years, mainly in laparoscopy for infertility<sup>8</sup>.

Qiang Liu and Xue-Bing Sun have reported seven episodes of indirect electrosurgical damage to non-targeted tissues, including incidental coagulative necrosis of appendix, fallopian tube, cystic pedicle and broad ligament stump, in gynaecological practice<sup>8</sup>. Such an electrical response is amplified with increasing contact to the cystic wall (cyst diameter >3 cm).

Unlike those from insulation failure or direct coupling, severe indirect injuries occur in proximity to the active electrode, to the tissue impeding the capacitive current, like in our case. The adverse thermal effects vary depending on current intensity, duration of action, contact area, tissue conductivity and current waveform.

Though monopolar cautery was used sparingly, to make incision on the fibroid and facilitate enucleation, the perforation away from the site of port entry and the operative field could have happened due to coupling injury while using hook.

### Recommendations :

We recommend some measures to minimise capacitive coupling injuries, especially due to monopolar

electrocautery. Laparoscopic instruments should be routinely inspected before a procedure. The use of electrocautery, especially monopolar current, should be minimised, and when imperative, the lowest pulsatile power settings should be applied with the active electrode completely in sight.

A preliminary understanding of the fundamental biophysical principles involved in capacitive coupling is critical to prevent tissue damage, especially to susceptible non-targeted tissues or organs like the bowel. From this case study, we conclude that thorough staff training, regular safety inspections and strict adherence to procedures are imperative to minimise such risks and injuries, along with careful postoperative monitoring for early identification of any complication.

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