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Case Report

Monitoring of the intraoperative analgesia by pupillometry during laparoscopic splenectomy for splenic hydatid cyst☆

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ABSTRACT

Echinococcosis causes a hydatid cyst, a worldwide disease. Human beings are intermediate hosts, but dogs complete the life cycle of the cestode. The most common presentation sites are the liver and lungs. We present an unusual case of a primary splenic hydatid cyst. Open splenectomy has traditionally been the treatment of choice for splenic hydatid cysts. In recent years, minimally invasive laparoscopic surgery has been used in appropriate cases. A healthy 48-year-old woman was scheduled for laparoscopic splenectomy. We controlled the intraoperative analgesia using pupillometry. We used it as a method to evaluate the depth of analgesia and to guide opioid administration based on the pupillary dilation reflex. This is regulated by the autonomous sympathetic system. It appears to be more sensitive and reliable than using simple variations in heart rate and blood pressure. It is an easy and safe to use method that might allow a reduction in postoperative analgesic requirements.

1. Introduction

Hydatidosis is a zoonotic disease caused by the tapeworm *Echinococcus granulosus* in its larval form that infects human beings as an accidental intermediate host.

Most hydatid cysts are located in the liver (50%-80%) followed by the lungs (25%). The spleen is affected in 0.5%-6% of the cases and it is generally associated to hydatid cysts in other organs. Primary splenic hydatidosis is unusual, often unique, and represents 1%-2% of all forms. Splenectomy is the standard treatment, but there has recently been a tendency to preserve the spleen where possible [1].

During surgery, bleeding, cardiovascular, or anaphylactic complications may occur, so surgical maneuvers on the cyst and the anesthetic management should be carried out very carefully, paying special attention to hemodynamic stability and perioperative pain control [2].

Because the hemodynamic changes during laparoscopy are not always correlated to the surgical stimulus, pneumoperitoneum, or opioid dose, it is important to control intraoperative analgesia more accurately. The variation in pupil diameter in response to nociceptive stimulation is a recognized and measurable natural phenomenon. It can be measured with a pupillometer. It has been used in adults and children and in patients under general anesthesia or deeply sedated in the intensive care unit. A decrease in the amplitude of the pupillary reflex suggests correct analgesia. A linear decreasing relationship has been described between the pupillary dilatation reflex (PDR) and the estimated effect-site remifentanil concentration. So, assessing the pharmacodynamical effects of opioids could also prove effective. [3].

We present a case of laparoscopic splenectomy for an unusual presentation of a primary splenic hydatid cyst under total intravenous (IV) anesthesia and monitoring of intraoperative analgesia by pupillometry.

2. Case report

The patient provided written informed consent for publication of this report.

A 48-year-old woman, weighing 58 kg and 158 cm in height, was born and lived in Uruguay (hyperendemic country), was the owner of various dogs in her homeland, and has been living in Spain for the last few years. No known drug allergies or medical history of interest apart from anxiety in treatment with benzodiazepines.

She presented with symptoms of biliary dyspepsia and moderately elevated transaminase values. Abdominal ultrasound and computed

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tomography scan showed a splenic cyst of 49 × 60 × 55 mm with a calcified wall area near the hilum and a positive serology (IgG = 1/80 vs IgG > 1/160) for *E granulosus*. Other findings included two small splenic hemangiomas and the presence of an accessory spleen on the omentum. The rest of the preoperative evaluation was normal.

Preoperative treatment with Albendazole (10 mg/kg, 400 mg/12 hours per 4 weeks) was initiated, pneumococcal and anti-haemophilus vaccines were administered, and she was scheduled for laparoscopic splenectomy under general anesthesia.

In this case, laparoscopic access was justified as it was a completely calcified lesion, with predictably strong walls and easy control of the splenic vascular pedicle, not needing manipulation on the spleen (Fig. 1).

The proximity of the lesion to the hilar area, and the presence of two splenic hemangiomas, advised for total splenectomy.

Anesthesia was induced and maintained with effect-site target-controlled infusions (TCI) of propofol 1% (Schnider model) and remifentanil 50 μg/mL (Minto model) administered with the Base Primea Orchestra infusion device (Fresenius Kabi, France).

The TCI is an automatically adjusted system for IV anesthetics based on the predicted pharmacokinetic models using parameters such as age, sex, body mass index, and an infusion profile to achieve a steady plasma concentration or "effect-site" concentration. The combination of propofol and remifentanil has become one of the standard European techniques for total IV anesthesia [4,5].

This open loop infusion system is designed to work by objectives, allowing to modify the concentrations of propofol or remifentanil based upon the needs of hypnosis or intraoperative analgesia. In our case report, TCI let us observe the analgesic needs very closely during the surgical procedure.

The hypnotic drug administration was adjusted to maintain bispectral index (BIS) values (Aspect Medical Systems) to around 40-60. Rocuronium was used as a muscle relaxant and its effect was monitored with the train-of-four ratio nerve stimulator.

The dose of remifentanil was guided by changes in the pupil diameter from an infrared pupillometry system (AlgiScan; IDMed, Marseille, France). It consists of a camera, infrared light source, video monitor, and video processing software, capturing pupil diameter as a real-time analog signal.

The pupilometer was used in the two following modes: (*a*) 100-Hz tetanus mode before incision, and (*b*) PDR measurement after incision and until the end of the surgery.

Using the 100-Hz tetanus mode, we were able to quantify the intrinsic pupillary reflex in response to a 100 Hz electrical stimulus lasting 5 seconds at a current setting of between 5 and 60 mA. The reflex was measured for 13 seconds (3 seconds prestimulation, 5 seconds intrastimulation, and 5 seconds poststimulation). The variables measured (minimum and maximum diameter as a percentage of variation, PDR, and sensitivity to pain—very strong, strong, weak, null) were viewed on the color liquid crystal display of the pupillometer. All data collected were analyzed using a graphical representation program (NLViewer® reed.edu).

The PDR is expressed as a percentage, using the formula PDR = [(max − min)/min] × 100, where min in the minimum diameter and max in the maximum diameter of the pupil (both in millimeters). This allowed us to measure the baseline pupil diameter, the percentage variation in diameter, and sensitivity to pain. Pupillary measurements can be taken for up to 60 seconds.

Before surgical incision, various PDR measurements were taken after electrical stimulus to the ulnar nerve through two skin electrodes at 100 Hz and 40 mA.

In accordance with the response, remifentanil concentration was modified to obtain and maintain a constant "null" sensitivity with a maximum of 6% pupil diameter variation. Pharmacological interactions were considered to modify the dose of propofol and remifentanil [6].

After proceeding to the surgical incision and laparoscopic access with carbon dioxide insufflation, the concentration of remifentanil was adjusted depending on the values of pupil diameter according to PDR mode taken every 10 minutes, positional changes of the patient or hemodynamic variables (blood pressure and heart rate).

If there were no changes in the measurement and sensitivity to pain remained "null" with a maximum of 6% pupil diameter variation, the effect concentration (Ce) of remifentanil was reduced by 0.2 ng/mL from its current value.

During induction of anesthesia, 1 g IV of acetaminophen was administered and 20 minutes before the end of surgery dexketoprofen 50 mg IV was given. The patient did not receive IV morphine or other opioids during surgery.

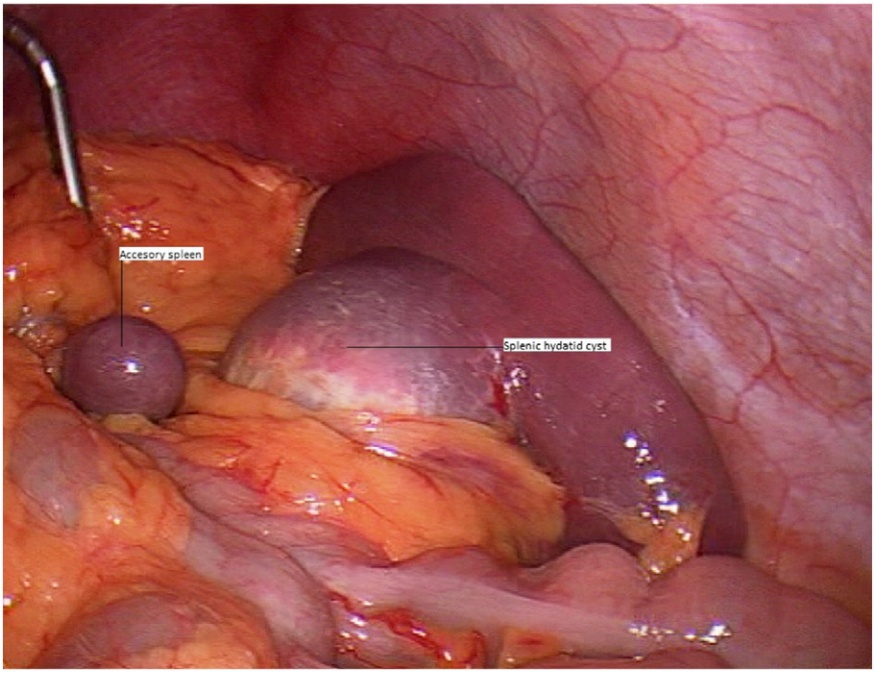

Fig. 1. Splenic hydatid cyst by laparoscopy.