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Oxidative stress in multi-port and single-port cholecystectomy



George Pappas-Gogos, MD, MSc,^{a,*} Constantinos C. Tellis, PhD,^b
 Grigorios Trypsianis, PhD,^c Konstantinos E. Tsimogiannis, MD, MSc,^a
 Evangelos C. Tsimoyiannis, MD, FACS,^a
 Constantinos E. Simopoulos, MD, FACS,^d Michael Pitiakoudis, MD, FACS,^d
 and Alexandros D. Tselepis, MD, PhD^b

^aDepartment of Surgery, “G. Hatzikosta” General Hospital of Ioannina, Ioannina, Greece

^bChemistry Department, Laboratory of Biochemistry, Ioannina University, Ioannina, Greece

^cDepartment of Statistics, Medical School, Democritus University of Thrace, Alexandroupolis, Greece

^dDepartment of Surgery, Democritus University of Thrace, Alexandroupolis, Greece

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ABSTRACT

Background: This study was designed to analyze and compare plasma levels of 8-isoprostane (8-epiPGF_{2α}), a biomarker of lipid peroxidation, and uric acid (UA), a marker of the antioxidant status, in standard laparoscopic (LC) and laparoendoscopic single-site cholecystectomy (LSSC). **Materials and methods:** Forty patients with noncomplicated cholelithiasis were randomized to undergo either LSSC (n = 20) or LC (n = 20). The patients had body mass index <30, American Society of Anesthesiologists score I or II, and no previous upper gastrointestinal surgery. Blood samples were taken preoperatively and 6 h and 24 h postoperatively. Levels of 8-epiPGF_{2α} were determined using enzyme-linked immunosorbent assay, whereas levels of UA were calculated using automated analyzer.

Results: No significant differences were observed in operative data among the groups. Levels of 8-epiPGF_{2α} were significantly higher in LSSC compared with LC at 6 h (P = 0.003) and 24 h (P < 0.001). 8-epiPGF_{2α} levels showed significant changes over time in LC (LSSC: P = 0.720, LC: P < 0.001). UA levels were significantly higher in LC compared with LSSC, 24 h postoperatively (P = 0.021). No significant changes over time in the UA levels in both groups (LSSC: P = 0.056, LC: P = 0.205).

Conclusions: LSSC is associated with increased oxidative stress compared with LC. Further studies are needed to confirm these results.

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1. Introduction

By the end of the last century, laparoscopic cholecystectomy (LC) was already the gold-standard procedure for the treatment of cholelithiasis [1].

Laparoendoscopic single-site cholecystectomy (LSSC) represents the evolution of the laparoscopic procedures after an increased interest for laparoscopic surgery with fewer incisions [2]. Different studies reported that LSSC is a feasible and safe procedure with acceptable morbidity [1–4].

* Corresponding author. Department of Surgery, “G. Hatzikosta” General Hospital of Ioannina, Nizna 1a, GR-45332 Ioannina, Greece. Tel.: +30 2651041162; fax: +30 2651040020.

E-mail address: pappasg8@gmail.com (G. Pappas-Gogos).
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Moreover, a study reported lower postoperative pain in LSSC, compared with LC [5].

Oxidative stress (OS) is the condition defined as an imbalance between production of oxidants, or so-called reactive species (RS) and the antioxidative mechanisms [6]. The generation of OS in laparoscopic surgery has been attributed to the abdominal inflation and/or deflation, which represents a model of ischemia–reperfusion, and the use of carbon dioxide (CO₂) for the creation of pneumoperitoneum, which has been implicated as a potential factor of local and systemic oxidative damage [7–9]. On the other hand, surgical trauma is also responsible for RS generation [10,11].

8-epiPGF_{2α} is considered the marker of choice for the assessing of lipid peroxidation and thus a valid marker of OS [12,13]. Uric acid (UA) is considered to be one of the most important low-molecular-mass antioxidants in the human biological fluids, and represents a marker of the antioxidant status [14].

Owing to the fact that LSSC represents the evolution in the issue of laparoscopic surgery, it was assumed that fewer incisions could be associated with lower oxidative damage. Thus, this study was designed to analyze and compare plasma 8-epiPGF_{2α}, and serum UA, in LSSC and LC in preoperative and postoperative period.

2. Materials and methods

2.1. Patients

The hospital's ethical committee approved the study protocol, and the patients gave their informed consent. Inclusion criteria were patients aged at least 18 y and suitability for elective cholecystectomy. Exclusion criteria were as follows: American Society of Anesthesiologists score III or higher, body mass index ≥ 30 , smoking, alcoholism, presence of systemic inflammatory disease, diabetes mellitus, presence of autoimmune diseases, history of cholecystitis, or cholecystitis at the time of operation, previous surgery in the upper abdomen, and history of malignancy. LSSC that would be converted to LC would also be excluded from the study. Gallstones were confirmed by ultrasonography in all patients.

The same surgeon performed all operations. Patients were randomly assigned in one of two groups. Group LSSC included 20 patients who underwent LSSC and group LC included 20 patients who underwent the standard four-port LC. All patients meeting the inclusion criteria were assigned one of forty closed envelopes. The surgeon was informed about the group of each patient in the operating room.

2.2. Operative technique

The anesthesiologists followed the same general anesthetic protocol. All patients were premedicated with intravenous paracetamol, ondansetron hydrochloride, and ranitidine. Anesthesia was induced using fentanyl (1.5 μ g/kg), propofol (2–2.5 mg/kg), and cisatracurium (0.16 mg/kg). After an endotracheal intubation, all patients were provided with mechanical ventilation using sevoflurane (1%–2%) and an air and/or oxygen mixture (30%). A nasogastric tube was inserted

in every patient at the beginning and removed after the operation. Before insertion of all trocars, 5 mL of ropivacaine hydrochloride 7.5 mg/mL (Naropein, ASTRA Pharmaceutical Production AB, Södertälje, Sweden) was infiltrated around the trocar wounds. Pneumoperitoneum with CO₂ was used in both groups. Intra-abdominal pressure was maintained at 10–11 mm Hg. The insertion into the abdominal cavity was performed by Hasson technique. In all patients of both groups, 40 mL of ropivacaine hydrochloride solution (2 mg/mL) was infused at the beginning of the procedure under the right hemidiaphragm. Local anesthetic infusion was performed using a suction device under visual control. At the end of the procedure, the suction was placed under the right hemidiaphragm under visual control, normal saline (30 mL/kg) at 37°C was infused, and once the pneumoperitoneum was deflated, the normal saline was suctioned.

2.3. Classic four-port LC

All patients were placed in reverse Trendelenburg position (30°) with the table tilted downward to the patient's left. After infiltration of ropivacaine hydrochloride around the umbilicus and establishment of pneumoperitoneum, one 10 mm trocar was placed in the midepigastrium just to the right of the falciform ligament, and two 5 mm trocars were placed in the upper-right abdomen two fingerbreadths below the right costal margin in the midclavicular and the midaxillary line under visual control. Dissection of the gallbladder was performed using ultrasonically activated coagulating shears (Harmonic Ace; Ethicon Endosurgery Inc, Smithfield, RI). The umbilical fascia was closed with absorbable suture, and the trocar wounds were sutured by intracutaneous stitches and covered by dermal glue (Dermabond; Ethicon Endosurgery Inc).

2.4. Laparoendoscopic single-site cholecystectomy

The patients were placed in the French position with the surgeon between the legs, the first assistant (cameraman) on the patient's left and the second assistant on the right, the scrub nurse near the surgeon's right hand, and the monitors at the shoulder level of the patient. After ropivacaine hydrochloride infiltration around the umbilicus, a single 12 mm intraumbilical incision was made and the umbilicus was pulled out, exposing the fascia. Pneumoperitoneum was induced through a special trocar for LSSC (TriPort; Olympus America, Center Valley, PA) and a 5-mm 45° long scope was introduced through the port. The patient was placed in reverse Trendelenburg position and rotated to the left. One 2-mm port was placed in the right of the umbilicus and a minigrasper was inserted for retraction of the gallbladder. Dissection of the gallbladder was performed using ultrasonically activated coagulating shears (Harmonic Ace), whereas a curved grasper (Olympus America) was used for traction of the gallbladder, initially to ensure exposure of Calot triangle and then to facilitate the entire dissection.

The cystic duct and the artery were clipped with a standard 5 mm clip applicator (Covidien, Norwalk, CT) and excised. The gallbladder was pushed upright and dissected free from the liver by means of the ultrasonic shears. Once the gallbladder

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