Alterations in respiratory function and hemodynamics during laparoscopic cholecystectomy under pneumoperitoneum

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Summary. Respiratory function and hemodynamics were studied during laparoscopic cholecystectomy (LC) under a 10 mmHg pneumoperitoneum (PP) by carbon dioxide insufflation. Blood-gas analysis and measurement of cardiac function by using a Swan-Ganz catheter were performed. Creatinine clearance rate was measured preoperatively and intraoperatively. Compared with values obtained before the institution of PP, blood-gas analysis showed a significant increase in PCO₂ (P < 0.01), and a significant decrease in pH (P < 0.01) and base excess (P < 0.05) during PP. With respect to cardiac function, there was no significant change in cardiac output, pulmonary arterial pressure, and pulmonary arterial wedge pressure. Intraoperative creatinine clearance rate (Ccr) was decreased in 29 of 48 cases, increased in 18 cases, and unchanged in 1 case, resulting in no significant difference overall between the values measured preoperatively and intraoperatively. However, in eight individual cases, the Ccr was found to have decreased significantly. Although alterations in respiratory function were observed, LC at 10 mmHg PP did not cause any crucial problems in respiratory or cardiac function. It should be kept in mind, however, that renal blood flow may decrease in some cases even at intraabdominal pressures under 10 mmHg.

Key words: Gallstones – Laparoscopic cholecystectomy – Blood-gas analysis – Hemodynamics – Creatinine clearance rate

Patients and methods

Patients

Seventy-five patients (68 with gallstones and seven with gallbladder polyps) were included in this study. They consisted of 37 males and 38 females with a mean age of 53.2 years.

Operative procedure

A four-puncture technique described elsewhere [2] was used in all patients. PP was established with CO₂ insufflation and intraabdominal pressure was maintained at approximately 10 mmHg by means of a high-flow insufflator.

Anesthesia

General anesthesia was maintained with nitrous oxide and oxygen in combination with sevoflurane or enflurane. The tidal volume was 10 ml/kg.

Arterial blood gases

Arterial blood gases were analyzed before creation of PP and at 15, 30, 45, 60, 90, and 120 min after insufflation, and again after PP.
Assessment of cardiac function

A Swan-Ganz catheter was inserted in six patients and cardiac output, pulmonary arterial pressure, and pulmonary wedge pressure were measured before PP, 30 min after institution of PP, and at the end of the procedure.

Assessment of renal function

Creatinine clearance rate (Ccr) was measured intraoperatively by the 1-h method (Fig. 1) and compared with the preoperative rate. Urine volume was recorded every hour and the mean urine volume was calculated.

Statistics

Figures are reported as the mean with standard deviations in parentheses. Student's t-test was used for statistical analysis.

Results

Arterial blood gas analyses

PO2 values obtained during the procedure are shown in Fig. 2. Toward the end of the operation, the PO2 tended to decrease slightly, never reaching statistical significance. The PCO2 obtained during PP was higher than prior to insufflation with a statistically significant difference (P < 0.01) (Fig. 2). The pH values during PP were lower than those before insufflation, and the difference reached statistical significance (P < 0.01) (Fig. 3). Likewise a tendency toward base excess was also observed, but the difference was not always significant (Fig. 3).

Cardiac function

Mean cardiac outputs measured before PP, 30 min after institution of PP, and at the end of procedure were