（日赤医学　第49巻　第2号　1997.9）（ 217 ）

＜原　著＞

Plasma levels of glucose and cortisol in the patients during laparoscopic cholecystectomy

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Key words: Metabolism; Glucose, Hormone; Cortisol,
Surgery; Laparoscopic Cholecystectomy

Abstract:

Plasma glucose and cortisol concentrations were measured during laparoscopic cholecystectomy under nitrous oxide-oxygen-halothane anesthesia. There was a significant increase ($p<0.01$) in the mean plasma glucose value from 92.8mg/dl to 134mg/dl 60 and 90 minutes after commencement of the procedure. The plasma cortisol concentration increased constatly and significantly ($p<0.01$) from 10.1 μ g/dl to the maximum level of 37.8 μ g/dl. It is concluded that laparoscopic cholecystectomy is not a minor procedure but is more stressful to the patients than generally considerd.

Introduction

Recently the laparoscopic cholecystectomy (LC) has been a very common procedure for cholelithiasis. It is less painful postoperatively and needs shorter hospital stay than conventional open cholecystectomy, and it is often assumed by the surgeon that it is a simple and minor operation. The procedure itself, however, requires pneumoperitoneum, which may cause barotrauma and/or gas embolism[1)2)3)] though rarely.The anesthesiologist, therefore, should take the responsibility for preventing and treating these complications.

The present study was undertaken to determine whether or not LC is a minor event to the patien by determining plasma glucose and cortisol levels during the procedure.

Materials and Methods

Six patients who were admitted to undergo LC were studied. Their mean age and body weight were 47.6±7.2 (Mean±SD) years old and 66.8±12.1kg, respectively. The nature of the study was explained to the patients and consent was obtained for the collection of blood samples.

Patients were premedicated with diazepam 10mg per os and atropine 0.5mg intramuscularly 1 hour before the induction of anesthesia. On arrival of the patient at the operating room, a control sample was obtained through the femoral artery puncture. Cannulas were inserted into an appropriate vein and a radial artery. Anesthesia was induced with thiopental 3mg/kg and tracheal intubation was facilitated with the aid of vecuronium 0.1mg/kg. Anesthesia was maintained with 1% halothane in a 40% mixture of O_2 in N_2O. Ventilation of the lung was controlled mechanically to maintain $PaCO_2$ level not exceeding a upper normal limit. The inflating gas used for the laparoscopy was

carbon dioxide, the flow of which was adjusted to maintain intraperitoneal pressure near 10mmHg automatically.

Blood samples were obtained through the radial artery cannula at the following intervals:

T_0 = on arrival at the operating room (sampled from a femoral artey as mentioned above);

T_1 = during preoperative aseptic preparation of the surgical area;

T_2 = 30 minutes after commencement of surgery;

T_3 = 60 minutes after commencement of surgery;

T_4 = 90 minutes after commencement of surgery.

Samples were analysed for glucose and cortisol by oxygen electrode method and fluorescence polarization immunoassay, respectively.

Blood loss was minimum and normal saline 5-10ml/kg/hr was infused throughout the operation.

The results were expressed as mean ± SEM and a Student's t-test was used to determine the significance of any difference of glucose and cortisol levels with time. P value less than 0.05 was considered statistically significant.

Results

A mean value of $PaCO_2$ measured when end-tidal PCO_2 reached the maximum value was 41.8mmHg (37.4-46.8mmHg).

The changes in plasma glucose and cortisol concentrations are shown in the table and the figures 1 and 2. The glucose concentration increased significantly ($P<0.05$) at T_1, but within a normal range. It increased gradually during the operation and the maximum glycemic response of 134mg/dl ($P<0.01$) was seen at T_3 and T_4. Plasma cortisol value increased to 24.2 μg/dl significantly ($P<0.01$) at T_1. The increase of cortisol levels was much greater during the operation reaching to the value of 37.8 μg/dl at T_4.

Discussion

We previously reported that the glycemic and hormonal changes were much greater in gastrectomy than in minor operations such as tympanoplasty or lumbar laminectomy and suggested that the measurment of plasma glucose and cortisol levels might be a useful tool to estimate the extent of the surgical trauma[4].

In LC hypercapnia may occur, because cabon dioxide is used to inflate the peritoneal cavity. No carbon dioxide retension, however, was detected in our patients during the procedure, and we can ignore the effects of hypercapnia on the glycemic and hormonal responses.

The plasma glucose level in our patients increased to about 145% of the control, which is almost identical with the value shown by Cambell

Table: Mean and SEM of plasma glucose and cortisol concentrations during laparoscopic cholecystectomy

	Glucose (mg/dl)	Cortisol (μg/dl)
T_0	92.8 ± 3.7	10.1 ± 1.8
T_1	98.1 ± 3.7*	24.2 ± 2.7**
T_2	118.5 ± 2.4**	31.3 ± 3.1**
T_3	134.6 ± 5.5**	35.8 ± 2.2**
T_4	134.5 ± 6.0**	37.8 ± 2.3**

* $p<0.05$, ** $p<0.01$ versus T_0

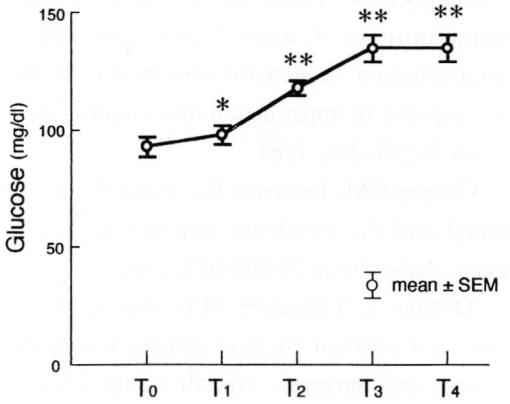

Fig.1 Changes in plasma glucose levels during laparoscopic cholecystectomy. T_0～T_4: Sampling points. For details, see the text. *p<0.05, **p<0.01 versus T_0

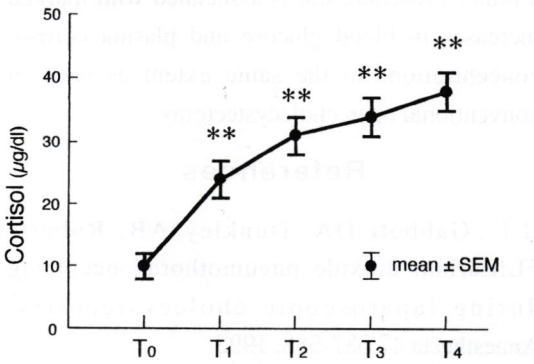

Fig.2 Changes in plasma cortisol levels during laparoscopic cholecystectomy. T_0～T_4: Sampling points. For details, see the text. **p<0.01 versus T_0.

et al[5] in the study of the patients undergoing conventional open cholecystectomy. In the gastric surgery, we[4] and Cooper et al[6] demonstrated the same degree of hyperglycemic responses, the values of which were about 140% and 150% of the controls, respectively. These results indicate that the procedure of LC increases the blood sugar concentration to the same level as seen in open upper abdominal surgery.

Plasma cortisol values increased significantly before commencement of the operation, i.e., when the patients were receiving halothane anesthesia alone. Halothane anesthesia itself has been shown to increase plasma cortisol levels through the stimulation of ACTH secretion[7]. During the procedure its concentrations increased still further to about 3.7 times the control value. Hosokawa et al[8] also demonstrated the increase in plasma cortisol concentrations to about 3.5 times the control during the open cholecystectomy under enflurane anesthesia. Interestingly, this rise of plasma cortisol levels in both studies is greater than that shown during gastrectomy[4][6]. Oyama et al[7] have noted a tendency toward higher plasma ACTH activity during operation than during halothane anesthesia alone. Therefore, the increase in plasma cortisol levels during operation was likely due to high plasma ACTH activity stimulated by surgical trauma. Our results indicate that LC auguments the cortisol response in the same degree as seen in open cholecystectomy.

The study performed by Cooper et al[9] revealed that gynecological laparoscopy for either the investigation of infertility or sterilisation increased significantly blood sugar and plasma cortisol, growth hormone and prolactin concentrations and emphasized that laparoscopy was not a minor procedure. The increase in plasma glucose and cortisol levels in their study, however, was less than ours. This means that their data might reflect the influence of pneumoperitoneum and exploration alone. The procedure of LC includes not only pneumoperitoneum and exploration, but also some other manipulations such as ablasion, cutting, cautery etc. with laparoscopic instruments. These manipulations on upper abdominal tissues may cause the marked

glycemic and hormonal changes.

In conclusion, this study has shown that LC is not a minor procedure but is associated with marked increases in blood glucose and plasma cortisol concentrations to the same extent as seen in conventional open cholecystectomy.

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受付 '97.8.2