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Pulmonary embolism following laparoscopic cholecystectomy:

Report of two cases and review of the literature

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Abstract. Laparoscopic abdominal surgery is considered a low-risk procedure for postoperative thromboembolic disease. We report two cases of pulmonary embolism following laparoscopic cholecystectomy, review the incidence of deep venous thrombosis and pulmonary embolism in laparoscopic cholecystectomy, and suggest a specific prophylactic scheme for patients undergoing laparoscopic cholecystectomy. In spite of the low incidence of postoperative thromboembolic disease following minimally invasive procedures, the risk of pulmonary embolism must not be underestimated and its symptoms must not be underdiagnosed.

Key words: Laparoscopic cholecystectomy — Pulmonary embolism — Compression stockings — Low-molecular-weight heparin

Postoperative thromboembolic disease is a frequent complication in surgical patients [11], but since many patients are asymptomatic, its reported incidence depends on which diagnostic modality is used [8].

Risk factors include a history of deep venous thrombosis (DVT), malignant process, being over 40 years of age, obesity, prolonged immobilization, and general anesthesia [3]. Several different prophylactic methods have been developed in the face of the high morbidity and mortality rates caused by DVT and pulmonary embolism in surgical patients.

Laparoscopic abdominal surgery is considered a low-risk procedure for postoperative thromboembolic disease. However, it may add some specific risk factors, such as reverse-Trendelenburg position, increased intraabdominal pressure, increased ventilatory pressure, and vasodilatory effects of hypercarbia and general anesthesia, all of which may enhance venous stasis.

We report two cases of pulmonary embolism following laparoscopic cholecystectomy (LC), review the incidence of deep venous thrombosis and pulmonary embolism in LC, and suggest a specific prophylactic scheme for patients undergoing laparoscopic cholecystectomy.

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Material and methods

We present our initial experience with 200 LCs and data from seven groups [1, 5, 6, 12, 16, 17, 19] published between January 1, 1991, and February 1, 1992. This study analyzes the results of over 2,200 operations.

Age, prophylactic methods of deep vein thrombosis, technical considerations, duration of operation, and thrombotic complications were evaluated and compared with our series.

The chi-square test for comparison of qualitative data and Student's t-test for quantitative criteria were used. Statistical significance was considered as $P < 0.05$.

Results

Age

The mean age was 58 years in our series while that for the eight groups studied as a whole was 49 ± 4 years, ranging from 43 years [16] to 58 years. Thus, the average age of our patients is significantly higher—$P < 0.001$ (Fig. 1)—than that of the other groups surveyed.

Antithrombotic prophylaxis

No prophylactic method ($n = 12$) was used in our series until one patient developed a nonfatal pulmonary embolism. Subsequently, compression stockings

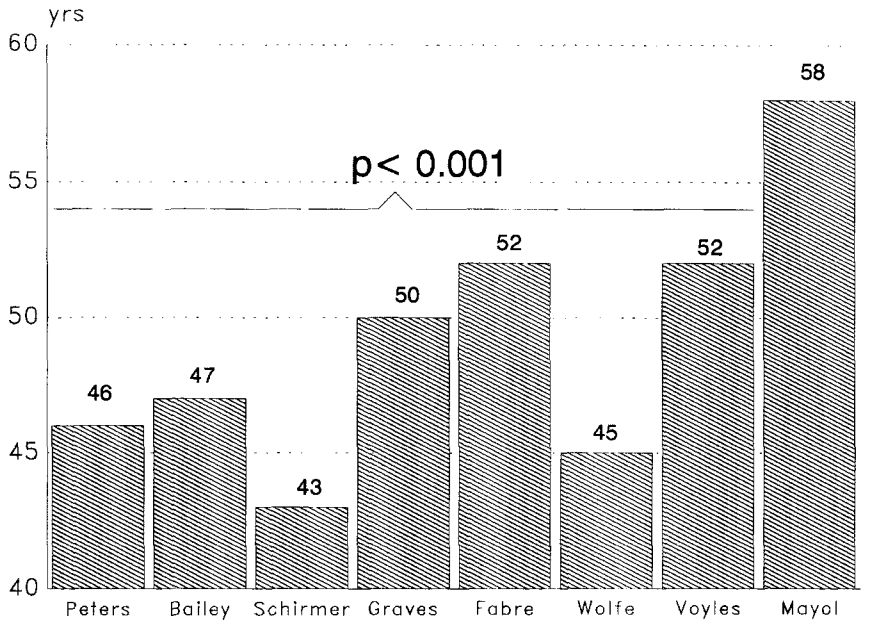

Fig. 1. Mean age of the series

were systematically used (n = 6). Nonetheless, one other patient experienced a nonfatal pulmonary embolism. Compression stockings and low-molecular-weight heparin (LMWH—enoxaporin, Rhône-Poulenc-Rorer) have been used together since then (n = 182).

In the literature reviewed, only Schirmer et al. [16] specifically recommend their prophylactic scheme based on sequential compression devices for the lower extremities and subcutaneous heparin.

Technical considerations

All groups used CO_2 pneumoperitoneum and reverse-Trendelenburg positioning.

Length of operation

The mean time was 99 min in our series. The average time for all series was 103 ± 17 min, ranging from 90 min to 138 min. The mean time of Schirmer's group [16] is significantly higher ($P < 0.001$).

Postoperative thromboembolic disease

In our series, two obese female patients who underwent LC for acute cholecystitis had postoperative pulmonary embolism.

No prophylactic scheme had been followed in the first patient (age 49 years). The operative time was 110 min (NS). Shoulder pain was present for 1 day after LC, and disappeared spontaneously. Abdominal postoperative course was uneventful. Postoperative chest radiography and abdominal ultrasonographic study showed no abnormality. She was discharged on the third postoperative day and readmitted on the seventh postoperative day because of dyspnea and thoracic pain. The gammagraphic scan and the chest radiography confirmed a multiple pulmonary embolism.

The second patient (age 73 years) was an obese female who had a history of chronic venous insufficiency of the lower extremities and had been fitted with above-knee compression stockings. The operative time was significantly higher (180 min, $P < 0.01$). On the second postoperative day, she developed intense dyspnea. Urgent gammagraphic scanning was performed. Several perfusion defects affecting both lungs were observed.

In both cases, pulmonary embolism was diagnosed by gammagraphic scanning and treated with intravenous heparin. The patients recovered and were discharged 7 days and 21 days after, respectively.

Fabre's series reported one patient (0.38% of the series) [5] who had sustained a nonfatal pulmonary embolism. Bailey and colleagues reported one individual who developed postoperative deep vein thrombosis treated with standard anticoagulation therapy, the incidence in their study being 0.3% [1]. No symptomatic postoperative thromboembolic disease was reported by the remaining authors ($P < 0.05$).

Hemorrhagic complications

In our series, none of the 18 individuals in which LMWH was not administered had postoperative hemorrhagic complications. Two patients of the 182 who received LMWH presented a hematoma of the umbilical wound (1%). None of the 200 patients had significant transoperative or postoperative bleeding and no transfusion was required.

In Bailey's series [1], two patients had a decreased hematocrit (one requiring transfusion) and one individual developed a rectus hematoma (0.8%).

Wolfe et al. [19] reported one patient with postoperative hemorrhage who required a four-unit transfu-

sion but no reoperation (0.2%). Heparin was not used in either of these two series. No morbidity was reported by Schirmer et al. [16].

Discussion

A discrepancy in the estimation of the incidence of postoperative thromboembolic disease is found. Radioactive fibrinogen uptake test shows that DVT appears in 20–30% of patients not having prophylaxis in a general surgery service. However, only 5% of the cases are clinically diagnosed and the incidence of symptomatic pulmonary embolism is under 1% [11].

Pathogenetic mechanisms (stasis, hypercoagulability, and endothelial lesion) were originally observed by Virchow and venous stasis seems to be the one predominantly involved in postoperative DVT [18]. Some specific risk factors could act during the laparoscopic cholecystectomy operation. Reverse-Trendelenburg position, pneumoperitoneum, and higher ventilatory pressure and vasodilation due to hypercarbia and general anesthesia are specifically related to the laparoscopic procedure. Moreover, obesity and a history of deep vein thrombosis are more frequent among those patients with cholelithiasis who undergo surgical treatment. Finally, technical difficulties, acute cholecystitis, obesity, or choledocholithiasis that lengthens the operation could increase the risk of venous thrombosis. Therefore, we think that patients undergoing LC are at a higher risk of developing postoperative deep vein thrombosis and pulmonary embolism.

From the experimental point of view, Shimomura et al. [15] have reported that average venous pressure in the lower limbs raises from 10.3 mmHg to 18.5 mmHg during pneumoperitoneum of 12 mmHg of intraabdominal pressure in humans, suggesting that the possibility of developing a deep vein thrombosis was very low due to a continuous return of blood. Furthermore, Ortega et al. [9] have found experimental data showing that a baseline flow rate of 1.24 L/min through the inferior vena cava increases to 1.92 L/m after a pneumoperitoneum of 15 mmHg is established.

Theoretically, the mini-invasive approach and the shorter postoperative recovery after LC lead to early mobilization, which may result in a lower risk of deep vein thrombosis and pulmonary embolism. However, the incidence of pulmonary embolism at the beginning of our series coincides with the observations reported by Sackier, Airan [13], and Fabre et al. [5] and suggests that although increased venous return and high venous pressure have been verified during pneumoperitoneum, this complication must not be underestimated, and further investigations are required.

In addition, it is difficult to evaluate a patient with shoulder or thoracic pain in the early postoperative period and to recognize whether the pain is provoked by an embolism or may be attributed to the pneumoperitoneum. Thus, prolonged or analgesic-resistant shoulder or thoracic pain should indicate further investigations and delayed discharge.

Therefore, in our opinion, antithrombotic prophylaxis is even more important than in open cholecystectomy.

Since we have started using compression stockings and enoxaparin, no DVT or pulmonary embolism has occurred.

Compression stockings increase the blood flow in the proximal femoral vein. This may reduce peripheral venous stasis [11], but the DVT postoperative incidence is only reduced 10% when this procedure is used alone. Thus, they are indicated as an adjuvant measure. Other advantages of this measure are absence of bleeding complications and low cost [11].

Low-molecular-weight heparins [2, 14] are fractions prepared from conventional heparin that inhibit activated factor X while losing their ability to prolong the activated partial thromboplastin time. Therefore, they have a strong antithrombotic effect with less bleeding than standard heparin [7]. This is specially important in the laparoscopic approach since a clean operating field will result in a shorter operative time and an easier procedure.

Fatal pulmonary embolism may appear after LC as reported by Deziel and colleagues in a survey of 77,604 laparoscopic cholecystectomies [4]. And it also may be the cause of an unexplained death as reported by Perissat and colleagues [10]. Therefore, we propose the following prophylactic scheme for low- and high-risk patients:

- *Low-risk patients* (under 60 years of age, no other known risk factor): Transoperative compression device for lower extremities during laparoscopic procedures and enoxaparin 20 mg s.c. 2 h before operation and then every 24 h until complete mobilization.
- *High-risk patients* (over 60 years or/and any additional risk factor): Transoperative compression device and enoxaparin 40 mg s.c. 12 h before operation and then every 24 h until discharged.

In spite of the low incidence of postoperative thromboembolic disease following minimally invasive procedures, the risk of pulmonary embolism must not be underestimated and its symptoms must not be underdiagnosed. Thus, the use of both antithrombotic prophylactic measures and early mobilization offers the following benefits: Proved antithrombotic effect, low cost, minimal side effects, and low risk of bleeding complications.

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