Alteration in coagulation profile and incidence of DVT in laparoscopic cholecystectomy

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A B S T R A C T

Introduction: Although laparoscopic cholecystectomy appears to be less traumatic to the patients than open surgery, decreased venous return from lower extremities and hypercoagulability occurring in patients undergoing elective laparoscopic cholecystectomy with CO₂ pneumoperitoneum makes it a potent risk factor for deep venous thrombosis.

Methods: The observational study of 50 patients undergoing elective laparoscopic cholecystectomy was designed to study alteration in PT, APTT, D-dimer and antithrombin III, which were measured preoperatively, 6 and 24 h postoperatively. It was accompanied by color duplex ultrasound of bilateral lower limbs preoperatively and 7th day postoperatively to look for evidence of deep venous thrombosis.

Results: Significant postoperative decrease in APTT and antithrombin III suggested activation of coagulation while decrease in D-dimer suggested activation of fibrinolysis. Values of PT had no statistically significant postoperative changes. Age, body mass index and duration of pneumoperitoneum were found to correlate with significant activation of coagulation and fibrinolysis. None of the patients developed clinical or radiological evidence of deep venous thrombosis in the postoperative period.

Conclusions: CO₂ pneumoperitoneum enhances the activation of coagulation and fibrinolysis associated with laparoscopic cholecystectomy. Patients with risk factors like old age, obesity or with expected long duration of laparoscopic surgery are likely to have significant activation of coagulation, making them a vulnerable risk group for development of postoperative deep vein thrombosis, warranting some form of thromboprophylaxis.

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1. Introduction

Approximately 15 years of experience and tens of thousands of cases have led to a strong knowledge base for advance laparoscopy. But our experience with and understanding of the effects of CO₂ pneumoperitoneum are far from nascent.1

Much has still to be learned however, concerning the pathophysiology and systemic complications of laparoscopic surgery.

It has long been known that a hypercoagulability state develops after surgery. The advantage of laparoscopic cholecystectomy over the open procedure seems to be related to the reduced surgical trauma. Patients who undergo laparoscopic cholecystectomy are operated on under general anesthesia, in a reverse Trendelenburg position with capnoperitoneum. All of these factors can induce venous stasis in the lower extremities, which in association with alteration in coagulation profile may lead to postoperative deep vein thrombosis.

A number of factors pertaining to the surgical technique may be relevant to the pathophysiology of the hypercoagulable state. First, the pneumoperitoneum and reverse Trendelenburg position of the patient during surgery may lead to venous stasis in the legs. Second it may further be speculated that this venous stasis could affect the endothelium and induce measurable changes in coagulation and fibrinolysis. All three elements of Virchow’s triad are present and thus the potential exists for thromboembolic complications.

The reported incidence of postoperative DVT in laparoscopic cholecystectomy varies considerably between 0 and 55%.2 The only firm conclusion from this variability in incidence is that further studies are needed.

This study aims to assess the degree of postoperative changes in coagulation profile and to look for evidence of thrombosis in deep...
veins of the lower limbs in patients undergoing elective laparoscopic cholecystectomy with CO₂ pneumoperitoneum.

2. Materials and methods

2.1. Study design and patient eligibility

A prospective observational study was conducted which enrolled 50 patients over the age of 18 years with ASA grade I and II scheduled for elective laparoscopic cholecystectomy for symptomatic gallstone disease. Before entry into the study, informed consent was obtained from all patients. Patients were excluded from the study if they had acute cholecystitis, cholangitis, acute pancreatitis or other acute inflammation. Patients with recent (6 months) surgery, recurrent or recent (<2 years) malignancy and current or recent (6 months) thromboembolic disease, hematological disorder, renal, hepatic, rheumatic or vascular disease (except arteriosclerosis) were excluded from the study. Patients with pregnancy or on anticoagulant treatment including aspirin or on oral contraceptives or danazol were also not included in the study.

2.2. Operative technique and postoperative care

Laparoscopic cholecystectomy was performed by the same surgical and anesthesiologist team in all patients. Antithrombotic prophylaxis was not given to any of the patients. Laparoscopic cholecystectomy was performed with conventional carbon dioxide pneumoperitoneum at a pressure of 12 mmHg using two 10 mm trocars and 30° reverse Trendelenburg position. Intraabdominal pressure was maintained at 12 mmHg. Antibiotic prophylaxis was not given as per unit protocol. Intraabdominal drains were not placed in any of the patients. All patients were extubated and transferred to the surgical ward postoperatively. Patients were encouraged to ambulate 24 h after the operation and were discharged after 48 h. All patients recovered well and had an uneventful postoperative course without any complication or death.

2.3. Blood collection and processing

Blood samples were taken preoperatively, 6 h after surgery and 24 h after surgery. Venous blood was collected in 3.8% sodium citrate at a ratio of nine parts blood to one part anticoagulant (1:10 ratio). Blood was centrifuged within 30 min and plasma was kept at −80 °C until analysis.

2.4. Biochemical assays

The coagulation and fibrinolytic profiles were obtained by determining the plasma prothrombin time (PT), activated partial thromboplastin time (APTT), antithrombin III and D-dimer value. The PT was expressed accurately in terms of the International Normalized Ratio (INR). The APTT was also expressed as the ratio of patient to test control value. The antithrombin III activity was expressed as percent value of the control activity and its measurement was made by a chromogenic assay. The D-dimer measurement was based on the enzyme immunoassay method and expressed in nanograms per milliliter.

2.5. Radiographic intervention

Duplex ultrasound combining real time B mode ultrasound with pulsed Doppler capability and color flow imaging was done preoperatively and on the seventh postoperative day to detect evidence of thrombosis in deep veins of the lower limbs.

2.6. Statistical analysis

Results were expressed as mean value ± SD. Wilcoxon sign rank tests were used to evaluate significant differences from baseline values within each group and Pearson correlation was used to assess the significance between two groups at each time point. A p value of less than 0.05 was considered significant.

3. Results

3.1. Patients demographic and operative data

Age of patients varied from 18 to 65 years with six male patients (12%) and 44 female patients (88%). The mean age in years was 36.0 ± 10.7. The body mass index of patients varied from 21 to 29.6 kg/m². The mean body mass index was 24.09 ± 1.99. The duration of pneumoperitoneum varied from 40 to 130 min with a mean of 74.20 ± 19.57 min.

3.2. Markers of coagulation and fibrinolysis

The plasma levels of the monitored parameters for the patients were altered (Table 1), thus registering activation of the coagulation process. PT did not show any significant operative variation both at 6 and 24 h postoperatively compared to the preoperative value. APTT, D-dimer and AT III showed statistically significant variation both at 6 and 24 h postoperatively.

Age, body mass index and duration of pneumoperitoneum were correlated with percent change in studied coagulation parameters both at 6 and 24 h postoperatively. There was no significant perioperative variation in PT and APTT at 6 and 24 h postoperatively. However, D-dimer and AT III showed significant perioperative variation in PT and APTT both at 6 and 24 h postoperatively in relation to age, sex and duration of pneumoperitoneum.

3.3. Prothrombin time

The mean prothrombin time preoperatively was 1.01 ± 0.2 INR, which decreased to 0.99 ± 4.74 INR, 6 h postoperatively, and 0.99 ± 4.65 INR, 24 h postoperatively. This postoperative change was found to be non-significant statistically (p = 0.06 and 0.07 respectively). Age, body mass index and duration of pneumoperitoneum were correlated with percent change in prothrombin time both at 6 and 24 h postoperatively. There was no significant correlation between age and percent change in prothrombin time at either point of time (p = 0.88 at 6 h and 0.35 at 24 h postoperatively). There was no significant correlation between body mass index and percent change in prothrombin time at either point of time (p = 0.98 at 6 h and 0.86 at 24 h postoperatively). There was no significant correlation between duration of pneumoperitoneum and percent change in prothrombin time.

Table 1

<table>
<thead>
<tr>
<th>Coagulation parameters</th>
<th>Sample</th>
<th>Preoperative</th>
<th>6 h Postoperative</th>
<th>24 h Postoperative</th>
</tr>
</thead>
<tbody>
<tr>
<td>PT</td>
<td>1.01 ± 0.2</td>
<td>0.99 ± 4.74 (0.06)</td>
<td>0.99 ± 4.65 (0.07)</td>
<td></td>
</tr>
<tr>
<td>APTT</td>
<td>1.01 ± 0.01</td>
<td>0.91 ± 0.04 (0.00)</td>
<td>0.95 ± 0.03 (0.00)</td>
<td></td>
</tr>
<tr>
<td>D-Dimer</td>
<td>166 ± 30.49</td>
<td>416.70 ± 119.25</td>
<td>315.26 ± 83.86</td>
<td></td>
</tr>
<tr>
<td>Anti thrombin III</td>
<td>91.5 ± 4.07</td>
<td>74.6 ± 8.13 (0.00)</td>
<td>79.4 ± 7.99 (0.00)</td>
<td></td>
</tr>
</tbody>
</table>
prothrombin time at either point of time \((p \text{ value} = 0.89 \text{ at } 6 \text{ h and } 0.39 \text{ at } 24 \text{ h postoperatively})\).

### 3.4. Activated partial thromboplastin time

The mean activated partial thromboplastin time preoperatively was \(1.01 \pm 0.01 \text{ min}, \) which decreased to \(0.91 \pm 0.04 \text{ min } 6 \text{ h postoperatively and } 0.95 \pm 0.03 \text{ min } 24 \text{ h postoperatively}. \) This postoperative change was found to be significant \((p \text{ value} = 0.000)\).

Age, body mass index and duration of pneumoperitoneum were correlated with percent change in activated partial thromboplastin time both at 6 and 24 h postoperatively. There was no significant correlation between age and percent change in activated partial thromboplastin time at either point of time \((p \text{ value} = 0.50 \text{ at } 6 \text{ h and } 0.09 \text{ at } 24 \text{ h postoperatively})\). There was significant correlation between body mass index and percent change in activated partial thromboplastin time at 6 h postoperatively \((p \text{ value} = 0.04)\) but not at 24 h postoperatively \((p = 0.43)\). There was no significant correlation between duration of pneumoperitoneum and percent change in activated partial thromboplastin time at either point of time \((p \text{ value} = 0.21 \text{ at } 6 \text{ h and } 0.37 \text{ at } 24 \text{ h postoperatively})\).

### 3.5. Antithrombin III

The mean antithrombin III preoperatively was \(91.5 \pm 4.07\%\), which decreased to \(74.6 \pm 8.13\% \text{ 6 h postoperatively and } 79.4 \pm 7.99\% \text{ 24 h postoperatively} \) This postoperative change was found to be significant statistically \((p \text{ value} = 0.000)\). Age, body mass index and duration of pneumoperitoneum were correlated with percent change in antithrombin III both at 6 and 24 h postoperatively. There was significant correlation between age and percent change in antithrombin III at both points of time \((p \text{ value} = 0.04 \text{ at } 6 \text{ h and } p = 0.002 \text{ at } 24 \text{ h postoperatively})\).

Body mass index was correlated with percent change in antithrombin III both at 6 h postoperatively and at 24 h postoperatively. There was significant correlation between body mass index and percent change in antithrombin III at both points of time \((p \text{ value} = 0.00 \text{ at } 6 \text{ h and } p = 0.00 \text{ at } 24 \text{ h postoperatively})\).

Duration of pneumoperitoneum was correlated with percent change in antithrombin III both at 6 h postoperatively and at 24 h postoperatively. There was significant correlation between age and percent change in antithrombin III at both points of time \((p \text{ value} = 0.008 \text{ at } 6 \text{ h and } p = 0.018 \text{ at } 24 \text{ h postoperatively})\).

### 3.6. D-Dimer

The mean D-dimer preoperatively was \(166 \pm 30.49 \text{ ng/ml}, \) which increased to \(416.70 \pm 119.25 \text{ ng/ml } 6 \text{ h postoperatively and } 315.26 \pm 83.86 \text{ ng/ml } 24 \text{ h postoperatively} \) This postoperative change was found to be significant statistically \((p \text{ value} = 0.000)\). Age, body mass index and duration of pneumoperitoneum were correlated with percent change in D-dimer both at 6 and 24 h postoperatively. There was significant correlation between age and percent change in D-dimer at both points of time \((p \text{ value} = 0.04 \text{ at } 6 \text{ h and } p = 0.002 \text{ at } 24 \text{ h postoperatively})\). Body mass index was correlated with percent change in D-dimer both at 6 h postoperatively and at 24 h postoperatively. There was significant correlation between body mass index and percent change in D-dimer at both points of time \((p \text{ value} = 0.008 \text{ at } 6 \text{ h and } p = 0.018 \text{ at } 24 \text{ h postoperatively})\).

### 3.7. Color duplex imaging of bilateral lower limbs

Patients were subjected to color duplex imaging of bilateral lower limbs on the 7th postoperative day to look for any evidence of deep vein thrombosis. None of the patients showed evidence of deep vein thrombosis on color duplex imaging.

### 4. Discussion

Its exceptionally fast acceptance, both by patients and surgeons, meant that laparoscopic surgery was introduced without much scientific evidence to support its safety. Surgeons seemed to spend the first years trying to increase their own experience by performing as many procedures as possible.

Most publications regarding laparoscopic cholecystectomy during the early 1990s were retrospective reports of personal or institutional experience with the operation. In most reports, data on complications were included, but whether complications were actively looked for or case-notes just checked retrospectively was not mentioned.

A few reports are available regarding levels of one or more of the presently relevant markers in patients undergoing cholecystectomy and only some of these studies have compared laparoscopic cholecystectomy with open cholecystectomy.

A comparative study between open and laparoscopic cholecystectomy could not be undertaken as laparoscopic cholecystectomy is the standard procedure. Thus it would not be ethical to operate on patients using the open cholecystectomy technique for research purposes.

### 4.1. Markers of coagulation and fibrinolysis

Prothrombin time is a measure of coagulation, which evaluates extrinsic pathway (factor VII) and common pathway protein factors (fibrinogen, prothrombin, Factor V and X). There was no statistically significant perioperative decrease in PT \((p \text{ value} > 0.05)\) in our study that could indicate hypercoagulability. Activated partial prothrombin time is a direct measure of coagulation, which tests the intrinsic pathway (factor XII, XI, IX, VIII) and abovementioned common pathway factors. Our study shows statistically significant \((p \text{ value} = 0.000)\) perioperative decrease in APTT, which suggests activated coagulation. Thrombin, an enzyme with weak proteolytic activity, acts to convert fibrinogen into fibrin fibers that enmesh platelets, blood cells, and plasma to finally form the clot. One of the primary down-regulators of the coagulation cascade is antithrombin III, which exerts its down-regulatory effect through the inactivation of several activated factors, including factors X, IX, XII and thrombin. By inactivating the numbered factors, thrombin production is reduced. Antithrombin also binds with thrombin and thereby blocks thrombin's interaction with fibrinogen. Our study shows a statistically significant perioperative decrease in antithrombin III \((p \text{ value} = 0.000),\) which shows a state of hypercoagulability. D-Dimer levels have been used as a marker of intravascular clot formation. D-Dimer is a cross-linked fibrin degradation product, which forms as a result of a breakdown of fibrin. D-Dimer levels are frequently increased after surgery or trauma and indicate the presence of an intravascular clot that has undergone lysis.

Our study shows a statistically significant \((p \text{ value} = 0.000)\) perioperative increase in D-dimer levels, which suggests formation of intravascular clot. The observed decreases in PT and antithrombin III indicate an activated coagulation. The increase in D-dimer indicates that both coagulation and fibrinolysis are activated, since it is the end product of the degradation of fibrin, which has to have been formed by coagulation in the first phase. Increased coagulation activity is commonly seen after surgery and can be
considered part of the normal response to surgical trauma. It is therefore difficult to know what is caused by the pneumoperitoneum and what is caused by the surgical procedure itself. In a comparison of laparoscopic cholecystectomy using CO2 pneumoperitoneum with gasless laparoscopic cholecystectomy using lifting devices, Larsen et al. demonstrated that there were no differences between the two groups in fragment 1 + 2, soluble fibrin or D-dimer, suggesting CO2 pneumoperitoneum does not enhance the activation of coagulation and fibrinolysis associated with laparoscopic cholecystectomy.

Lauro et al. also suggested that, perioperatively; the coagulative-fibrinolytic changes are lower in laparoscopic than in open cholecystectomy. While in a comparison of laparoscopic and open gastric bypass, Nguyen et al. demonstrated there were similar increases in fragment 1 + 2, TAT and fibrinogen, whereas the D-dimer increase was lower in the laparoscopic group during the first 24 h. They suggested laparoscopic gastric bypass induces a hypercoagulable state similar to open group and DVT prophylaxis should be given during laparoscopic gastric bypass. Vecchio et al. showed significant perioperative increase in fibrinogen, beta thromboglobulin and D-dimer, suggesting laparoscopic cholecystectomy induces activation of coagulation and fibrinolysis. Therefore, they recommended routine thromboembolic prophylaxis in patients undergoing laparoscopic surgery. Caprini et al. reported a marked hypercoagulable state after laparoscopic cholecystectomy as seen by an increase in thromboelastographic index and decrease in partial prothrombin time, on the first postoperative day as compared with preoperative values.

Fibrinolysis activation could counteract the increase in coagulation activity, and the increase in D-dimer found in our study indicates that this may be the case. Martinez-Ramos et al. found a greater increase in fibrinolytic activity after laparoscopic cholecystectomy than after an open operation of similar duration (Bassini herniorrhaphy), and also a greater increase in tPA in the laparoscopic cholecystectomy group with no changes in PAI-1. Vander Velpen et al. found similar increases in tPA and PAI-1 after open cholecystectomy and laparoscopic cholecystectomy, with a trend toward a higher fibrinolysis inhibition early postoperatively in the open cholecystectomy group. A significant increase in PAI-1 in the open cholecystectomy group with no change in the laparoscopic cholecystectomy group has also been found in other studies. Rahr et al. also found no changes in tPA or PAI-1 levels in a comparison of pre- and postoperative values in laparoscopic cholecystectomy patients, except for a transient increase in tPA activity during the operation. So, the available literature is contradictory, but the majority of studies seem to indicate activation of coagulation and higher activation or lower inhibition of fibrinolysis in patients undergoing laparoscopic compared to open cholecystectomy.

In our study, we tried to correlate markers of activation of coagulation and fibrinolysis with known risk factors of deep vein thrombosis. No previous study to date has studied such types of correlation. We did not find any correlation of percent change in prothrombin time or activated partial thromboplastin time with age, body mass index or duration of pneumoperitoneum. We found positive correlations between percent change in antithrombin III and D-dimer with age, BMI and duration of pneumoperitoneum, which suggest a significant hypercoagulable state with old age, obesity and duration of surgery. These correlations seem to indicate that age, obesity and duration of pneumoperitoneum should be considered as risk factors for activation of coagulation and fibrinolysis.

5. Deep venous thrombosis in laparoscopic cholecystectomy

None of the patients in our study showed any evidence of deep vein thrombosis in our study when they were subjected to bilateral color duplex imaging of bilateral lower limbs on the 7th postoperative day, despite the fact that none of the patients were given any form of thromboprophylaxis. The frequency of postoperative DVT in laparoscopic cholecystectomy varies from 0 to 55% in the few studies that have been published. Blake et al. reported 0% incidence of DVT in patients undergoing laparoscopic cholecystectomy. Five-hundred and eighty-seven patients participated in their study and examined for DVT, which was clinical examination. Wazz et al. also reported 0% incidence of DVT in patients undergoing laparoscopic cholecystectomy. Sixty-one patients participated in their study. No patient was given any form of thromboprophylaxis. Patients underwent color duplex evaluation of bilateral lower limbs preoperatively and on the 1st postoperative day. Bounamaeux et al. also reported 0% incidence of DVT in patients undergoing laparoscopic cholecystectomy. Forty patients participated in their study. Twenty-five patients were given low molecular weight heparin and 15 patients were not given any form of thromboprophylaxis. Patients underwent bilateral pedal venography on the 6–10th postoperative day to look for evidence of DVT. Caprini et al. reported 1% incidence of DVT in patients undergoing laparoscopic cholecystectomy. One-hundred and twenty patients participated in their study. Patients were given graduated compression stockings and sequential compression. Twenty-six patients were also given low molecular weight heparin. Patients underwent bilateral color duplex imaging on the 7th postoperative day to look for evidence of DVT. Lord et al. reported 1.7% incidence of DVT in patients undergoing laparoscopic cholecystectomy. One-hundred patients participated in their study. Patients were given graduated compression stockings and preoperative intermittent calf compression. Patients underwent bilateral color duplex imaging preoperatively, 1st postoperative day and at 2–4 weeks to look for evidence of DVT. Contrary to these studies, Krasinski et al. reported a high incidence of DVT to the tune of 47% in patients undergoing laparoscopic cholecystectomy. Forty patients participated in their study. Patients were given thromboprophylaxis in the form of low molecular weight heparin. Patients underwent bilateral color duplex imaging preoperatively, 2nd, 7th and 30th postoperative day to look for evidence of DVT. Patel et al. found an alarming incidence of 55% for venous thromboembolism in patients who underwent laparoscopic cholecystectomy. Twenty patients participated in their study. Patients were given thromboprophylaxis in the form of graduated compression stockings and preoperative electrical calf compression and pharmacological therapy. Patients underwent bilateral color duplex imaging preoperatively, 1st, 7th and 30th postoperative day to look for evidence of DVT. The highest numbers were found in small studies using duplex Doppler investigations. Studies by Patel et al. and Krasinski et al., which reported maximum incidence of DVT in laparoscopic cholecystectomy, involved only 20 and 40 patients respectively. Color duplex imaging has been shown to have a significant learning curve and to have limitations in asymptomatic patients and those with isolated calf vein thrombosis. Zero percent frequency of DVT found by phlebography on postoperative days 7–11, as reported by Bounamaeux et al., contradicts the findings by Patel et al. and Krasinski et al. Seven out of the 11 thrombi found in the study by Patel et al. were found on postoperative day 1. In the other studies using color duplex imaging, only Wazz et al. and Lord et al. studied their patients earlier than on postoperative day 5. It is a possibility that small thrombi could occur frequently in the first postoperative days, but that the early ambulation made possible by reduced postoperative pain in laparoscopically operated patients may result in early thrombolysis. The patients in Lord’s study received what would seem to be a more than adequate prophylaxis against...
thromboembolism (LMWH, GCS and intraoperative intermittent calf compression), which may explain the low frequency of DVT (1.7%). The patients in the study by Wazz et al., however, did not receive any thrombomobil prophylaxis, and still no thrombi were found, which is difficult to explain in light of the results of Patel et al. and Krasinski et al. In the light of these contradictory studies it can be concluded that the sample sizes are generally small in these studies and the timing of and number of examinations vary widely, as do the results, which range from a reassuring 0% to a deeply disconcerting 55%. In a meta analysis of 60 series involving 153,832 patients undergoing laparoscopic cholecystectomy, Lindberg et al. revealed an incidence of 0.03% for deep vein thrombosis and 0.06% for pulmonary embolism, while all patients were given prophylaxis against venous thromboembolism. The only firm conclusion one can draw from these conflicting results is that further studies are needed. Ikeda et al., in his study on incidence of portal or splenic vein thrombosis after laparoscopic splenectomy, demonstrated higher risk of postoperative portal or splenic vein thrombosis in laparoscopic group as compared to open (55 vs 19%, p value = 0.03). They concluded one of the factors for higher incidence of postoperative portal or splenic vein thrombosis in the laparoscopic group may be pneumoperitoneum, which causes coagulation activation as well as stasis of venous blood in portal vein. Cubillana et al. reported a case of renal vein thrombosis occurring in a patient after laparoscopic cholecystectomy. Several factors could increase the rate of postoperative thromboembolic complications in laparoscopically performed operations as compared to open operations:

1. Laparoscopic operations typically take longer than open operations, at least until the surgeon has become experienced in laparoscopic surgery. Longer duration of the surgical procedure increases the risk of thromboembolic complications.
2. The pneumoperitoneum necessary for exposure during laparoscopic operations can compress the inferior caval vein, causing venous stasis in the lower body.
3. The reverse Trendelenburg position required for proper exposure of the operative field during laparoscopic operations in the upper abdomen further reduces the venous return from the lower body.
4. Perioperative venous dilation has been implicated as one factor of importance in the pathogenesis of postoperative DVT, possibly by causing microscopic intimal tears and causing platelet aggregation and activation of the coagulation system although this is modified by an increase in fibrinolysis.

All three elements of Virchow’s triad are present and thus the potential exists for thromboembolic complications. Reduced postoperative pain after laparoscopic surgery, on the other hand, quickens the mobilization of the patient after surgery, which should reduce the risk of thromboembolic complications. The net result of these contradictory factors is still debatable.

Our study indicates activation of coagulation and fibrinolysis, as shown by postoperative decrease in APTT and antithrombin and increase in D-dimer. But no patient in our study had evidence of deep vein thrombosis on color duplex imaging of bilateral lower limbs. These observations suggest a low incidence of thrombosis in the face of theoretical and laboratory evidence of postoperative hypercoagulability. Fibrinolysis activation could counteract the increase in coagulation activity, and the increase in D-dimer found in our study indicates that this may be the case, which may explain the low incidence of thrombosis.

Furthermore, it is a possibility that small thrombi formed initially in the postoperative period might have thrombolysed by increased fibrinolytic activity and so could not be visualized by color Doppler done on the 7th postoperative day. It should also be kept in mind that most studies including ours have used color duplex imaging of bilateral lower limbs as a method to detect deep vein thrombosis, which has only 63.5% sensitivity in detecting distal deep vein thrombosis.

6. Conclusions

Patients with risk factors like old age, obesity or with expected long duration of laparoscopic surgery are likely to have significant activation of coagulation, making them a vulnerable risk group for development of postoperative deep vein thrombosis, warranting some form of thromboprophylaxis. Further studies with large sample size and more sensitive means to detect distal calf vein thrombosis like MR venography performed on postoperative day one are required to support these findings.

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Conflict of interest
None.
Ethical approval
Ethical approval was obtained from the institutional ethical committee.

References

