Galician Medical Journal

Scientific and Practical Journal of Ivano-Frankivsk National Medical University

I.M. Gudz, O.O. Tkachuk-Grigorchuk, O.L. Tkachuk

Changes in Coagulation Profile During Planned Laparoscopic Operations

Ivano-Frankivsk National Medical University, Ivano-Frankivsk, Ukraine

Abstract.

Pneumoperitoneum may be a risk factor for venous thromboembolism. However, nowadays there is no reasonable algorithm for the prevention of thrombotic complications of laparoscopic interventions.

The objective of the research was to assess the impact of laparoscopic surgery on coagulation parameters considering the number of other risk factors. The parameters of blood coagulation and thromboelastography in patients during laparoscopic cholecystectomy were investigated.

Results. Blood coagulation capacity increased slightly during laparoscopic surgery. The patient's age, body mass index and duration of surgery correlated with signs of hypercoagulability. Surgery duration had the strongest effect on coagulation parameters. In patients having no risk factors for thrombotic complications the indicators of thromboelastography did not exceed the reference values. However, in patients with existing risk factors for thrombotic complications thromboelastogram showed significant deviations from the norm.

Conclusions. Simple laparoscopic surgery did not significantly affect the risk for thrombotic complications. The age of patients over 40 years, body mass index over 30 kg/m^2, duration of laparoscopic surgery more than 1 hour should be included to risk factors for venous thrombosis. Thromboelastography can be used for screening assessment of the risk for thrombotic complications in patients undergoing laparoscopic surgery.

Keywords: laparoscopic surgery; pneumoperitoneum; coagulometry; thromboelastography.

Problem statement and analysis of the recent research

Insufflation of carbon dioxide into the peritoneal cavity during laparoscopic surgery increasing abdominal pressure may result in stasis of venous blood in the inferior vena cava and common iliac veins. In addition, common surgical position used in cholecystectomy - the Trendelenburg position – reduces venous return. All the above-mentioned factors may contribute to episodes of venous thromboembolism (VTE) of both clinically symptomatic and asymptomatic forms [1, 2].

Questions concerning the necessity and extent of antithrombotic prophylaxis during laparoscopic surgery remain controversial. Statistical data indicate a low incidence of postoperative VTE after short-term planned laparoscopic interventions [1]. However, during long-term surgeries the number of complications naturally increases [2]. Nowadays, there is no reasonable algorithm for antithrombotic prophylaxis considering the patient's condition before surgery, existence of additional risk factors for thrombus formation, type and duration of laparoscopic surgery, pneumoperitoneum regimes and others.

The objective of the research was to assess the impact of pneumoperitoneum on the state of the coagulation system during laparoscopic surgery as well as relationship between the patients' age, body mass index (BMI), duration of surgery and coagulation profile in the postoperative period.

Materials and methods

There were examined 70 patients (56 females and 14 males with the average age of 48.5 ± 12.4 years and the BMI equal to 27 ± 5.4 kg/m^2) with no recognized risk factors for VTE and normal platelet count who did not undergo anticoagulation therapy and whose coagulation profile was within normal limits. All patients underwent laparoscopic cholecystectomy for chronic calculous cholecystitis. The average operating time was 42.4 ± 12.3 min. Standard CO^2 insufflation at 15 mm Hg pressure was used. Advanced surgical interventions were performed in 6 patient suffering from concomitant surgical diseases and complicated cholecystitis (esophageal hiatal hernioplasty, umbilical hernia repair,

choledochotomy and lithoextraction). The average operating time in this group was 73.2 ± 18.5 min. Coagulation profile was evaluated using the activated partial thromboplastin time (APTT), international normalized ratio (INR) and thrombin time (TT). Integrated state of the coagulation and fibrinolysis systems was evaluated using the parameters of thromboelastography (TEG), namely, the reaction time (RT), maximum amplitude (MA), α-angle, k-time. Blood sampling was performed twice: at admission (sample A) and 5 hours after surgery (sample B). The data were statistically processed using the Wilcoxon signed-rank test and Pearson correlation coefficient.

Results and discussion

There were determined statistically significant changes in coagulation profile under the influence of laparoscopic surgery (Table 1).

Table 1

Parameters of coagulation system before and after laparoscopic surgery

Parameter	Before surgery	After surgery	p
APTT (sec)	35.45 ± 5.12	33.5 ± 7.23	<0.05
INR	1.23 ± 0.12	1.16 ± 0.13	<0.05
TT (sec)	16.45 ± 2.11	16.34 ± 1.91	<0.05

Changes in the parameters of coagulation profile were directed towards hypercoagulation, however, they did not exceed the reference values and were not accompanied by any clinical manifestations of venous insufficiency or venous thrombosis.

When analyzing the mean values of TEG before and after surgery statistically significant differences between the parameters were not found (Table 2).

Table 2

Parameters of thromboelastography before and after laparoscopic surgery

Parameter	Before surgery	After surgery	p
r-time (min)	16.28 ± 5.18	16.36 ± 6.03	>0.05
k-time (min)	4.56 ± 1.34	4.24 ± 1.11	>0.05
α-angle (degree)	38.4 ± 12.5	35.12 ± 9.13	>0.05
MA (mm)	48.8 ± 14.5	51.33 ± 10.5	>0.05

Obviously, in patients of mixed group without differentiation according to risk factors for thrombotic complications no unidirectional changes were found in the integral average values of thrombus formation kinetics due to the compensation of some clotting factors for others during laparoscopic surgery.

The investigation of the influence of the patient's age on coagulation profile revealed certain regularities (Table 3).

Table 3

Correlation between coagulation parameters and patient's age

Parameter	Correlation coefficient	p
APTT	-0.23 ± 0.01	<0.05
INR	-0.54 ± 0.08	<0.05
TT	-0.32 ± 0.04	<0.05

The relationship between the patient's age, prothrombin time and thromboplastin time was found to be rather weak; however, the value of the international normalized ratio demonstrated reverse medium-strength correlation. Thus, in the postoperative period greater coagulation capacity was detected among elderly patients.

The dependence of coagulation parameters on the body mass index was also significant, however, correlation was considered weak (Table 4).

Table 4

Correlation between coagulation parameters and body mass index

Parameter	Correlation coefficient	p
APTT	-0.38 ± 0.06	<0.05
INR	-0.68 ± 0.07	<0.05
TT	-0.62 ± 0.07	<0.05

The most noticeable correlation was a medium-strength correlation between the BMI and INR indicating the necessity of inclusion of patients with alimentary obesity to risk group for VTE

However, it should be noted that when making an individual analysis of coagulation parameters in patients, all the parameters did not exceed the reference values indicating the necessity to consider all the clinical and laboratory investigations as well as patient's medical history when determining the indicators for performing systemic prophylaxis of thrombotic complications.

The strength of the correlation between coagulation parameters and duration of laparoscopic surgery was especially pronounced (Table 5).

Table 5

Correlation between coagulation parameters and duration of laparoscopic surgery

Parameter	Correlation coefficient	p
APTT	-0.58 ± 0.12	<0.05
INR	-0.72 ± 0.14	<0.05
TT	-0.64 ± 0.09	<0.05

The correlation between the BMI and duration of surgery was strong being greater than the correlation between the patient's age and body mass index indicating primary consideration of the duration of surgery when evaluating risk factors for VTE in patients who underwent laparoscopic interventions.

Considering the obtained results two groups of patients were formed by an empirical method. Each group comprised 10 patients who differed by the aggregate risk for thromboembolic complications (Table 6).

Table 6

Criteria for formation of risk group for VTE

Parameter	Risk group	Control group
Age	under 40 years	40 years and more
BMI	to 30 kg/m^2	30 kg/m^2 and more
Duration of surgery	to 60 min	60 min and more

Both groups of patients underwent thromboelastography. Blood samples were drawn 5 hours after surgery.

The obtained values of TEG indicated a reliable tendency to decrease the r-time (rate of initial fibrin formation) and k-time (time to clot firmness) and to increase the alpha angle (rate of clot growth) as well as maximal amplitude (MA) which measures maximal stiffness of the clot (Table 7).

Table 7

Thromboelastography parameters in both groups of patients

Parameter	Risk group	Control group	p
r-time (min)	12.11 ± 1.13	7.5 ± 0.91	<0.05
k-time (min)	4.23 ± 0.95	1.8 ± 0.64	<0.05
α-angle (degree)	35.4 ± 5.4	67.9 ± 3.12	<0.05
MA (mm)	45.3 ± 11.4	73.5 ± 6.34	<0.05

Since differences between TEG parameters were significant, in our opinion, the method of thromboelastography can be used in screening assessment of the risk for thrombotic complications in patients who underwent laparoscopic surgeries. Obviously to a quick visual assessment of such risk graphical analysis of the shape of the thromboelastography trace can be used (Fig. 1, 2).

Conclusions

1. Typical laparoscopic surgeries (laparoscopic cholecystectomy in uncomplicated chronic calculous cholecystitis) do not significantly affect hemostasiological parameters and are not accompanied by the signs of the risk for postoperative thrombotic complications.

2. The age of patients over 40 years, body mass index over 30 kg/m^2, as well as duration of laparoscopic surgery more than 1 hour should be included to risk factors leading to significant increase in clotting properties of the blood.

3. Thromboelastography as a method for integrated evaluation of thrombus formation kinetics can be used for screening assessment of the risk for thrombotic complications in patients undergoing laparoscopic surgery.

Prospects for further research

We plan to use this method to study the risk for thromboembolic complications in patients with complicated forms of cholelithiasis and concomitant pathology of veins of the lower extremities.

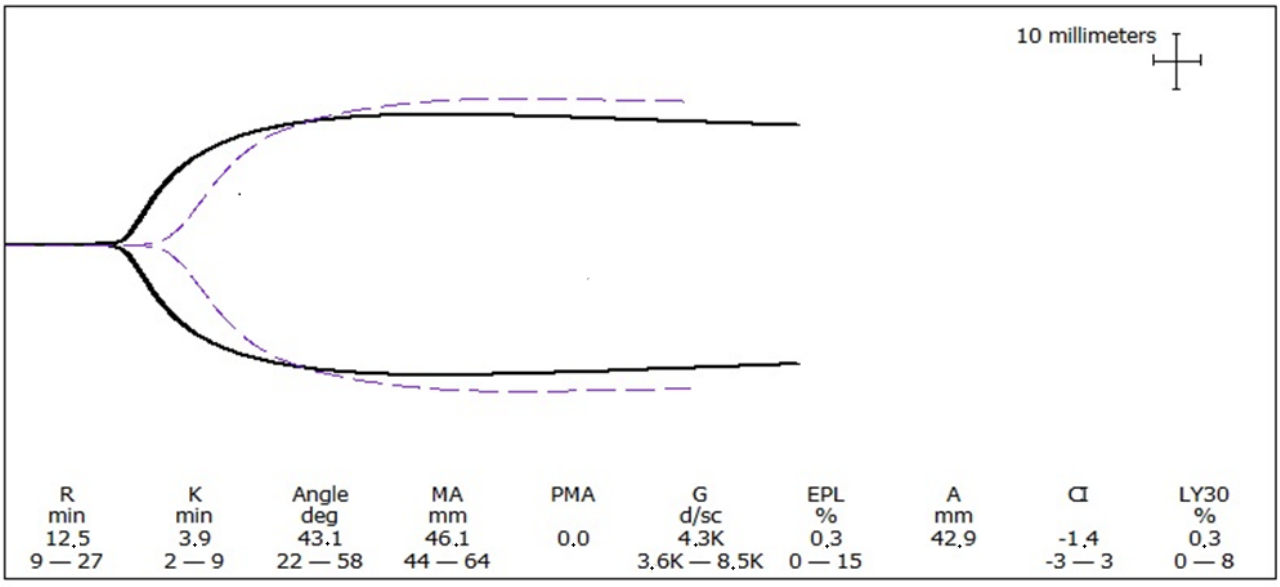

Fig. 1. Example of thromboelastogram of the control group
32-year-old female patient M., BMI – 26.2 kg/m^2, duration of surgery – 35 min

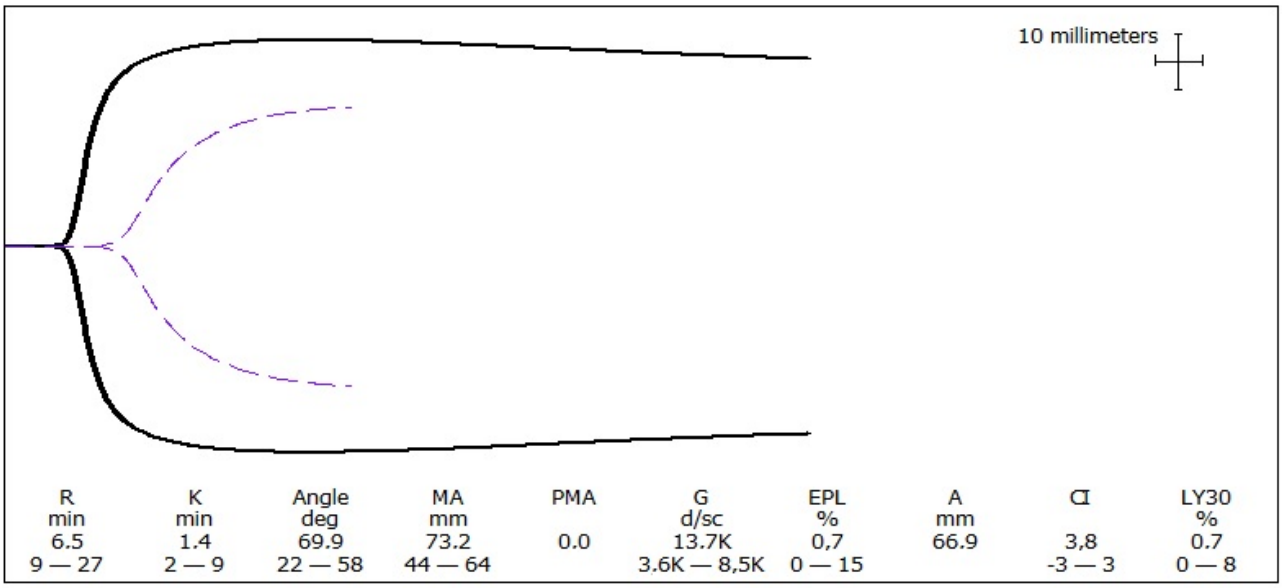

Fig. 1. Example of thromboelastogram of risk group (susceptibility to hypercoagulability)
67-year-old female patient S., BMI – 36.5 kg/m^2, duration of surgery – 75 min

References

1. Amin B, Zhang C, Yan W, Sun Z, Zhang Y, Du D, Gong K. Effects of pneumoperitoneum of laparoscopic cholecystectomy on the coagulation system of patients: a prospective observational study. Chin Med J (Engl). 2014;127(14):2599-2604.
2. Stein PD, Matta F, Sabra MJ. Pulmonary embolism and deep venous thrombosis following laparoscopic cholecystectomy. Clin Appl Thromb Hemost. 2014 Apr;20(3):233-237.
3. Fortor F, Ferro B, Mancini B, Letizia R, Abramo A, Anselmino M, Di Salvo C, Giunta F. Role of thromboelastography in monitoring perioperative coagulation status and effect of thromboprophulaxis in bariatric surgery. Obes Surg. 2012 Jan;22(1):113-118.