DIAGNOSTIC INSTRUMENTS FOR DEEP VEIN THROMBOSIS AFTER LAPAROSCOPIC FUNDOPLICATION

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ABSTRACT

Background. Deep vein thrombosis remains an important health care problem as it is related with the complications having high morbidity and mortality rate. It is considered the third most common acute cardiovascular disease after ischemic heart disease and stroke and effects millions of people worldwide. The aim of this study was to evaluate the rate of deep vein thrombosis (DVT) in patients undergoing laparoscopic fundoplication in two different prophylactic regimes and propose the best. To estimate the sensitivity and specificity of ultrasound (US) for the diagnosis of deep vein thrombosis (DVT) of proximal and distal leg veins.

Materials and methods. The study was performed on 121 patients who were randomized into two groups. All the patients received intermittent pneumatic compression during the laparoscopic fundoplications. The first group received low molecular weight heparin 12 h before the operation, 6 and 30 h after it. The second group received low molecular weight heparin only 1 h before the laparoscopic fundoplication. All the patients underwent color duplex scan examination preoperatively and spiral CT venography with US scan on the third postoperative day to determine the presence and location of deep vein thrombosis.

Results. CT venography revealed posterior tibial vein thrombosis in two (3.3%) I group patients. The sensitivity and specificity of US in our study for femoropopliteal DVT, as compared with CT venography, were both 100% and for inferopopliteal DVT - sensitivity and specificity 98%.

Conclusions. US is highly sensitive and specific noninvasive imaging option for evaluation of proximal DVT, and it is less accurate for the calf veins. The better anticoagulation effect was obtained when low molecular weight heparin was administered 1 hour before the laparoscopic fundoplication.

Keywords: venous thromboembolism, CT venography, sonography.

INTRODUCTION

Venous thromboembolism is important social and health care problem, because 20-30 % of patients develop deep vein thrombosis (DVT) after general surgical operations, while 5.5 % of patients have this complication when laparoscopic fundoplication are performed without appropriate prophylaxis [1,2]. The most frequent reason for pulmonary embolism are thrombi forming in the channels of proximal leg veins and deep pelvic veins. The development of deep venous thrombosis is related with stasis, hypercoagulation state and injury of the venous wall (Virchow‘s triad).

DVT usually starts in calf veins, but it may develop more proximally and cause life-dangerous pulmonary embolism. 80 - 90 % of pulmonary embolism masses are caused by DVT or a thrombus formed in the pelvis [3,2]. Laparoscopic surgery causes variable serum hypercoagulability; there are data suggesting that the patient dependent positioning in combination with intraoperative pneumoperitoneum decreases venous flow from the lower extremities and possibly increases the risk of DVT development [4,2].

The increased intra-abdominal pressure associated with pneumoperitoneum and reverse Trendelenburg position during laparoscopic fundoplication generates venous stasis in the lower limb by compressing the retroperitoneal vena cava and iliac veins, which is already present due to general anesthesia [5,2]. The combination of stasis, hypercoagulability, and injury of the venous wall allows thrombus to develop.

The intermittent pneumatic compression of the calf with an external pressure cuff for the prevention of DVT is a well-established prevention measure [6,7,8,9]. Methods that have used to prevent postoperative deep vein thrombosis during laparoscopic surgery include not only mechanical techniques, but also drug therapy (low-molecular-weight-heparin).

The prophylaxis and treatment of this disease is very important in the clinical practice, so, an early and exact diagnosis is relevant in order to evaluate the exact location and extent of DVT.

The classical symptoms in patients with acute leg DVT are pain or sensitivity, edema and swollen legs, but these symptoms are not specific and characteristic to this kind of pathology only.

The clinical signs and symptoms of pulmonary embolism also are not specific: dyspnea or tachypnea 70-80% (respiratory rate >20/min), hemoptysis 11%, pleuritic pain 50% (angina-like chest pain), tachycardia 25-30% (heart rate >100/min), cough 20-37% – nonproductive, and sometimes productive of clear, bloody or occasionally purulent sputum, rales 50% and deep venous thrombosis 15% [10]. In practice it is often difficult to detect DVT and acute pulmonary embolism PE because from one third to 2/3 patients do not have any symptoms of DVT at all according to the data of different literature.

AIM

he aim of this study was to evaluate the rate of DVT in patients undergoing laparoscopic fundoplication in two different prophylactic regimes and propose the best. To estimate the sensitivity and specificity of ultrasound (US) for the DVT of proximal and distal veins.

MATERIALS AND METHODS

This was a prospective randomized clinical study, where 121 patients undergoing elective laparoscopic fundoplication because of gastroesophageal reflux disease, caused by hiatal hernia, were studied. All the patients gave their written informed consent, and The Kaunas Regional Biomedical Research Ethics Committee approved the study (protocol no. BE-2-13). This randomized clinical study was also registered on the ISRCTN registry with trial ID ISRCTN62203940. All the patients were randomized into two groups. The first group of 59 patients received LMWH Bemiparinum (Zibor, Berlin Chemie, Luxembourg) 2500 IU 0.2 ml subcutaneously 12 h before the operation, 6 and 30 h after it. The second group of 62 patients received LMWH Bemiparinum 2500 TV 0.2 ml. subcutaneously 1 h before the operation. Both groups received intermittent pneumatic compression (IPC) during all laparoscopic fundoplication. The IPC was performed using "Kendall SCD™ 700 Series" apparatus. All the patients underwent color duplex scan examination preoperatively and spiral CT venography with color duplex scan on the third postoperative day in order to detect possible DVT. One experienced radiologist reported all these examinations. Images of each extremity were reviewed for the presence of acute DVT in the common femoral vein, superficial femoral vein, deep femoral vein, and popliteal vein, tibial anterior and posterior vein, peroneal vein. We aquired 5-mm-thick axial CT (TOSHIBA, AQUILION ONE TSX-301, slice 320) venograms from the ankle to the iliac wing after injection of 150 ml of 300 mg/ml contrast medium at a flow rate of 3 ml/sec through an antecubital vein on the third postoperative day. Optimal and homogeneous venous enhancement was obtained when scanning was started 180 sec after contrast medium injection.

Criteria for DVT diagnosis were: intraluminal filling defect, or localized nonopacification of venous segment.

Sensitivity and specificity values from ultrasound for femoropopliteal and infrapopliteal DVT evaluation, were calculated. CT venography was used as the gold standart of reference for diagnosis of deep vein thrombosis.

RESULTS

The patients in both groups were similar in terms of age, weight, height, gender, duration of surgery, and American Society of Anesthesiologists (ASA) class (Table). There was no massive or minor bleeding during all laparoscopic operations. No drains were left after the operation. All the patients left the hospital after an uneventful 3-5 days stay. CT venography revealed posterior tibial vein thrombosis in two (3.3%) patients of the Ist group on the third postoperative day [Figure]. The sensitivity and specificity of US in our study for femoropopliteal DVT, as compared with CT venography, were both 100% and for inferopopliteal DVT - sensitivity and specificity 98 %.

DISCUSSION

DVT is common disease and can result in fatal PE.

Conventional venography was the gold standard in deep vein thrombosis diagnosis and the only imaging test for a long time in order to specify the suspected deep vein thrombosis in legs, pelvis or inferior vena cava [11,12,13]. Contrast enhanced X-ray venography is particularly helpful for assessing recurrent acute deep vein thrombosis in patients with a prior history of deep vein thrombosis in whom venous anatomy is often complex and difficult to evaluate application of other methods [14,13] or when to remove an inferior vena cava filter.

Conventional venography is presently replaced with non-invasive or less invasive radiological examination methods: the first-choice method is ultrasound, but there are also other ones – computed tomography venography and magnetic resonance venography. Ultrasound is the imaging examination of choice for suspected lower extremity deep venous thrombosis.

US is widely recognized as the most cost-effective and preferred imaging modality for diagnosing proximal DVT [15,16,17, 18-23]. US is a non-invasive and easy-to-perform examination without the effect of ionizing radiation and contrast agent (for example, on the bedside, if necessary) and it can be repeated a few times.

Color Doppler ultrasonography (CDUS) has become the initial diagnostic tool due to its high sensitivity for the detection of DVT, and some authors now believe that CDUS should be considered as the gold standard for DVT diagnosis [18].

Doppler color-flow imaging can assist in characterizing a clot as obstructive or partially obstructive; the uneven color-flow can also help to locate the isoechogenic thrombus.

A recent meta-analysis found US to have high sensitivity (range, 93.2%–95.0%; pooled sensitivity, 94.2%) and high specificity (range, 93.1%–94.4%; pooled specificity, 93.8%) for diagnosing proximal DVT [12,13]. In the same study, US was found to have a much lower sensitivity (range, 59.8%–67.0%; pooled sensitivity, (63.5%) for diagnosing distal DVT [13]. Such variations suggest that the diagnostic performances of ultrasonography in distal DVT are poorer than for proximal clots. A meta-analysis by Kearon et al. suggested a sensitivity of 50–75% and an acceptable specificity (90 to 95%) [24]. The calf US examination is not routinely performed in many centers due to relatively low accuracy. However, if the patient indicates local pain in the calf, the examination of this region should be performed. The iliac and pelvis veins are not visible consistently with ultrasound mostly due to gas in the intestine.

CTV permits routine evaluation of deep veins of the calves, the iliac veins/IVC, and the deep femoral vein, none of which are routinely well evaluated with US [12,13].

Many studies found, that the amount of contrast agent used in CTV was lower by about 80% than in venography. Studies comparing the findings of CTV with tones of venography showed 100% sensitivity and 96-97% specificity.

CTV enables comprehensive evaluation of some regions in one examination – i.e., pulmonary CT angiography evaluating pulmonary embolism and evaluation of pelvic and deep leg veins.

Magnetic resonance imaging may also be a promising noninvasive tool in the diagnosis of DVT, but is expensive, has long examination times, and is often difficult in acutely ill patients [25].

CT venography has been compared with sonography for the diagnosis of femoropopliteal DVT in several studies [26-31]. The sensitivity and specificity values of CT venography in these studies ranged from 89 % to 100 % and 94% to 100% respectively [27-31]. Cham et al. [28] demonstrated that of the 116 patients, 15 had DVT that was found at both CTV and sonography, and 4 other patients had thrombus correctly identified in the CTV, that was initially missed by sonography. In Loud et al.'s [29] study of 308 of patients who had sonographic correlation, CT venography was 97% sensitive and 100% specific for DVT in the thighs, and 4 patients had initially negative results from sonography and positive findings from CT venography, but repeated sonography helped to confirm the presence of DVT. In Lim et al. study [32], the sensitivity and specificity of CT venography for femoropopliteal DVT, as compared with sonography, were both 100%.

Most studies only appeared to report proximal DVT. Only few studies reported results for distal DVT. Goodacre et al. performed a systematic review, meta-analysis and meta-regression of diagnostic cohort studies that compared US to contrast venography in patients with suspected DVT. Overall sensitivity for proximal DVT (95% confidence interval) was 94.2% (93.2 to 95.0), for distal DVT was 63.5% (59.8 to 67.0), and specificity was 93.8% (93.1 to 94.4). Duplex US had pooled sensitivity of 96.5% (95.1 to 97.6) for proximal DVT, 71.2% (64.6 to 77.2) for distal DVT and specificity of 94.0% (92.8 to 95.1). Compression US alone had pooled sensitivity of 93.8 % (92.0 to 95.3%) for proximal DVT, 56.8% (49.0 to 66.4) for distal DVT and specificity of 97.8% (97.0 to 98.4) [33].

The sensitivity and specificity of US in our study for femoropopliteal DVT, as compared with CT venography, were both 100% and for inferopopliteal DVT sensitivity and specificity were both 98%.

CONCLUSIONS

1. Our study demonstrated that hypercoagulation state (inferopopliteal DVT) was observed after laparoscopic fundoplication in patients, when low molecular weight heparin was administered 12 h before the operation together with intraoperative intermittent pneumatic compression.
2. Our recommendation is that LMWH, as DVT prophylactic measure, has to be administered 1h before laparoscopic operation to ensure the drug optimal effect.
3. Ultrasonography has become the first-line accepted imaging method in the diagnostic procedure for patients with clinically suspected DVT. US is highly sensitive and specific noninvasive imaging options for evaluating proximal DVT, and it is less accurate for the calf and pelvic veins, and in asymptomatic patients.
4. CT venography can be combined with CT

Table. Patients demographic characteristics

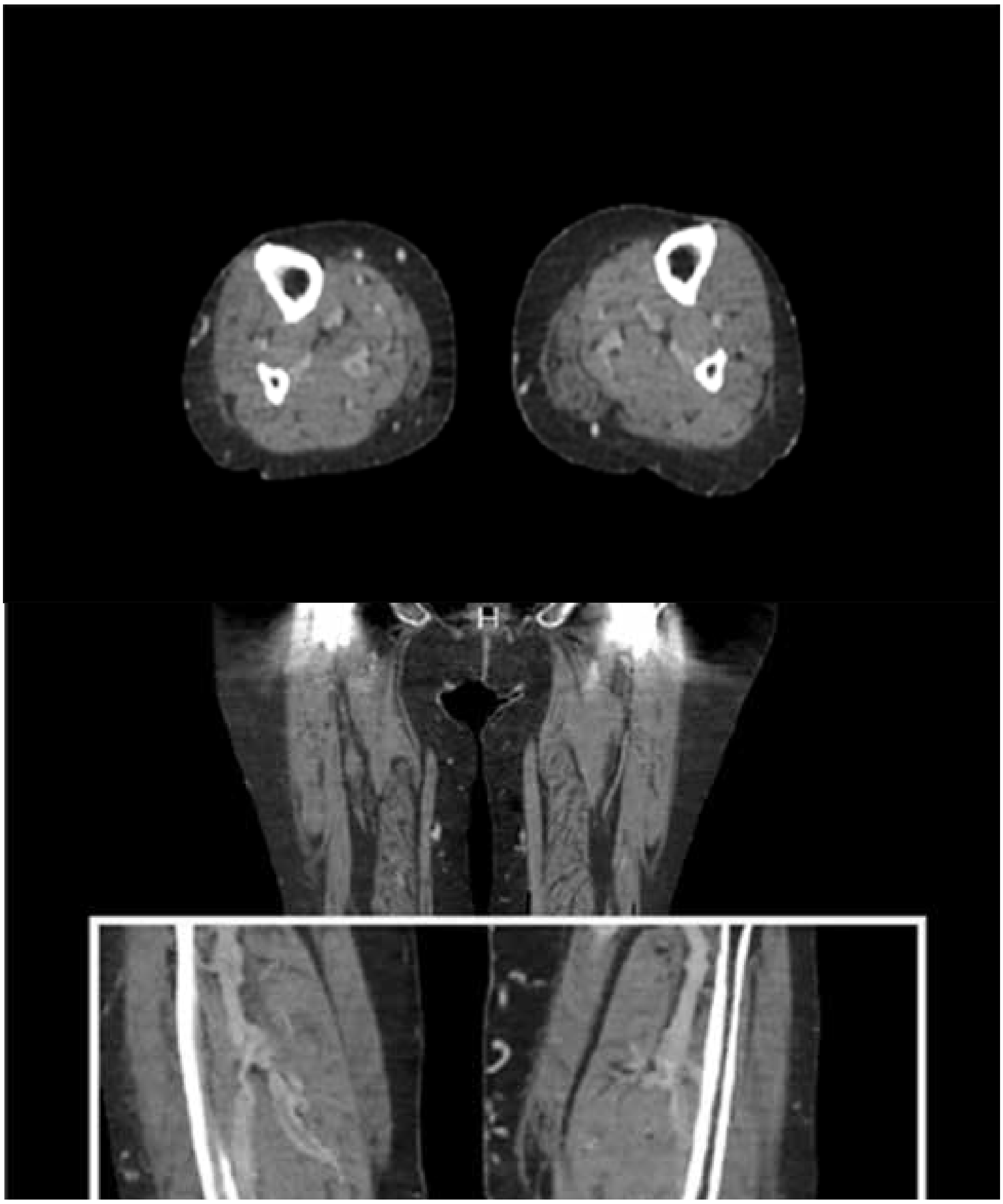
Value	I group (n=59)	II group (n=62)	p values
Age (years)	55.27 ±14.25	55.24±14.65	p=0.886
Male/female (n/n)	18/37	16/35	p=0.881
BMI	27.03 ±5.04	26.72±4.82	p=0.463
Duration of surgery (min)	136.73 ±45.16	129.71±36.84	p=0.638
ASA class			
I	7	6	p=0.921
II	29	30	p=0.921
III	18	15	p=0.921
IV	1	0	p=0.661
Postoperative stay (days)	3.98±0.913	4.04±0.979	p=0.835

Values are mean ±SD

pulmonary angiography and it is nowadays the imaging test of choice in patients with clinically suspected PE.

5. In clinical practice, CT venography for leg vein evaluation has to be compared with sonography.

Figure. Axial and coronal CT venogram: at the calf level - DVT in right tibial posterior vein.



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