ORIGINAL ARTICLE

Prevalence of pulmonary thromboembolism in patients undergoing abdominopelvic surgery with respiratory distress

Prevalencia de tromboembolia pulmonar en pacientes intervenidos de cirugía abdominopélvica con dificultad respiratoria

Carlos A. López-Bernal[1], Eduardo Vázquez-Cruz[2], Aurelio López-Colombo[1], Álvaro J. Montiel-Jarquín[1], Felipe Cruz-Vega[3], and Jorge Loria-Castellanos[3]*

[1]High Specialty Medical Unit, Puebla Specialty Hospital, Instituto Mexicano del Seguro Social (IMSS), Puebla; [2]Family Medicine Unit No. 6 in Puebla, IMSS, Puebla; [3]IMSS Division of Special Health Projects, Mexico City, Mexico

Abstract

Objective: *The objective of the study was to determine the prevalence of pulmonary thromboembolism (PET) and to identify its risk factors in patients operated on a scheduled basis, in the general surgery service from the High Specialty Medical Unit Hospital de Especialidades de Puebla, of the Mexican Social Security Institute.* **Methods:** *Descriptive, retrospective, and cross-sectional study of 52 patients' records with PET and pulmonary angiotomography whose indication was respiratory distress; from 2612 operated patients from November 2015 to March 2018, the sampling was not probabilistic. The statistics was descriptive, with measures of central tendency and dispersion. Fisher test and Rho Spearman were used.* **Results:** *There was association between the development of PET and trans-surgical time (p = 0.018), with the D Dimer (p = 0.014), there was correlation between PET and Wells scale (p=0.001) and blood transfusion (p=0.044). Age, gender, body mass index, pre-operative diagnosis, thromboprophylaxis, blood transfusion, and surgical approach were not risk factors.* **Conclusion:** *The prevalence of post-operative PET in patients with respiratory distress after surgical procedure is 5.7% and the mortality is 33.3%.*

Key words: *General surgery. Prevalence. Pulmonary thromboembolism.*

Resumen

Objetivo: *Determinar la prevalencia de la tromboembolia pulmonar (TEP) e identificar sus factores de riesgo en los pacientes intervenidos en el servicio de cirugía general de manera programada de la Unidad Médica de Alta Especialidad Hospital de Especialidades de Puebla, del Instituto Mexicano del Seguro Social.* **Método:** *Estudio descriptivo, retrospectivo y transversal de 52 expedientes de pacientes con TEP y angiotomografía pulmonar cuya indicación fue la dificultad respiratoria, de 2612 pacientes operados de noviembre de 2015 a marzo de 2018. El muestreo fue no probabilístico. La estadística fue descriptiva, con medidas de tendencia central y de dispersión. Se utilizó prueba de Fisher para riesgo y Rho de Spearman.* **Resultados:** *Hubo asociación entre el desarrollo de TEP y el tiempo transquirúrgico (p = 0.018), y con el dímero D (p = 0.014); hubo correlación entre la TEP y con la escala de Wells (p = 0.001) y con la transfusión de hemoderivados (p = 0.044). La edad, el sexo, el índice de masa corporal, el diagnóstico preoperatorio, la tromboprofilaxis, la transfusión de hemoderivados y el abordaje quirúrgico no fueron factores de riesgo.* **Conclusión:** *La prevalencia de TEP posquirúr-*

Correspondence:
*Álvaro J. Montiel-Jarquín
Calle 2 Norte 2004, Centro
C.P. 72000, Puebla, México
E-mail: dralmoja@hotmail.com

Date of reception: 06-11-2018
Date of acceptance: 08-02-2019
DOI: 10.24875/CIRUE.M20000094

Cir Cir (Eng). 2020;88(1):20-26
Contents available at PubMed
www.cirugiaycirujanos.com

gica en pacientes que cursan con dificultad respiratoria después del procedimiento quirúrgico es del 5.7% y la mortalidad es del 33.3%.

Palabras clave: *Cirugía general. Prevalencia. Tromboembolia pulmonar.*

Introduction

Pulmonary thromboembolism (PTE) is a clinical manifestation that consists of pulmonary circulation mechanical obstruction by a thrombus or embolus in an environment of hypercoagulability and endothelial damage. It is the most dreaded complication of venous thromboembolic disease[1].

PTE is associated with congenital risk factors, such as dysfibrinogenemia, anti-thrombin deficiency, C protein deficiency or S protein deficiency, and acquired risk factors, such as major surgery, advanced age, prolonged immobilization, cancer or previous thrombosis, which cause endothelial damage and that explain its pathophysiology[2-4].

The importance of recognizing these risk factors has as its main element preventing them if possible and developing strategies to reduce the incidence of PTE[5-7]. Hypercoagulability state and endothelial damage have been shown to be present up to 28 days after surgery and can still cause PTE[8].

The prevalence of PTE in operated patients is uncertain, but it is estimated to be 5-25% in patients associated with surgical events, a figure comparable to the incidence of the disease itself[9]. Abdominal surgery involves surgical procedures that are a risk factor for the development of PTE; it can be associated up to 6% as a direct cause of it[10].

For the diagnosis of PTE, pulmonary angiotomography has become the gold standard. In patients with low or intermediate clinical probability of PTE, as assessed using the Wells rule, a negative result has a high negative predictive value (NPV) of up to 96%, while only 60% has a high probability. In contrast, the positive predictive value (PPV) of a positive pulmonary angiography is high (92-96%) in patients with intermediate or high clinical probability, but much lower (58%) in patients with low probability before the test for PTE[11].

The treatment of choice in patients with PTE continues to be anticoagulation, as well as mechanical ventilation and hemodynamic life support. Anticoagulation is recommended to prevent both early death and recurrent or fatal symptomatic PTE. Anticoagulation standard duration should cover at least 3 months[12].

Knowing the prevalence of PTE in patients operated at the general surgery department is useful for improving and proposing prophylactic measures adapted to the needs of the hospital, as well for as the average population served at that department, in addition to optimizing the use of resources and offering better post-surgical results to patients, and thus reduce thrombotic events morbidity and mortality.

The purpose of this work was to determine the prevalence of PTE and identify its risk factors in the general surgery department of the High Specialty Medical Unit (UMAE – *Unidad Médica de Alta Especialidad*) of the Mexican Institute of Social Security (IMSS – *Instituto Mexicano del Seguro Social*) of Puebla, in the period comprised between November 2015 and March 2018. All patients had a pulmonary angiography, the indication of which was respiratory distress after scheduled surgical procedures and was part of the PTE diagnostic protocol.

This study complied with the following ethical guidelines: it was approved by the local research and ethics committees for health research of the participating medical unit, it was designed according to the General Statute of Health in matters of research, Technical Standard number 313, Federal regulation title 15, in addition to the Declaration of Helsinki, as well as the Official Mexican Standard NOM-012-SSA3-2012. Informed consent was not filled out because data were collected from patient records.

Methods

A descriptive, retrospective, and cross-sectional study was carried out where only medical records were analyzed of patients who had a pulmonary angiotomography and who, after elective abdominal surgery, presented with respiratory distress at the UMAE, Specialty Hospital of Puebla, National Medical Center Major General Manuel Ávila Camacho, IMSS, from November 2015 to March 2018.

The sampling frame was non-probabilistic, and the sample size was suitable to the researcher, given by the total number of patients who met the inclusion criteria in the study period and to eliminate sampling bias. The eligible population was 2612 electively operated

patients during the study period. From this total number of patients, 52 abdominal surgery patients who had a pulmonary angiotomography available with post-operative respiratory distress as its indication were selected. Patients of both genders, IMSS affiliates, with PTE diagnosed by pulmonary angiotomography, with complete medical records were included. Patients operated on in another hospital unit with a previous PTE diagnosis were excluded from the study. Due to the type of study, there were no censoring criteria, and no hypothesis was generated as well.

The following variables were used for the study: pre-surgical diagnosis, gender, age, body mass index, mechanical thromboprophylaxis, drug thromboprophylaxis, Wells scale score, pulmonary angiotomography, D-dimer, American Society of Anesthesiology (ASA) scale, surgical approach, surgical time in minutes, trans-surgical bleeding in milliliters, surgical pathology-associated comorbidity, and differential diagnoses.

Results

A total of 2612 patients were reviewed, out of whom 52 met the selection criteria. Patient age was 50.4 years, ranging from 28 to 76 (± 13.5 years). Gender distribution was 50% males and 50% females (n = 26 each).

As an anthropometric measure, the body mass index was measured, and a mean of 28.18 was found, ranging from 21 to 39 (± 4.2974 kg/m^2). Regarding patient pre-surgical diagnoses, the most common was rectal cancer, with 14 patients (26.9%), followed by colon cancer and pancreatic cancer with seven patients each (13.5%), and in third place, gastric cancer with four patients (7.7%); the rest are shown in table 1.

Of the performed interventions, surgical approach was open in 43 patients (82.7%) and laparoscopic in 9 (17.3%). Among the comorbidities the patients had, type 2 diabetes mellitus and high blood pressure were the most common, with 16 (30.8%) each; the rest of comorbidities are shown in table 2.

Patient surgical risk was calculated with the ASA scale. ASA I was observed in 2 (3.8%), ASA II in 46 (88.5%), and ASA III in four patients (7.7%). Mean trans-operative surgical time was 164.9 min, ranging from 55 to 320 (± 69.6 min). The number of patients requiring blood products was 19 (36.5%), while 33 (63.5%) did not require them.

Mean observed trans-surgical bleeding was 541.4 mL, ranging from 5 to 1900 (± 480.7 mL). Mean D-dimer after acute respiratory distress was 1697.96 μg/L, ranging from 670 to 3452 (± 812.1 μg/L). As for the Wells scale for PTE suspicion, in 19 patients (36.5%), it was 2 points, in 28 patients (53.8%), it was 3 points and in five patients (9.6%), it was 4 points.

Observed prophylactic measures were mechanical thromboprophylaxis with compression bandages, which were used in all patients; drug thromboprophylaxis, in which enoxaparin was used, was preoperatively administered in 12 patients (23.1%) and postoperatively in 30 (57.7%); no medication was used in ten patients (19.2%).

As a final cause for respiratory distress, pulmonary atelectasis was found in 23 patients (44.2%) and acute lung edema in 6 (28.8%); the rest are shown in table 3.

The comparison surgical time means between the patients who developed and did not develop PTE was

Table 1. Diagnoses of the patients included in the study

Diagnosis	n	%
Rectal cancer	14	26.9
Colon cancer	7	13.5
Pancreatic cancer	7	13.5
Gastric cancer	6	11.5
Esophageal cancer	4	7.7
Intestinal perforation	9	17.3
Lithiasic cholecystitis	4	7.7
Gastroesophageal reflux disease	5	9.6
N	52	100

Table 2. Comorbidity of patients with post-surgical respiratory distress

Disease	n	%
Type 2 diabetes mellitus	16	30.8
High blood pressure	16	30.8
Ischemic heart disease	6	11.5
Chronic kidney disease	4	7.7
Chronic obstructive pulmonary disease	1	1.9
No comorbidity	9	17.3
Total	52	100

Table 3. Post-operative respiratory distress etiology

Diagnosis	n	%
Pulmonary atelectasis	23	44.2
Acute lung edema	6	11.5
Mediastinitis	5	9.6
Abdominal sepsis	15	28.8
Pulmonary thromboembolism	3	5.7
N	52	100

Table 4. Association between gender, Wells scale, packed red blood cell transfusion, and surgical approach and the development of pulmonary thromboembolism

Variable	Thromboembolism		Total	Fisher	p
	Yes	No			
Gender					
Males	1	25	26		
Females	2	24	26		0.5
Total	3	49	52		
Wells scale					
2 points	0	19	19		
3 points	0	28	28		0.001
4 points	3	2	5		
Total	3	49	52		
Blood product transfusion					
Yes	3	16	19		
No	0	33	33		0.044
Total	3	49	52		
Surgical approach					
Open	3	40	43		
Laparoscopic	0	9	9		0.558
Total	3	49	52		

statistically significant (p = 0.018, Spearman). In addition, to find out the association between blood product transfusion and the appearance of PTE in patients with post-surgical respiratory distress, a comparison was made using 2 × 2 contingency tables with Fisher's exact test, where a significant difference was obtained (p = 0.044) between the patients who developed PTE and those who did not. As for D-dimer, a statistically significant value was obtained using Spearman's correlation (p = 0.014). Regarding the Wells scale as a suspicion scale for the development of PTE, using Fisher's exact test, p = 0.001 was obtained, which was considered statistically significant ($p \leq 0.05$) (Tables 4 and 5) (Fig. 1).

Table 5. Correlation between age, body mass index, D-dimer, surgical time, and bleeding and the development of pulmonary thromboembolism

Variables and development or not of pulmonary thromboembolism	Spearman's Rho	p
Patient age	–0.233	0.816
Body mass index	–0.605	0.548
D-dimer	–2.540	0.014
Surgical time (min)	–2.451	0.018
Trans-surgical bleeding (mL)	–0.248	0.077

No variables were found to be risk factors for the development of PTE (Fig. 2).

Discussion

In the present study, the prevalence of PTE was determined in patients who underwent surgery in the general surgery department in the setting of abdominal surgery and who experienced respiratory distress after the procedure.

Patient mean age was found to be in the fifth decade, which compared to other studies is lower. The study by Parry et al.[13] and that by Melloul et al.[14] observed a patient mean age between 10 and 15 years older than in this study. The study by Jeremitsky et al.[15] had a similar age to that of the patients in our sample[16]. In said studies, age is not regarded as a risk factor, except for the study by Stroh et al.[16], where a higher prevalence of PTE was observed in older people. Contrary to what Stroh et al.[16] observed, within the present study, no age differences or associations with the development of PTE were observed.

As for gender, the sample consisted of the same number of men and women, which is different from what was observed in the study by Parry et al.[13], which had a lower number of women than of men. However, no associations with gender were observed, similar to that which was observed by Melloul et al.[14] and consistent with that which was observed in the present study, where gender did not have an association with the presence of PTE. Another study, carried out of Jeremitsky et al.[15], observed that thrombotic events were more common in women than in men.

Regarding the surgeries within the study, all were elective and most patients had an open procedure; this variable was not associated with the presence of PTE. However, in contrast to the study by Melloul et al.[14],

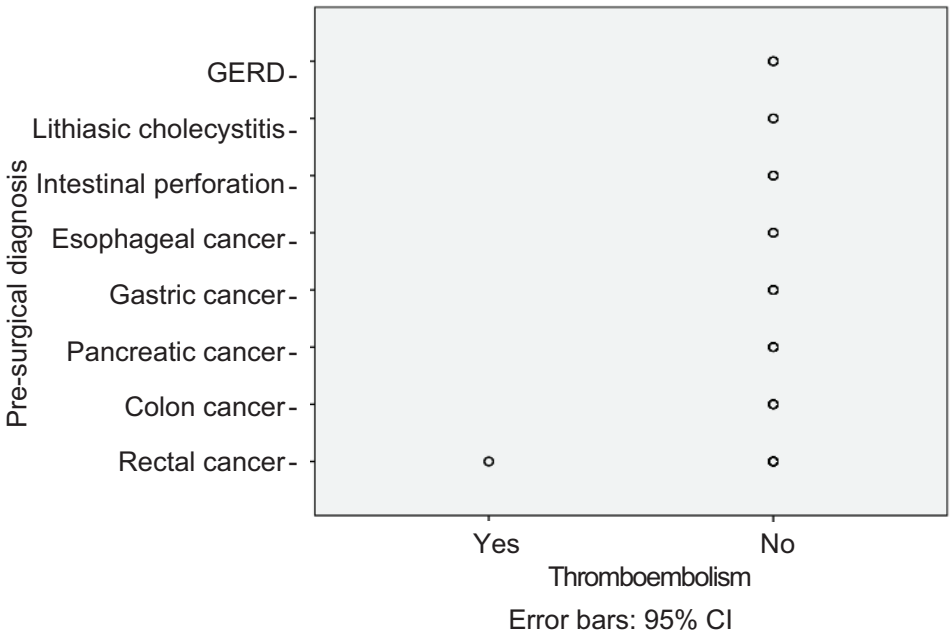

Figure 1. *Correlation between pre-operative diagnosis and pulmonary thromboembolism development.*

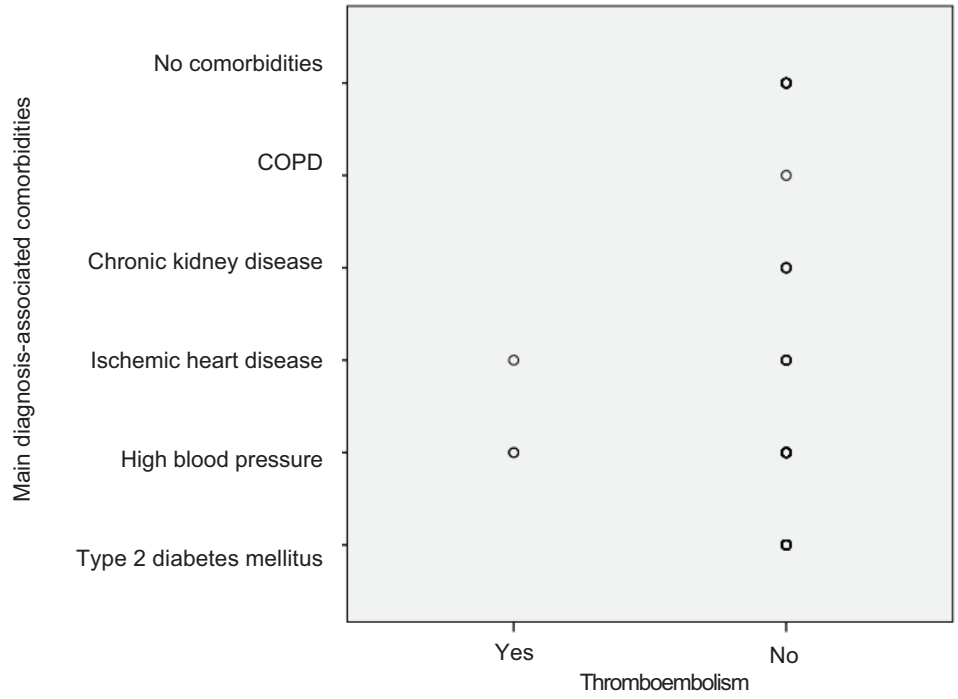

Figure 2. *Correlation between main diagnosis-associated comorbidities and the development of pulmonary thromboembolism.*

associations between surgeries and the presence of PTE were observed, with major resections in open surgery being found to be associated with a higher prevalence of PTE[14].

The two most common comorbidities were high blood pressure and type 2 diabetes mellitus, but they were not found to be associated with the development of PTE in patients, similar to the results of the study

by Stroh et al.[16], who also found high blood pressure and type 2 diabetes to be common comorbidities and, similarly, they did not have a statistically significant association. As for differences, their study found sleep apnea as comorbidity, but this was not observed among the patients of the present study. Contrary to our findings, the study by Kokudo et al.[17] also found comorbidities such as chronic obstructive pulmonary disease, ischemic heart disease, smoking, and alcoholism, which are variables that were not observed in this study.

The surgical risk that was most commonly observed in our patients was ASA II, which was not associated with the presence of PTE, which is consistent with what Kokudo et al.[17] observed in their study, where surgical risk was not associated as a risk factor.

Surgical time had a mean of 164 min, and this variable was found to be correlated with the presence of PTE. In patients who had PTE, surgical time was statistically longer than in the patients who did not have PTE ($p = 0.10$). This was similar to that which Kokudo et al.[17] found in their study, where surgical time and the presence of PTE were also associated. This result is different from that reported by Parry et al.[13], who did not find an association between both variables. Trans-surgical bleeding was not a variable that was observed to be correlated with the presence of PTE, which was similar to that observed by Parry et al.[13].

Regarding the Wells scale, most patients had a score of 3. When statistical analysis was carried out, mean score was observed to be different in patients with PTE in comparison with those without it. As for prophylactic measures, all patients received mechanical prophylaxis with medium compression stockings, and medications were used in most patients; this variable was not associated with the appearance of PTE.

PTE prevalence in patients with post-operative respiratory distress was 5.7%, which is higher than that found by Wang et al.[18] in their study, where PTE accounted for 0.46% of post-surgical thrombotic events.

D-dimer, as a test performed in patients with acute respiratory distress, showed a sensitivity of 95%, specificity of 5%, a NPV of 94%, and a PPV of 51%. Despite being statistically significant, in our study, it has low specificity and turns out to be highly sensitive. Regarding the Wells scale as a scale for the probability of PTE, it offers a sensitivity and specificity in our study of 50%, a NPV of 94% and a PPV of 6%, which indicated that this is an adequate test for the diagnostic workup of patients with suspected PTE. With regard to pulmonary angiotomography as a reference study, we obtained a sensitivity of 100% and specificity of 50%, PPV of 6%, and NPV of 100%; this confirms the test as the standard method for PTE diagnosis.

Similarly, mean age, body mass index, bleeding amount, gender, pre-operative diagnosis, surgical risk on ASA scale, trans-surgical bleeding, and type of approach and comorbidity were compared, and they were not different between patients with post-surgical respiratory distress who developed PTE and those who did not.

Based on these results, avoiding prolonged surgical times and inappropriate use of blood transfusions are proposed, as well as using the Wells scale to identify patients with likelihood of PTE, and D-dimer determination in patients at risk of PTE. Using prophylactic measures, such as low molecular weight heparin, presurgically as long as there are no contraindications, and systematic use of medium compression stockings in the lower limbs is recommended, as well as early mobilizing the patients.

Conclusion

The prevalence of post-surgical PTE in patients with respiratory distress is 5.7%, and mortality is 33.3%. No risk factors for the development PTE were found.

Conflicts of interest

The authors declare that they have no conflicts of interest.

Funding

This research work received no funding from any institution for its performance.

Ethical disclosure

Protection of people and animals. The authors declare that the followed procedures complied with the ethical standards of the responsible human experimentation committee and were in accordance with the World Medical Association and the Declaration of Helsinki.

Confidentiality of data. The authors declare that they have followed the protocols of their work center on the publication of patient data.

Right to privacy and informed consent. The authors have obtained informed consent from the

patients and/or subjects referred to in the article. This document is in the possession of the corresponding author.

References

1. Kozek LS, Fenger EC, Thienpont E, Baraurkas G. European guidelines on perioperative venous thromboembolism prophylaxys. Eur J Anaesthesiol. 2017;34:1-7.
2. Cabrera RA, Nellen HH. Epidemiología de la enfermedad tromboembólica venosa. Gac Med Mex. 2007;143:3-5.
3. Wakefield TW, McLafferty RB, Lohr JM, Caprini JA, Gillespie DL, Passman MA. Call to action to prevent venous thromboembolism. J Vasc Surg. 2009;49:1620-3.
4. Palta S, Saroa R, Palta A. Overview of the coagulation system. Indian J Anaesth. 2014;58:515-23.
5. Imigo FG, Castillo EF, Sánchez AH. Profilaxis de la enfermedad tromboembólica en cirugía. Cuad Cir 2010;24:34-9.
6. Bahl V, Mei HH, Henke KP, Wakefield WT, Campbell AD, Caprini AJ. A validation study of a retrospective venous thromboembolism risk scoring method. Ann Surg. 2010;251:344-50.
7. Marti C, John G, Konstantinides S, Combescure C, Sanchez O, Lankeit M, et al. Systemic thrombolytic therapy for acute pulmonary embolism: a systematic review and meta-analysis. Eur Heart J. 2015; 36:605-14.
8. Ulrych J, Kvasnicka T, Fryba V, Komarc M, Malikova I, Burget F, et al. 28 day post-operative persisted hypercoagulability after surgery for benign diseases: a prospective cohort study. BMC Surg. 2016;16:1-8.
9. Albores AR, Nava ZA, Guerra SA, Plascencia OT, Rubio JB. Sobre la tromboembolia pulmonar. El residente. 2014;9:124-7.
10. Sakon M, Kakkar AK, Ikedal M, Sekimoto M, Nakamori S, Yano M, et al. Current status of pulmonary in general surgery in Japan. Surg Today. 2004;34:905-10.
11. Horii Y, Yoshimura N, Hori Y, Takaki S, Takano T, Inagawa S, et al. Correlation between the site of pulmonary embolism and the extent of deep vein thrombosis: evaluation by computed tomography pulmonary angiography and computed tomography venography. Jap J Radiol. 2011; 29:171-6.
12. Agnelli G, Buller RH, Cohen A, Curto M, Gallus SA, Johnson M, et al. Oral apixaban for the treatment of acute venous thromboembolism. N Engl J Med. 2013;369:799-808.
13. Parry K, Sadeghi AH, Van Der Horst S, Westerink J, Ruurda JP, Van Hillegersberg R. Intermittent pneumatic compression in combination with low-molecular weight heparin in the prevention of venous thromboembolic events in esophageal cancer surgery. J Surg Oncol. 2017;115: 181-5.
14. Melloul E, Dondéro F, Vilgrain V, Raptis DA, Paugam BC, Belghiti J. Pulmonary embolism after elective liver resection: a prospective analysis of risk factors. J Hepatol 2012;57:1268-75.
15. Jeremitsky E, St. Germain N, Kao AH, Ong AW, Smith RS. Risk of pulmonary embolism in trauma patients: not all created equal. J Surg. 2013;154:810-5.
16. Stroh C, Michel N, Luderer D, Wolff S, Lange V, Köckerling F, et al, Risk of thrombosis and thromboembolic prophylaxis in obesity surgery: data analysis from the German Bariatric Surgery Registry. Obes Surg. 2016;26:2562-71.
17. Kokudo T, Uldry E, Demartines N, Halkic N. Pulmonary embolism, specific risk factor after pancreas resection? Pancreas. 2014;43:891-4.
18. Wang L, Pryor AD, Altieri MS, Romeiser JL, Talamini MA, Shroyer L, et al. Perioperative rates of deep vein thrombosis and pulmonary embolism in normal weight vs obese and morbidly obese surgical patients in the era post venous thromboembolism prophylaxis guidelines. Am J Surg.