Effect of Obesity on Percutaneous Thrombectomy Outcomes in the Treatment of Lower Limb Deep Vein Thrombosis

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ABSTRACT

Objective: To evaluate the effect of obesity on percutaneous thrombectomy (PT) results for the management of lower limb deep vein thrombosis (DVT).

Study Design: Retrospective cohort study.

Place and Duration of Study: Department of Cardiology, Avcilar Hospital, Istanbul, Turkey, between August 2020 and January 2021.

Methodology: Patients who underwent PT for lower limb DVT were included. Patients' demographic characteristics, operative parameters, and postoperative outcomes were recorded in prospective manner. Patients were divided into two groups, as patients with body mass index (BMI) <30 kg/m^2 (Group 1) and patients with BMI ≥30 kg/m^2 (Group 2). The two groups were compared according to patient demographic properties, intraoperative results, and postoperative outcomes.

Results: Eventually, 62 patients were enrolled into the non-obese group and 30 patients had BMI ≥30 Kg/m^2. Comparison of the groups demonstrated that the mean operation time and the mean fluoroscopy time were significantly higher in obese patients (121.5 min *vs.* 134.5, p = 0.017 and 19.8 min *vs.* 25.9 min, p = 0.006, respectively). In addition, the mean hospitalisation period and the mean ICU stay were significantly longer in patients with ≥30 kg/m^2 (p = 0.025 and p = 0.007). Postoperative visual analog scale (VAS) score in the first hour was significantly higher in obese patients (2.4 *vs.* 3.0, p = 0.008). The presence of obesity did not have a significant effect on success and complication rates following PT (p = 0.368 and p = 0.646).

Conclusion: Obesity prolonged operation time and fluoroscopy time during PT. Additionally, obesity was associated with significantly longer hospitalisation period, and ICU stay, and higher VAS score in the first hour following PT.

Key Words: *Complication, Deep vein thrombosis, Obesity, Percutaneous thrombectomy, Success, VAS score.*

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INTRODUCTION

Deep vein thrombosis (DVT) is a social health problem with one per 1000 annual incidence.[1] Lower limbs are the most common site of DVT, and untreated DVT is associated with edema, pain, ulcers, and pulmonary embolism.[2] Anticoagulation therapy is the most accepted treatment option for DVT. However, long-lasting anticoagulation administration has risks including irregular use, side effects and interaction with other medicines.[3] Thus, percutaneous thrombectomy (PT) was introduced into the medical field for management of lower limb DVT. Loffroy and colleagues performed PT for 30 patients with acute iliofemoral DVT, and achieved 86.7% success rate.[4] In another study by Dumantepe and Uyar, success was 90.7% for PT in 58 patients.[5] However, factors affecting success and complications have not been investigated yet.

According to the World Health Organisation, individuals with ≥30 Kg/m^2 are accepted as obese. Due to reduction of physical activity and changes in dietary habits, obesity has become a pandemic disease.[6] Many studies focus on the effect of obesity on invasive procedure outcomes. Refahiyat and colleagues claimed that obesity was a risk factor for radiation exposure for health workers during coronary angiography.[7] In another study by Badrudin *et al*., obesity was found to be a predictive factor for re-hospitalisation after coronary artery bypass surgery.[8] Although previous studies showed the effect of PT in the management of DVT, no study has investigated the effect of obesity on PT outcomes.

The aim of the present study was to evaluate the effect of the obesity on PT results for the management of lower limb DVT.

METHODOLOGY

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The present study included patients who underwent PT for lower limb (popliteal, femoral, external iliac and common iliac veins) DVT between August 2020 and January 2021. Patient demographic properties and procedure-related parameters were recorded in an electronic database in prospective manner. All PT procedures were done with same technique by the same cardiology team (CB and ES). All patients in the present study had unilateral lower limb DVT, and diagnosis of DVT was revealed by a combination of detailed physical examination and venous duplex ultrasound findings. Patients with bilateral limb DVT, with psychiatric and/or neurologic disease(s), and patients under the age of 18 were excluded from the study. Other exclusion criteria were lack of information about body mass index (BMI) and active infection in percutaneous access area.

Patients' demographic characteristics and thrombus findings were noted. Data about the procedure (operation time and fluoroscopy time) and postoperative period (hospitalisation time, duration of intensive care unit (ICU) stay, decrease of hemoglobin level, postoperative visual analog scale (VAS) in the 1st and 24th hours, success of PT, complications according to Clavien-Dindo classification and follow-up period), were recorded. Procedures with complete removal of thrombus without requiring any additional procedure were considered successful.

All procedures were performed in the same manner under local anesthesia. Before starting the procedure, 5000 IU heparin sodium was administered; and to prevent thromboembolic events, vena cava filter was inserted from the contralateral femoral vein. Percutaneous access was performed from the popliteal vein with an 18 gauge needle under fluoroscopy and ultrasonography guidance, and 8 F introducer sheath was inserted (Invamed, Ankara, Turkey). Venography was done to evaluate thrombus and patency of vein, and 0.035-size guidewire was advanced beyond the thrombosis. Mechanical thrombectomy was performed until complete removal of thrombus was achieved. At the end of the procedure, venography was routinely performed to evaluate venous patency. Success of PT was re-evaluated at the end of the first month with venous duplex ultrasonography.

A total of 92 patients were divided into two groups, as patients with BMI <30 Kg/m^2 (Group 1) and patients with BMI ≥30 Kg/m^2 (Group 2). The two groups were compared according to patient demographic properties, intraoperative results, and postoperative outcomes.

The Statistical Package for the Social Sciences version 25 (SPSS IBM Corp., Armonk, NY, USA) programme was used for statistical evaluation. For variable distributions, the Kolmogorov-Simirnov test was used. Independent student t-test was used in comparison of normally distributed parameters and the Mann-Whitney U-test was used for comparison of non-normally distributed variables. Quantitative data are shown as mean ± standard deviation values. Categorical values were categorised and compared using the $\chi 2$ test or Fisher's Exact test. Qualitative data are presented as numbers and percentages. The data were analysed at 95% confidence level and *p* value of less than 0.05 was accepted as statistically significant.

RESULTS

Ninety-two patients with the mean age 54.6 years and 28.3 Kg/m^2, were enrolled in the study. Most common sites of lower limb DVT were femoropopliteal (40.2%) and iliofemoral (29.3%) veins. The mean operation and fluoroscopy time were 125.7 minutes (min) and 21.8 min, respectively. Complications were faced in 16 (17.4%) cases, and most complications were categorised as Clavien-Dindo grade 1-2 [12 (13.1%) patients]. Success was achieved in 82 (89.1%) patients (Table I).

Table I: Demographic data and operative information of all patients.

	n=92
Age (years)*	54.6±16.5
Sex:	
Male	51 (55.4%)
Female	41 (44.6%)
BMI (kg/m^2)*	28.3±4.1
ASA score*	2.0±0.5
Smoking status	51 (55.4%)
Diabetes mellitus	15 (16.3%)
Hypertension	29 (31.5%)
Coexistent malignancy	48 (52.2%)
DVT history	41 (44.6%)
Site of DVT:	
Iliofemoral	27 (29.3%)
Popliteal	17 (18.5%)
Femoral	11 (12.0%)
Femoral/popliteal	37 (40.2%)
Side involved:	
Right	46 (50.0%)
Left	46 (50.0%)
Operation time (min)*	125.7±24.7
Fluoroscopy time (min)*	21.8±10.0
Hospital stay (days)*	3.9±1.7
ICU stay (days)*	1.6±1.2
Success	82 (89.1%)
Decrease of hemoglobin (g/dl)*	1.1±1.0
Complications:	16 (17.4%)
Clavien-Dindo grade 1-2	12 (13.1%)
Clavien-Dindo grade 3-5	4 (4.3%)
VAS score*:	
Postoperative 1th hour	2.6±1.1
Postoperative 24th hour	0.9±0.9
Follow-up (months)*	21.5±8.7

**Mean ± standard deviation. BMI: Body mass index, ASA: American society of anesthesiologists classification, DVT: Deep vein thrombosis, ICU: Intensive care unit, VAS: Visual analogue scale.*

Comparison of preoperative parameters between groups revealed that age, gender, and ASA score were similar between the groups (p = 0.378, p = 0.104, and p = 0.462, respectively). In addition, presence of diabetes mellitus, hypertension, coexistence malignancy, and DVT history did not have significant differences (p = 0.948, p = 0.223, p = 0.238, and p = 0.289, respectively). The only statistically significant demographic parameter was mean BMI between the groups (33.1 Kg/m^2 *vs.* 26.0 Kg/m^2, p <0.001, Table II).

Table II: Comparison of demographic data between groups according to body mass index.

	BMI <30 (n=62)	BMI ≥30 (n=30)	p-value
Age (years)*	55.7 ± 15.8	52.4 ± 17.9	0.378
Gender: Male Female	 38 (61.3%) 24 (38.7%)	 13 (43.3%) 17 (56.7%)	 0.104
BMI (Kg/m^2)*	26.0±2.6	33.1±1.6	***<0.001***
ASA score*	2.0±0.5	1.9±0.5	0.462
Smoking status	37 (59.7%)	14 (46.7%)	0.239
Diabetes mellitus	10 (16.1%)	5 (16.7%)	0.948
Hypertension	17 (27.4%)	12 (40.0%)	0.223
Coexistent malignancy	35 (56.4%)	13 (43.3%)	0.238
DVT history	30 (48.4%)	11 (36.7%)	0.289
Duration of symptoms (days)*	6.8±3.9	7.1±4.4	0.760

**Mean ± standard deviation. BMI: Body mass index, ASA: American society of anesthesiologists classification, DVT: Deep vein thrombosis.*

Table III: Comparison of preoperative data and postoperative results between groups, according to body mass index.

	BMI <30 (n=62)	BMI ≥30 (n=30)	p-value
Site of DVT: Iliofemoral Popliteal Femoral Femoral/popliteal	 19 (30.6%) 11 (17.8%) 9 (14.5%) 23 (37.1%)	 8 (26.7%) 6 (20.0%) 2 (6.7%) 14 (46.7%)	0.642
Side involved: Right Left	 34 (54.8%) 28 (45.2%)	 12 (40.0%) 18 (60.0%)	0.182
Lesion length (cm)*	10.8±1.9	11.2±1.7	0.343
Operation time (min)*	121.5±22.8	134.5±26.5	***0.017***
Fluoroscopy time (min)*	19.8±9.4	25.9±10.1	***0.006***
Amount of blood (ml)*	259.0±41.0	249.6±37.0	0.291
Stenting rate	10 (16.1%)	4 (13.3%)	0.726
Hospital stay (days)*	3.6±1.5	4.5±1.9	***0.025***
ICU stay (days)*	1.4±1.1	2.1±1.4	***0.007***
Success	54 (87.1%)	28 (93.3)	0.368
Decrease of hemoglobin (g/dl)*	1.2±1.0	1.0±1.1	0.310
Complications: Clavien-Dindo grade 1-2 Clavien-Dindo grade 3-5	10 (16.1%) 7 (11.3%) 3 (4.8%)	6 (20.0%) 5 (16.7%) 1 (3.3%)	0.646 0.518 0.606
VAS score*: Postoperative 1th hour Postoperative 24th hour	 2.4±0.8 0.8±0.8	 3.0±1.4 1.1±1.0	 ***0.008*** 0.174
Re-operation	1 (1.6%)	1 (3.3%)	0.548
Follow-up (months)*	22.6±8.6	19.4±8.6	0.103

**Mean ± standard deviation. DVT: Deep vein thrombosis, ICU: Intensive care unit, VAS: Visual analogue scale.*

Comparison of the groups demonstrated that the mean operation time and the mean fluoroscopy time were significantly higher in obese patients (121.5 min *vs.* 134.5 min, p = 0.017 and 19.8 min *vs.* 25.9 min, p=0.006, respectively). In addition, the mean hospitalisation period and the mean ICU stay were significantly longer in patients with ≥30 Kg/m^2 (p = 0.025 and p = 0.007). Postoperative VAS score in the first hour was significantly higher in obese patients (2.4 *vs* 3.0, p = 0.008); however, VAS score in 24th hour was not significantly different (0.8 *vs.* 1.1, p= 0.174). Lastly, the presence of obesity did not have a significant effect on success and complication rates following PT (p = 0.368 and p = 0.646, respectively).

DISCUSSION

Percutaneous thrombectomy is increasingly chosen for the treatment of lower limb DVT. However, the number of studies examining the factors affecting PT outcomes is limited. In the present study, the authors aimed to clarify the effect of obesity on PT outcomes for the first time. The authors found that obesity was associated with higher VAS score in the first hour after PT and longer operation time, fluoroscopy time, hospitalisation time and ICU stay. In addition, obesity had no effect on success and complications following PT.

The effect of obesity on the duration of surgical procedures is a topic of interest. Michalka and colleagues investigated the effect of obesity on primary hip arthroplasty, and did not find any significant correlation between obesity and operation time.[9] In contrast, Simsek *et al.* analysed the impact of obesity on renal stone surgery, and found a positive correlation between obesity and prolonged operative time.[10] In the present study, the mean operation and the mean fluoroscopy time were significantly longer in obese patients. The authors believe that more difficult positioning for obese patients, difficulties in identifying anatomical landmarks in obese cases, and limited movement of catheters due to acute angulation could be reasons for these results.

No studies examined predictive factors affecting the duration of hospitalization, following the PT procedure. However, Prabhakar *et al.* found significant correlation between obesity and prolonged hospitalisation stay after coronary artery bypass graft surgery.[11] Kuduvalli and colleagues stated that BMI ≥35 Kg/m^2 was a predictive factor for longer hospitalisation time and prolonged ventilation time after cardiac bypass surgery.[12] Similarly, this study also showed longer operation time and ICU stay for obese patients. The present authors believe that difficult postoperative mobilisation and relatively low lung capacity in obese cases were reasons for these outcomes.

VAS is used for the subjective assessment of acute and chronic pain. Auffinger and colleagues studied the impact of obesity on pain, following cervical spine disease surgery, and concluded that obese patients had higher pain VAS scores.[13] Similarly, Majchrzak *et al*. focused on postoperative pain, following lung cancer surgery, and the mean VAS was 4.5 and 3.4 in severe obese patients and non-obese patients (p <0.001).[14] In accordance, patients with ≥30 Kg/m^2 had higher VAS score in the first hour following PT.

Studies, which investigated the effect of obesity on success of procedures and complications, provided conflicting results. Davenport and colleagues investigated the 30th day morbidity and mortality after vascular surgeries, and concluded that morbidity and mortality were increased only in patients with BMI ≥40 Kg/m^2.[15] In contrast, Engel *et al.* claimed that underweight patients had similar success, and higher mortality and complication rates following coronary artery bypass surgery compared to obese patients.[16] In the present study, the authors did not determine any significance in terms of success and complications, following PT in the comparison of obese and non-obese patients.

The small patient number and retrospective nature could be considered limitations of this study. However, data was recorded in the electronic database in prospective manner. Additionally,

the authors did not evaluate the effect of obesity on cost of procedures. Moreover, the authors did not have data about puncture number during percutaneous access and number of maneouvers during clot removal; and the effect of obesity on these parameters could be the subject of another studies.

CONCLUSION

The present study demonstrated for the first time that obesity prolonged operation time and fluoroscopy time during PT. Additionally, obesity was associated with significantly longer hospitalisation period, and ICU stay, and higher VAS score in the first hour following PT.

ETHICAL APPROVAL:
The study was approved by the Institutional Ethics Committee of Bezmialem Vakif University, (Date: 06.04.2020; Number: 2020/105).

PATIENTS' CONSENT:
Patients' consents were obtained 24 hours before the procedure.

CONFLICT OF INTEREST:
The authors declared no conflict of interest.

AUTHORS' CONTRIBUTION:
ES: Conception, data analyses, interpretation of data, and drafting of manuscript.
CB: Conception, data analyses, and interpretation of data.

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