Original Article

DOI: 10.4274/haseki.galenos.2022.8233
Med Bull Haseki 2022;60:248-253

# The Impact of Age on Percutaneous Thrombectomy Outcomes in the Management of Lower Extremity Deep Vein Thrombosis

Hakki Kursat Cetin*, Corc Baytaroglu**

*University of Health Sciences Turkey, Sisli Hamidiye Etfal Training and Research Hospital, Clinic of Cardiovascular Surgery, Istanbul, Turkey

**Halic University Faculty of Medicine, Avcilar Hospital, Clinic of Cardiology, Istanbul, Turkey

## Abstract

**Aim:** Percutaneous thrombectomy (PT) results may differ in elderly patients compared to younger patients. We analyzed the effect of being elderly on PT results for lower extremity deep vein thrombosis (DVT).

**Methods:** We retrospectively reviewed patient charts who were treated with PT for lower extremity (common iliac, external iliac, femoral, and popliteal veins) DVT between October 2016 and March 2021, and patients with unilateral lower extremity DVT and older than 18 years old were enrolled in the cohort study. Patients' preoperative characteristics, operative parameters, and post-procedural outcomes were stored in the electronic data system. All participants were divided into 2 groups according to being elderly or not, as patients <65 years and patients ≥65 years. The two groups were compared in terms of preoperative patient data, operative parameters, and postoperative results.

**Results:** One hundred and five patients were enrolled in the study (62 patients were <65 years of age and 43 patients were ≥65 years of age). The mean hospitalization time was 3.1 days for non-elderly patients and 3.8 days for elderly patients (p=0.030). In addition, the duration of mean intensive care unit (ICU) stay was significantly longer in elderly patients (1.2 vs 1.7, p=0.024). Older patients had a lower success rate, but the difference was not statistically significant (93.5% vs 88.4%, p=0.482). Grade 1-2 Clavien-Dindo complications and the overall complication rate were significantly higher in elderly patients (6.4% vs 20.9%, p=0.027 and 12.9% vs 30.2%, p=0.029). The Pearson correlation test revealed that older age was associated with longer hospitalization time and ICU stay (p=0.001 and p=0.001).

**Conclusion:** Elderly patients are more frail depending on age and comorbidities, and the hospitalization time and ICU stay after PT are prolonged in these patients. In addition, elderly patients face significantly more complications following PT in comparison with non-elderly patients.

**Keywords:** Aged, venous thrombosis, lower extremity, hospitalization, thrombectomy

## Introduction

Deep vein thrombosis (DVT) is described as an abnormal clot formation, particularly in the deep veins of the lower extremities. Untreated DVT is a serious health problem and results in edema, pain, ulceration, pulmonary embolism, and even death (1). The incidence of DVT is influenced by many factors, including the presence of motion-restricting disease, the presence of cancer, obesity, and aging. Silverstein et al. (2) investigated the incidence of DVT according to age and found that the incidence DVT was stable until the age of 65 and increased 3-fold after the age of 65. On the other hand, the World Health Organization considers individuals over the age of 65 to be elderly. Due to better living conditions, healthcare facilities, and nutritional possibilities, life expectancy has increased from the fifties to the eighties in the last century (3). Thus, the number of individuals who seek treatment for DVT has increased. Although aging is not a disease per

**Address for Correspondence:** Hakki Kursat Cetin,
University of Health Sciences Turkey, Sisli Hamidiye Etfal Training and Research Hospital, Clinic of Cardiovascular Surgery, Istanbul, Turkey
Phone: +90 536 728 63 12 E-mail: hakkikursatcvs@gmail.com ORCID: orcid.org/0000-0001-7082-9859
**Received:** 18.02.2022 **Accepted:** 22.05.2022

se, aging-associated deterioration in body functions can be determined, and the selection of treatment options becomes more complicated in the elderly.

Percutaneous thrombectomy (PT) is an alternative minimally invasive surgical modality instead of long-lasting anticoagulation for lower extremity DVT Loffroy and colleagues performed PT for patients with lower extremity DVT, and the authors achieved an 86.7% venous patency rate during 22.3 months of follow-up (4). In another study by Dumantepe and Uyar (5), 68 patients diagnosed with lower extremity DVT were treated with PT. Dumantepe and Uyar (5) obtained a 95% success rate with complications in three cases.

Although previous studies investigated the effectiveness and reliability of PT for the management of lower extremity DVT, no studies to date have evaluated the effect of age on PT outcomes. In elderly patients, changes in vascular structure and existing comorbidities may affect PT results. In this study, our purpose was to analyze the effect of being elderly on PT results for lower extremity DVT.

## Materials and Methods

### Ethical Standards

The study was approved by the local ethics committee (Ethics Committee of Bezmialem Vakif University, approval number: 2020-112, date: 17.04.2020). Also, the study was planned in accordance with the Helsinki Declaration.

### Study Design

In this study, we retrospectively reviewed patient charts who were treated with PT for lower extremity (common iliac, external iliac, femoral, and popliteal veins) DVT between October 2016 and March 2021. Before PT, all patients were informed about how the procedure would be performed, its success rate, and possible complications, and informed consent was obtained from all patients. The PT procedures were performed in the same manner. Patients with unilateral lower extremity DVT and those older than 18 years old were enrolled in the study. Diagnostic DVT was done with a detailed physical examination and venous duplex ultrasonography. Exclusion criteria were presence of bilateral lower extremity DVT, presence of active neurologic and/or psychiatric disorder(s), inability to access preoperative and operative patient data and being <18 years old.

Patients' preoperative characteristics, operative parameters, and post-procedural outcomes were saved in the electronic data system, prospectively. Recorded preoperative parameters were age (years), sex, body mass index (BMI), duration of symptoms (days), the presence of hypertension, diabetes mellitus, coexistent malignancy, and DVT history. Also, thrombus properties (length, location, and side), operation and fluoroscopy time (minutes), estimated blood loss (milliliters), and stenting rates were noted. Also, the hospitalization period and duration of intensive care unit (ICU) stay (minutes), requirements for re-operation, complications according to the Clavien-Dindo classification, and success of the procedure were noted. Procedures with the removal of thrombus during the procedure and cases with venous patency in the first month of follow-up were considered successful.

### PT Technique

Under local anesthesia, 5000 IU of heparin sodium was used for anticoagulation and a vena cava filter was placed two centimeters below the renal veins from the contralateral femoral vein. Percutaneous access was obtained from the popliteal vein with an 18 F gauge needle, and an introducer sheath with an 8 F (INVAMED, Ankara, Turkey) size was inserted. Then, thrombus characteristics and venous patency were evaluated by venography, and a 0.035-size guidewire was placed beyond the thrombus. Mechanical thrombectomy was performed repeatedly until the thrombus was removed. At the end of the procedure, venography was performed to assess venous patency, and the success was re-assessed with venous duplex ultrasonography at the end of the first month.

Finally, all participants were divided into 2 groups according to being elderly or not, as patients <65 years and patients ≥65 years. The two groups were compared in terms of preoperative patient data, operative parameters, and postoperative results.

### Statistical Analysis

For statistical evaluation, The Statistical Package for the Social Sciences version 25 (SPSS IBM Corp., Armonk, NY, USA) was used. The variable distribution was assessed by the Shapiro-Wilk test and Q-Q plots. The independent Student's t-test was used for the comparison of normally distributed values between groups. The Mann-Whitney U test was performed for the comparison of non-normally distributed variables. Quantitative data is summarized as mean ± standard deviation values. Categorical values were categorized and compared using the $\chi^2$ test or Fisher's exact test. Correlations between age, and complications, duration of hospitalization, and duration of ICU were calculated using Pearson's correlation test. The data was analyzed with a 95% confidence level, and a p-value less than 0.05 was considered statistically significant.

## Results

One hundred and five patients were enrolled in the study (62 patients were <65 years of age and 43 patients were ≥65 years of age). The sex ratio, mean BMI, smoking status, presence of diabetes mellitus, hypertension,

malignant status, and DVT history were not statistically significant among the groups (p=0.619, p=0.513, p=0.330, p=0.177, p=0.055, p=0.710, and p=0.557, respectively). The mean age was significantly higher in elderly patients (42.9 years and 72.6 years, p=0.001). Preoperative patient data is summarized in Table 1.

Comparison of elderly and non-elderly patients demonstrated that length, location and side of thrombus were similar between groups (p=0.755, p=0.953, and p=0.907, respectively). The mean operation time and the mean fluoroscopy time were longer in patients <65 years, but the differences were not statically significant (p=0.940 and p=0.291) (Table 2).

The mean hospitalization time was 3.1 days for non-elderly patients and 3.8 days for elderly patients (p=0.030). In addition, the duration of mean ICU stay was significantly longer in elderly patients (1.2 vs 1.7, p=0.024). Older patients had a lower success rate, but the difference was not statistically significant (93.5% vs 88.4%, p=0.482). Grade 1-2 Clavien-Dindo complications and the overall complication rate were significantly higher in elderly patients (6.4% vs 20.9%, p=0.027 and 12.9% vs 30.2%, p=0.029). However, Grade 3-5 Clavien-Dindo complications were comparable between the groups (p=0.588) (Table 3). The Pearson correlation test revealed that older age was associated with longer hospitalization time and ICU stay (p=0.001 and p=0.001) (Table 4).

## Discussion

The aging of the world population has increased the number of elderly patients who will need treatment in many medical disciplines (6). Lower extremity DVT is common in elderly individuals. However, to our knowledge, no study has investigated the efficiency and reliability of PT in the elderly population. In this study, we showed the impact of being elderly on PT outcomes. We found that hospitalization time and the duration of ICU stay were significantly longer in elderly patients. Additionally, overall complications and Clavien-Dindo grade 1-2 complications were significantly more common in patients with ≥65 years old.

**Table 1. Comparison of preoperative demographic data of patients according to their age**

| | Age <65 years (n=62) | Age ≥65 years (n=43) | p-value |
|---|---|---|---|
| **Age (years), mean ± SD** | 42.9±9.3 | 72.6±6.7 | **0.001**[a] |
| **Gender, n (%)**<br>Male<br>Female | <br>33 (53.2%)<br>29 (46.8%) | <br>25 (58.1%)<br>18 (41.9%) | <br>0.619 |
| **BMI (kg/m²), mean ± SD** | 28.6±4.1 | 28.1±3.9 | 0.513 |
| **Smoking status, n (%)** | 33 (53.2%) | 27 (62.8%) | 0.330 |
| **Diabetes mellitus, n (%)** | 7 (11.3%) | 9 (20.9%) | 0.177 |
| **Hypertension, n (%)** | 15 (24.2%) | 18 (41.9%) | 0.055 |
| **Coexistent malignancy, n (%)** | 34 (53.9%) | 22 (51.2%) | 0.710 |
| **DVT history, n (%)** | 31 (50.0%) | 24 (55.8%) | 0.557 |
| **Duration of symptoms (days), mean ± SD** | 6.8±4.2 | 6.5±3.7 | 0.701 |

[a]: Student's t-test
BMI: Body mass index, SD: Standard deviation, DVT: Deep vein thrombosis

**Table 2. Comparison of the operational data of the patients according to their age**

| | Age <65 years (n=62) | Age ≥65 years (n=43) | p-value |
|---|---|---|---|
| **Site of DVT, n (%)**<br>Iliofemoral<br>Popliteal<br>Femoral<br>Femoral/popliteal | <br>15 (24.2%)<br>12 (19.3%)<br>9 (14.5%)<br>26 (41.9%) | <br>11 (25.6%)<br>9 (20.9%)<br>7 (16.3%)<br>16 (37.2%) | <br><br>0.953 |
| Side involved, n (%)<br>Right<br>Left | <br>31 (50.0%)<br>31 (50.0%) | <br>22 (51.1%)<br>21 (48.9%) | <br>0.907 |
| **Lesion length (cm), mean ± SD** | 10.5±2.6 | 10.4±2.1 | 0.755 |
| **Operation time (min), mean ± SD** | 124.5±24.6 | 124.1±27.8 | 0.940 |
| **Flouroscopy time (min), mean ± SD** | 23.7±10.8 | 21.5±9.7 | 0.291 |
| **Amount of blood (mL), mean ± SD** | 253.7±38.4 | 258.9±40.9 | 0.508 |
| **Stenting rate, n (%)** | 3 (4.8%) | 2 (4.6%) | 0.965 |

DVT: Deep vein thrombosis, SD: Standard deviation

| Table 3. Comparison of postoperative results and complications according to their age | | | |
|---|---|---|---|
| | **Age <65 years (n=62)** | **Age ≥65 years (n=43)** | **p-value** |
| Hospital stay (days), mean ± SD | 3.1±1.5 | 3.8±1.7 | **0.030**[a] |
| ICU stay (days), mean ± SD | 1.2±1.1 | 1.7±1.2 | **0.024**[a] |
| Success, n (%) | 58 (93.5%) | 38 | 0.482 |
| Decrease of Hgb (g/dL), mean ± SD | 1.1±0.9 | 1.3±1.1 | 0.300 |
| Complications, n (%) | 8 (12.9%) | 13 (30.2%) | **0.029**[b] |
| Clavien-Dindo grade 1-2 | 4 (6.4%) | 9 (20.9%) | **0.027**[b] |
| Bradycardia<br>Hemoglobinuria<br>Leg pain | 1 (1.6%)<br>2 (3.2%)<br>1 (1.6%) | 3 (7.0%)<br>3 (7.0%)<br>3 (7.0%) | |
| Clavien-Dindo grade 3-5 | 4 (6.4%) | 4 (9.3%) | 0.588 |
| Acute renal failure<br>Major hemorrhage<br>Pulmonary embolism<br>Sepsis | 1 (1.6%)<br>2 (3.2%)<br>1 (1.6%)<br>None | 1 (2.3%)<br>1 (2.3%)<br>1 (2.3%)<br>1 (2.3%) | |
| Re-operation, n (%) | 1 (1.6%) | 1 (2.3%) | 0.793 |

*Mean ± standard deviation, [a]: Student's t-test, [b]: Chi-squared test
ICU: Intensive care units, SD: standard deviation

Complications occurring in elderly patients may be more difficult to manage and could be fatal. Batchelor et al. (7) analyzed the outcomes of percutaneous coronary interventions in 7472 elderly individuals and stated that there were significantly higher complications, including vascular complications, renal failure, stroke, and death, in elderly patients. In another study, Polanczyk et al. (8) compared elderly and non-elderly patients in terms of complications following non-cardiac surgeries, and the authors found that perioperative complications increased 1.8-times and 2.1-times in patients between 70 and 79 years and ≥80 years in comparison with patients between 50 and 59 years. However, no study has investigated the complications in the elderly according to the complication severity classification. In this study, the overall complication rate was significantly higher in elderly patients. In addition, evaluating complications according to their severity revealed that serious complication rates (Clavien-Dindo grade 3-5) were similar in elderly and non-elderly patients, but slight complications (Clavien-Dindo grade 1-2) were significantly higher in elderly patients.

The effect of being elderly on hospitalization time and duration of ICU is a controversial topic and has not been evaluated following PT yet. Lin et al. (9) compared outcomes for elderly and non-elderly patients following surgery for left-sided valve infective endocarditis and discovered a longer duration of ICU stay in elderly patients (4.5 days vs 3.0 days, p=0.001), but similar hospitalization time between elderly and non-elderly patients (37.5 vs 37 days, p=0.405). In Polanczyk et al.'s (8) study, the mean hospitalization time was 7.4 days in patients aged 50-59 years and 9.2 days in patients aged 70-79 years. In this study, we found significantly longer hospitalization time and ICU stay following PT in elderly patients in comparison with non-elderly patients. We believe that movement restrictions of the skeletal system, relatively low lung capacity, and longer extubation time in the elderly may play a role in these results. A different study may be necessary to determine factors affecting hospitalization time and the duration of ICU stay in the elderly.

| Table 4. Correlation analysis of hospital stay and ICU stay time with age | | | |
|---|---|---|---|
| **Pearson correlation** | | **Hospital stay** | **ICU stay** |
| Age | Correlation coefficient[a]<br>Sig. (2-tailed)<br>N | 0.384<br>**0.001**[b]<br>105 | 0.462<br>**0.001**[b]<br>105 |

[a]: Between 0.3-0.7 values shows a moderate correlation, [b]: Pearson correlation test
ICU: Intensive care units

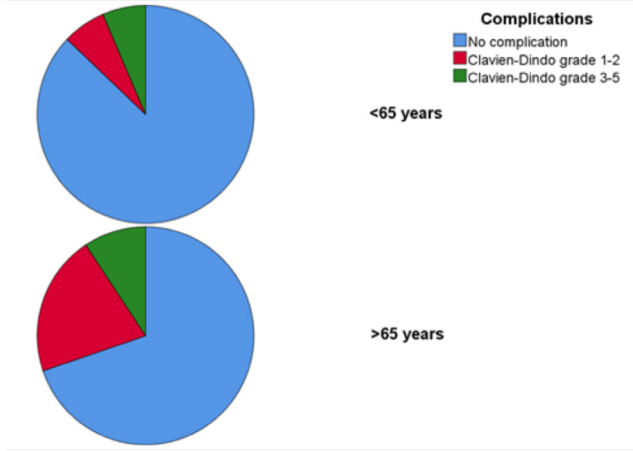


**Figure 1.** Distribution of complications according to groups

Although the definition of being elderly was not similar in different studies, many reports stated that being elderly was not an unfavorable factor for minimal invasive procedures (10,11). Tamburino and colleagues analyzed the charts of 663 patients who underwent transcatheter aortic valve implantation and reported 98% success rate following surgery, with a similar success rate to the non-elderly population (12). In another study, Klein et al. (13) investigated the impact of aging on percutaneous coronary interventions, and the authors achieved angiographic success in 93% of elderly patients. In this study, we did not find a significant difference in PT success between elderly and non-elderly patients. We suggest that performing the same technique regardless of age in all patients and not being a factor in changing the procedure technique have led to this situation.

### Study Limitations

Small patient numbers and the retrospective nature of the study could be considered limitations of this study. Despite the retrospective evaluation of the data, all parameters were recorded in the electronic database prospectively. Secondly, being elderly was accepted as aged ≥65 years, but biological age could be different according to individuals and the effects of comorbidities. Additionally, this study included only a one-month follow-up outcome after the procedure, long-term follow-up results are lacking. We believe that long-term outcomes of PT among elderly patients could be the subject of another study. Finally, we did not compare the cost of physical therapy in elderly and non-elderly populations, which will be clarified in future research.

## Conclusion

This study showed for the first time that hospitalization time and duration of ICU stay were significantly longer in elderly patients. In addition, elderly patients faced significantly more complications following PT in comparison with non-elderly patients. Our findings should be supported by prospective randomized studies with higher patient numbers.

### Ethics

**Ethics Committee Approval:** The study was approved by the local ethics committee (Ethics Committee of Bezmialem Vakif University, approval number: 2020-112, date: 17.04.2020).

**Informed Consent:** Informed consent was obtained from all patients.

**Peer-review:** Internally peer-reviewed.

### Authorship Contributions

Concept: H.K.C., Design: H.K.C., Data Collection, or Processing: C.B., Analysis, or Interpretation: C.B., Literature Search: C.B., Writing: H.K.C.

**Conflict of Interest:** No conflict of interest was declared by the authors.

**Financial Disclosure:** The authors declare that this research did not receive any specific grant from the funding agencies.

## References

1. Yuen HLA, Tran H, Chunilal S. Upper Extremity Deep Vein Thrombosis: Current Knowledge and Future Directions. Semin Thromb Hemost 2021;47:677-91.
2. Silverstein RL, Bauer KA, Cushman M, Esmon CT, Ershler WB, Tracy RP. Venous thrombosis in the elderly: more questions than answers. Blood 2007;110:3097-101.
3. Rahman MM, Rana R, Khanam R. Determinants of life expectancy in most polluted countries: Exploring the effect of environmental degradation. PLoS One 2022;17:e0262802.
4. Loffroy R, Falvo N, Guillen K, et al. Single-Session Percutaneous Mechanical Thrombectomy Using the Aspirex®S Device Plus Stenting for Acute Iliofemoral Deep Vein Thrombosis: Safety, Efficacy, and Mid-Term Outcomes. Diagnostics (Basel) 2020;10:544.
5. Dumantepe M, Uyar I. The effect of Angiojet rheolytic thrombectomy in the endovascular treatment of lower extremity deep venous thrombosis. Phlebology 2018;33:388-96.
6. Ergul A. Quality and Reliability of YouTube Videos on Surgical Treatment of Uterine Leiomyomas. Cureus 2021;13:e20044.
7. Batchelor WB, Anstrom KJ, Muhlbaier LH, et al. Contemporary outcome trends in the elderly undergoing percutaneous coronary interventions: results in 7,472 octogenarians. National Cardiovascular Network Collaboration. J Am Coll Cardiol 2000;36:723-30.
8. Polanczyk CA, Marcantonio E, Goldman L, et al. Impact of age on perioperative complications and length of stay in patients undergoing noncardiac surgery. Ann Intern Med 2001;134:637-43.
9. Lin CY, Lu CH, Lee HA, et al. Elderly versus non-elderly patients undergoing surgery for left-sided native valve infective endocarditis: A 10-year institutional experience. Sci Rep 2020;10:2690.
10. Wang H, Zhang L, Sun M, Kang L, Wei X. Perioperative treatment compliance, anxiety and depression of elderly patients with ophthalmic surgery and the influential factors. Ann Palliat Med 2021;10:2115-22.
11. Zhu J, Wang G, Du P, He J, Li Y. Minimally Invasive Pancreaticoduodenectomy in Elderly Patients: Systematic Review and Meta-Analysis. World J Surg 2021;45:1186-201.
12. Tamburino C, Capodanno D, Ramondo A, et al. Incidence and predictors of early and late mortality after transcatheter aortic valve implantation in 663 patients with severe aortic stenosis. Circulation 2011;123:299-308.

13. Klein S, Burke LE, Bray GA, et al. Clinical implications of obesity with specific focus on cardiovascular disease: a statement for professionals from the American Heart Association Council on Nutrition, Physical Activity, and Metabolism: endorsed by the American College of Cardiology Foundation. Circulation 2004;110:2952-67.