

Clinical, Laboratory and Echographic Evaluation of Patients with Deep Vein Thrombosis Following Total Knee Arthroplasty

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Abstract

Introduction: Total knee arthroplasty, being a major surgery, carries a risk of post-operative deep vein thrombosis (DVT). The main objective of the present study was to elucidate the association of clinical, laboratory, and echographic findings with the occurrence of DVT. **Patients and Methods:** The present study was prospective and non-randomized, with restricted exclusion criteria. Forty patients were submitted to total knee arthroplasty due to osteoarthritis. Patients were clinically evaluated by laboratory tests, assessment of pain and calf circumference, and the presence of Homans' sign. Echo Doppler was performed in each patient on postoperative day 7. The echographic evaluation divided the patients into two groups: positive (G1) and negative for thrombosis (G2). All patients received prophylactic heparin during the 7-day hospital admission. **Results:** Eleven patients complained of pain (analgesic medication was used during the entire admission). Leg circumference variation from the pre-operative period to post-operative day 7 was: G1, 1.70 ± 1.12 cm and G2, 0.68 ± 1.25 cm ($p = 0.03$). Homans' sign was considered positive in 10 patients. Echographic evaluation was positive in 11 patients (27.5%). No cases of pulmonary embolism, infection, or death were observed. **Conclusions:** The incidence of DVT was 27.5%, with an increase in leg circumference being the main predictive factor ($p = 0.03$).

Keywords

Knee Arthroplasty, DVT, Knee Replacement

1. Introduction

The occurrence of deep vein thrombosis (DVT) remains a serious post-operative risk following total knee arthroplasty (TKA). It is not unusual to observe edema, hyperemia, peripheral vein distension in the operated leg, mild fever, and pain [1] [2] [3] [4]. Despite adequate prophylaxis being consensual, diagnosis of DVT can often be delayed due to insufficient clinical signs. At other times, clinical suspicion exists but complementary evaluation fails to confirm the event. The present study intended to verify the association of clinical, laboratory, and echographic findings with DVT in patients submitted to TKA.

2. Patients and Methods

The present study was prospective and non-randomized and was performed between January and November 2017. Forty patients submitted to TKA at the Orthopedics and Traumatology Service of the Santa Casa de Porto Alegre Hospitalar Complex were studied. The mean age was 70.4 ± 6.8 years old. A total of 33 patients (82.5%) were male and 7 (17.5%) were female; 21 patients had surgery on the right leg (52.5%). Twenty-nine patients presented with tricompartmental osteoarthritis and 11 with bicompartamental commitment, none of whom had a previous history of DVT. The exclusion criteria for the present study were varicose veins or previous DVT, corticosteroid use, continuous anticoagulant, antiaggregant, or thrombolytic use, a body mass index (BMI) > 35 , hepatic or renal insufficiency, and cardiac prosthesis or valve replacement. The Ethics Committee of our institution approved the present study.

All patients were submitted to rachidian anesthesia and a thigh tourniquet with a pressure > 350 mmHg was used in every case. The surgical approach was anterior trans-vastus. Following cementation of the implants (femoral, tibial, and patellar), the tourniquet was deflated and haemostasis was performed. The limbs were dressed in a compressive inguinal-podalic fashion. Suction drains were placed and removed after 48 hours. Prophylactic anticoagulation was performed with subcutaneous non-fractionated heparin at a dose of 5000 units three times daily, starting immediately following surgery and maintained during the 7-day admission. All patients started motor physical therapy the day after surgery and were stimulated to gait training with crutches or walkers following removal of the drains (48 h post-op).

Laboratory examinations were performed pre-operatively and again on post-operative day 7, analyzing red blood cell count/hematocrit, platelet count, hemoglobin, prothrombin time, and thromboplastin time. Clinical evaluation considered pain, leg circumference, and the presence of Homans' sign was observed. The criteria used to determine the presence of Homans' sign was calf pain at dorsiflexion of the foot. The pain criterion was the use of analgesic medication during the entire admission. Only calf pain was considered, not knee or surgery-related pain. Measurement of calf circumference was performed using a measuring tape 15-cm inferior to the tibial anterior tuberosity pre-operatively

and on post-operative days 2 and 7. Bilateral echo Doppler was performed in every patient prior to discharge from the hospital to detect DVT. Patients were divided into two groups: G1 (positive echographic findings for DVT) and G2 (normal echography).

Statistical analysis was performed using a Student's *t*-test. Results were catalogued and analyzed using the SPSS software. Detectable variables were the presence of DVT according to complementary exams, leg circumference, Homans' sign, and comorbidities (hypertension and diabetes mellitus). Statistical significance is considered positive at $p < 0.05$. An ethics committee approved the present study.

3. Results

Thirty patients presented with clinical comorbidities (75%). Hypertension (27 cases; 67.5%) and diabetes mellitus (3 cases, 12.5%) were the most prevalent. Two patients had both hypertension and diabetes. Laboratory findings and their correlation with DVT are displayed in **Table 1**. With respect to leg circumference, the mean variation from the pre-operative measurement to post-operative day 2 was 2.33 ± 1.26 cm (G1, 2.57 ± 1.25 cm; G2, 1.68 ± 1.1 cm; $p = 0.03$) and from the pre-operative measurement to post-operative day 7 was 1.70 cm (G1, 1.7 ± 1.12 cm and G2, 0.68 ± 1.25 cm ($p = 0.03$)).

Homans' sign was considered positive in 10 patients (25%), and echographic confirmation was obtained in four of these cases (40%). A positive echo Doppler was observed in 11 cases (27.5%). Both tibial and fibular veins were compromised in 6 (54.4%) cases; only the tibial vein in 2 cases (18.1%); only the fibular vein in 2 cases (18.1%); and the soleal vein in 1 case (9%).

For all patients diagnosed with DVT, the chosen treatment was oral anticoagulants. No fatal cases as a result of DVT or other causes were observed in the present study during hospital admission and the first post-operative month. No cases of infection were observed.

Table 1. Demographic evaluation of the results.

<i>Laboratory</i>	DVT		p value
	Positive Echography (G1)	Negative Echography (G2)	
Hemoglobin (g/dL)	13.21 ± 0.78	12.90 ± 1.31	0.46
Hematocrit (%)	38.82 ± 2.30	38.55 ± 4.17	0.84
Platelet count (/mm ³)	$269.727.27 \pm 100.496.9$	$285.758.62 \pm 58.229.62$	0.53
Prothrombin Time (s)	13.89 ± 0.52	13.69 ± 0.60	0.33
Thromboplastin Time (s)	35.70 ± 3.59	33.58 ± 3.25	0.08
<i>Clinical Data (leg circumference)</i>			
Pre-operative Values (cm)	38.45 ± 4.50	35.36 ± 2.25	0.01
Post-operative Variation (2 days)	2.57 ± 1.25	1.68 ± 1.10	0.03
Post-operative Variation (7 days)	1.70 ± 1.12	0.68 ± 1.25	0.03

4. Discussion

Virchow described the triad of factors responsible for thrombogenesis: venous stasis, endothelial lesion, and hypercoagulability. Major surgeries such as total knee arthroplasty (TKA) offer a favorable scenario for the occurrence of this pathology [5]. Due to the increasing longevity of the population, TKA surgeries increase in number every year, with an estimated 700,000 annually in the USA [6]. Among the complications of this procedure, deep vein thrombosis (DVT) is the most common, with its reported incidence in the literature varying due to the number of comorbidities and chronic medication use [7] [8].

The main risk factors for DVT are widely described; however, the literature shows no reliable factors to increase suspicion leading to early diagnosis [7] [8]. Among these factors, pre-operative laboratory tests, calf pain, and limb circumference can be reported. Currently, most patients submitted to TKA present with systemic clinical comorbidities such as diabetes, hypertension, obesity, and dyslipidemia, all of which are correlated with post-operative DVT [7] [8]. The present study demonstrates this correlation, with at least one of the pathologies present in 75% of our patients, despite the nonexistence of a statistically significant difference between normal patients and those with DVT ($p < 0.5$).

The hemoglobin levels ($p = 0.46$), hematocrit levels ($p = 0.84$), platelet count ($p = 0.53$), prothrombin time ($p = 0.33$), and thromboplastin time ($p = 0.08$) showed no statistically significant difference between G1 and G2.

Clinical evaluation considered calf pain, limb circumference, and Homans' sign. Calf pain is reported as the main symptom in most DVT cases but can be confused with hematoma and post-operative edema. In the present study, 54.5% (6/11) of patients with DVT presented with pain upon calf palpation; however, since there was no statistical significance ($p = 0.38$), this factor is more important in raising suspicion of DVT than in diagnosis itself [9]. Nevertheless, many thrombi are silent, with the primary clinical manifestation being venous thromboembolism dyspnea or thoracic pain due to pulmonary embolism. Pain remains the most present symptom of DVT; however, it is a very subjective factor that is not easily characterized, since it can be confused with pain due to surgical aggression. Pain should lead to suspicion if calf located and more intense and frequent than usual [10] [11].

Post-operative limb circumference variation is basically due to edema related to hematoma and venous stasis, both of which are risk factors for DVT. In the present study, variation in limb circumference from the pre-operative period to post-operative days 2 and 7 proved to be a reliable and statistically significant risk factor for DVT ($p = 0.03$ for both pre-op to day 2 and pre-op to day 7). There was a decrease in leg circumference from post-operative day 2 to day 7, but with no statistical significance.

Homans' sign is used as a clinical indicator of DVT, but it does not have a confirmatory value [9] [12]. In the present study, Homans' sign was present in 25% of the patients, but in only 4 in the DVT group, showing low sensitivity and

specificity. No statistical significance could be demonstrated when comparing the presence of the sign in patients with or without DVT. DVT is a diagnostic challenge, since it is not always clinically evident. Echo Doppler and venogram are described as the main diagnostic tools for DVT; echo Doppler is the most widely used due to being less invasive, portable, and cheaper. It does, however, present limitations, especially being examiner-dependent [13] [14] [15] [16]. The gold standard exam is venogram, but it is invasive, painful, and more expensive, being known itself as a cause of DVT [17] [18].

Most thrombi form in the deep calf veins and subsequently ascend through the thigh vessels [19] [20] [21]. In the present study, 27.5% of TKA patients developed DVT post-operatively, with both the tibial and fibular veins compromised in 54% of the cases. It is known that larger veins cause more intense symptoms, but no such cases were observed in our study. Therefore, none of the patients needed extended hospital admission following echographic diagnosis of DVT. The contralateral limb can also be affected, but this was not observed in our cases. No major complications appear to occur when small leg vessels are compromised, suggesting that early mobilization and adequate anticoagulant prophylaxis can be sufficient in these cases. Pre-existing hypertension and diabetes could not be statistically correlated with DVT in the present study.

The present study has some limitations. We recognize that echographic venous evaluation is medical examiner dependent, and the gold standard is flebography. Also, the performed research has a small number of patients.

5. Conclusion

Evaluation of 40 cases of total knee arthroplasty using bilateral lower limb echo Doppler with adequate post-operative anticoagulant prophylaxis revealed a DVT incidence of 27.5%. Clinical suspicion must be based mainly on pain assessment and leg circumference measurement in the operated limb, the latter being the most important predictor of DVT ($p = 0.03$).

Conflicts of Interest

Authors claim not having any conflicts of interest regarding this article.

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