

Rate of Venous Thromboembolism After Shoulder Arthroplasty in a Portuguese Population

Taxa de Tromboembolismo Venoso Após Artroplastia do Ombro numa População Portuguesa

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ABSTRACT

INTRODUCTION: We aimed to identify the rate of symptomatic venous thromboembolism (VTE) in patients undergoing shoulder arthroplasty (SA) and to evaluate the role of possible associated risk factors.

METHODS: The authors retrospectively reviewed all patients who underwent shoulder arthroplasty (SA) at the same institution between February 2010 and October 2021. Patients were included if they had a follow-up of at least 3 months and consented to inclusion in the study. The authors identified cases in which symptomatic VTE occurred in the 3 months following surgery. Exclusion criteria included previous surgeries within a 3-month period or the use of pharmacological prophylaxis for VTE.

RESULTS: One hundred and three patients (average age 69.33 years; 31.7% male) were eligible for the study. Two cases of symptomatic VTE were identified, corresponding to a VTE rate of 1.94% (95% CI: 0.24% - 6.84%). Pre-disposing factors for VTE (history of neoplasm, previous VTE, family history of VTE, oral contraceptive therapy, hormone therapy, peripheral vascular disease, BMI > 30) were analyzed. The presence of these risk factors did not statistically correlate with VTE occurrence (Fisher's exact test $p = 0.113$).

CONCLUSION: The results of this single-center retrospective study suggest that the incidence of symptomatic VTE after shoulder arthroplasty, in patients without routine pharmacological prophylaxis, is relatively low. However, due to the small number of events and inherent methodological limitations, these findings must be interpreted with caution. The selective use of pharmacological prophylaxis in high-risk patients may be reasonable, but larger prospective studies are needed to clarify the precise role of pharmacological prophylaxis in this population.

KEYWORDS: Arthroplasty/adverse effects; Postoperative Complications; Shoulder Joint/surgery; Venous Thromboembolism/epidemiology; Venous Thromboembolism/etiology

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RESUMO

INTRODUÇÃO: O nosso objetivo foi identificar a taxa de tromboembolismo venoso (TEV) sintomático em doentes submetidos a artroplastia do ombro (AO) e avaliar o papel de potenciais fatores de risco associados.

MÉTODOS: Os autores avaliaram retrospectivamente todos os doentes submetidos a AO de forma a identificar os casos em que ocorreu TEV sintomático nos 3 meses após a cirurgia, numa mesma instituição, entre fevereiro de 2010 e outubro de 2021. Foram incluídos os doentes com seguimento de pelo menos 3 meses e que consentiram a sua inclusão neste estudo. Os critérios de exclusão incluíram a profilaxia farmacológica para TEV ou realização de cirurgias prévias com menos de 3 meses de intervalo.

RESULTADOS: Foram incluídos 103 doentes (idade média de 69,33 anos e 31,7% do sexo masculino). Identificaram-se 2 casos de TEV sintomático, correspondendo a uma taxa de TEV de 1,94% (IC 95%: 0,24% - 6,84%). Foram estudados os fatores predisponentes para TEV (história de neoplasia, TEV prévio, história familiar de TEV, contraceção hormonal, terapia hormonal, doença vascular periférica, IMC > 30). A presença dos fatores de risco para TEV incluídos não se correlacionou estatisticamente com a ocorrência de TEV (teste exato de Fisher $p = 0,113$).

CONCLUSÃO: Os resultados deste estudo retrospectivo unicêntrico sugerem que a incidência de TEV sintomático após artroplastia do ombro, em doentes sem profilaxia farmacológica de rotina, é relativamente baixa. Contudo, devido ao reduzido número de eventos e às limitações metodológicas inerentes, estes achados devem ser interpretados com cautela. Considera-se aceitável a utilização seletiva de profilaxia farmacológica em doentes de alto risco, sendo, no entanto, necessários estudos prospetivos de maior dimensão para clarificar o papel da profilaxia farmacológica nesta população.

PALAVRAS-CHAVE: Articulação do Ombro/cirurgia; Artroplastia/efeitos adversos; Complicações Pós-Operatórias; Tromboembolia Venosa/epidemiologia; Tromboembolia Venosa/etiologia

INTRODUCTION

The Virchow triad, comprising hypercoagulability, stasis, and endothelial injury is understood to be causally related to venous thrombosis.¹

In contrast to lower extremity arthroplasty, there is a scarcity of evidence regarding thromboembolic prophylaxis after upper extremity surgery, substantiating the lack of robust standardized guidelines. Consequently, pharmacological prophylaxis after SA relies on the risk stratification of individual patients, considering the risk of thrombotic events and bleeding complications.²

A recent systematic review, with 12 566 shoulders from 9 studies, reported an overall incidence of venous thromboembolism (VTE) of 0.81% following shoulder arthroplasty (SA), with an associated mortality rate of 4.1%.³

Among the reported risk factors for 30-day postoperative VTE following SA are a higher body mass index, hypoalbuminemia (<3.5 g/dL), a prolonged length of stay, African American ethnicity, and longer surgery length.⁴⁻⁶

The identification of risk factors associated with VTE may allow to identify patients at greater risk of this complication, permitting orthopedic surgeons to se-

lect patients who may benefit the most from more aggressive antithrombotic prophylaxis, particularly pharmacological prophylaxis.

The primary objective of this study is to report the prevalence of VTE in a group of patients undergoing SA in the Portuguese population. Secondary objectives are to identify risk factors associated with VTE.

MATERIAL AND METHODS

After obtaining Institutional Review Board approval for this study, we examined our database for all SAs performed at our institution between February 2010 and October 2021 and identified cases in which symptomatic VTE occurred in the 3 months after surgery.

All patients who received surgical treatment comprising SA, had a follow-up of at least 3 months, and giving consent were included.

Patient's records were retrospectively reviewed to gather information regarding demographic data, medical history including predisposing factors for VTE (neoplasm history, previous VTE, family history of VTE, oral contraceptive therapy, hormone therapy, peripheral vascular disease, BMI > 30). Likewise, collected data included age at surgery, sex, antiaggregation

and hypocoagulation therapy, type of arthroplasty, tranexamic acid and cement use.

Patients with previous surgeries in a 3-month period or pharmacological prophylaxis for VTE were excluded.

Investigation for VTE with chest computed tomography (CT) angiography was not performed routinely, but only if the patient presented suggestive symptoms (including shortness of breath, tachycardia, and chest pain). Deep vein thrombosis (DVT) was also investigated by ultrasound in symptomatic patients (pain, warmth, redness, and swelling).

The Fisher's exact test was used to determine if there was an association between VTE predisposing factors and VTE event.

All statistical analyses were performed using a software package (Stata, version. 13.1; StataCorp, Texas, USA).

One hundred and sixty-five, patients underwent shoulder arthroplasty and provided consent for inclusion in the study.

RESULTS

After exclusion criteria were applied, 103 patients were eligible for the study (Fig. 1).

The average age was 69.47 years (range 43-88). Thirty-three patients were male, corresponding to 32.04% of the total included. The mean follow-up time was 27.17 months (range 3-131).

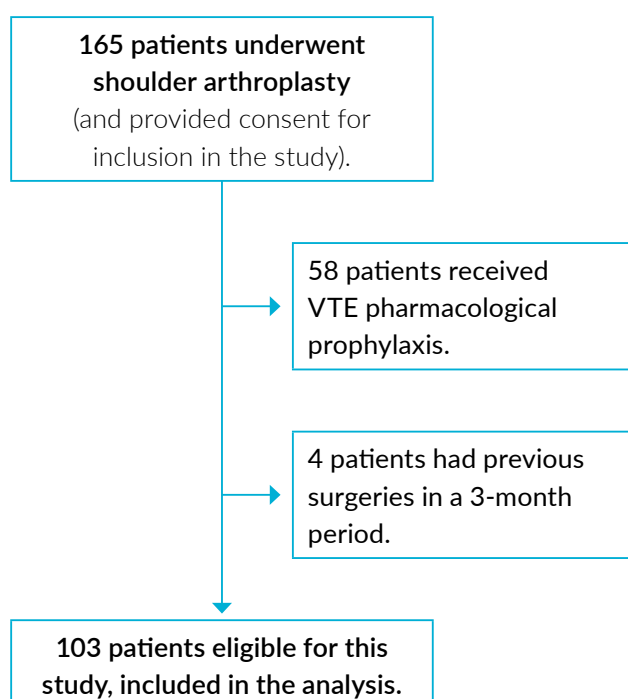


FIGURA 1. Flowchart of the included patients.

The most frequent indication for arthroplasty in this population was centered omarthrosis and the main type of arthroplasty performed was the reverse shoulder arthroplasty. The mean length of stay was 3.5 days.

Cement use was employed in 14 cases (13.59%). Regarding the risk factors for TVE, the BMI >30 was the most prevalent, in 21.36% of the patients.

Characteristics of the studied population are summarized on Table 1.

Incidence of VTE and studied predisposing factors are shown in Table 2.

No cases of DVT were reported. There were two cases of symptomatic VTE that followed reversed arthroplasty, representing an overall incidence of 1.94% (95% CI: 0.24% - 6.84%).

The first one was an 82-year-old female who submitted to reverse arthroplasty due to a proximal humerus fracture. The mechanism of injury was a fall from a standing position. She was unable to provide a reason for being on antiaggregation therapy. She had no predisposing factors except a BMI of 34.67.

The second case was a 64-year-old female for whom a reversed arthroplasty was performed due to malunion of a proximal humerus fracture after conservative treatment. Regarding predisposing factors for VTE, she had a previous history of VTE, neoplasm history and a BMI of 41.64.

TABLE 1. Characteristics of the studied population.

Age years (Standard deviation; range)	69.47 (±9.46; 43-88)
Male gender	33 (32.04%)
Type of arthroplasty:	
Anatomic	3
Reverse	74
Stemless anatomic	19
Reverse + tendon transfer	7
Indication for arthroplasty:	
Malunion	6
Hemiarthroplasty failure	2
Arthroplasty failure	2
Fracture	6
Avascular necrosis	3
Centered omarthrosis	33
Eccentric omarthrosis	20
Massive cuff rotator tear (cuff tear arthropathy)	31
Cement use	14 (13.59%)
Tranexamic acid	37 (35.92%)
Hypocoagulation	4 (3.88%)
Antiaggregation	18 (17.48%)

TABLE 2. Predisposing factors for VTE and incidence of VTE.

Inpatient time days (Standard deviation; range)	3.51 ($\pm$ 1.21; 2-9)
Neoplasm history	8 (7.77%)
Previous VTE	1 (0.97%)
Family (1st degree) history of VTE	7 (6.79%)
BMI > 30	22 (21.36%)
Length of stay > 4 days	7 (6.79%)
Oral contraceptive therapy	0
Hormone therapy	0
Peripheral vascular disease	0
DVT	0
VTE	2 (1.94%)
Any predisposing factor for VTE	33 (32.04%)
Fisher's exact test	$p = 0.113$

*Fisher's exact test correlating any predisposing factor for VTE to presence of VTE

Ultrasound of the lower extremities was negative for DVT in both patients. No surgical complications were reported during the follow-up period.

DISCUSSION

In this study, we retrospectively identified all the SAs performed at a single institution over 11 years and evaluated the cases for the development of VTE.

The main limitations of this study arise from its retrospective nature and the small sample size. The wide 95% confidence interval (0.24% to 6.84%) for the VTE incidence reflects this sample size limitation and underscores the need for larger, multicenter cohorts to achieve a more precise estimate. Patients who received VTE pharmacological prophylaxis were intentionally excluded because the authors seek to study the true incidence of VTE and real impact of the studied risk factors.

Although literature on VTE following SA is limited and retrospective in nature, most of the published studies report a VTE rate of less than 1%.^{3,7-12} Kunutsor *et al*,¹³ reported a VTE rate of 0.85% in a meta-analysis that included 672 495 total shoulder arthroplasties. It is important to note that our calculated VTE rate of 1.94% reflects an unmedicated cohort, as patients receiving pharmacological prophylaxis were intentionally excluded to assess the baseline incidence. This methodological decision influences the overall estimate, as the excluded group likely comprised patients identified by their surgeons as having a higher baseline risk for VTE. Therefore, our findings should be interpreted within the context of this specific, potentially lower-risk subgroup.

Despite the low overall incidence of VTE in SA patients, with the expansion of SA indications, shoulder orthopedic surgeons will be expected to manage a broad spectrum of medical comorbidities in arthroplasty patients. Potential physiopathological mechanisms of VTE in SA patients include axillary vein damage, emboli formation through intramedullary reaming and lower-extremity venous stasis from beach chair positioning.^{7,8,14,15}

There is consensus regarding mechanical prophylaxis use, detailed on the AAOS guidelines from 2009, given its safety profile.¹⁶

Although no specific regime of pharmacological prophylaxis is approved for SA patients, extrapolation from lower extremity orthopedic guidelines endorses its use in high-risk populations, with consideration for the individual risk factors and risk of bleeding. Identifying arthroplasty patients who are at high risk for VTE is often difficult, as there are few guidelines on VTE prophylaxis and studies evaluating SA patients present heterogeneous results.^{3,17,18}

In our study, the presence of the included VTE risk factors did not statistically correlate with VTE occurrence, but a trend was noticed and should not be disregarded as VTE is a rare but potentially devastating event.

Gowd *et al*¹⁹ developed a supervised machine learning model to predict postoperative complications after total shoulder arthroplasty, including VTE. The machine learning algorithms implemented in this study were able to create accurate models for the prediction of some adverse events (any adverse event, anemia requiring transfusion, and extended length of stay), however for VTE the models presented limited predictive value, probably due to the limited incidence of this complication.

CONCLUSION

The results of this single-center retrospective study suggest that the incidence of symptomatic VTE after shoulder arthroplasty, in patients without routine pharmacological prophylaxis, is relatively low. However, due to the small number of events and inherent methodological limitations, these findings must be interpreted with caution. The selective use of pharmacological prophylaxis in high-risk patients may be reasonable, but larger prospective studies are needed to clarify the precise role of pharmacological prophylaxis in this population.

CONTRIBUTORSHIP STATEMENT/ DECLARAÇÃO DE CONTRIBUIÇÃO

SCR - Conception, design, acquisition, analysis, and interpretation of data.

DG, NM, MS and AC - Critical revision of important intellectual content and supervision.

All authors and approved the final version to be published

SCR - Conceção, design, aquisição, análise e interpretação de dados.

DG, NM, MS e AC - Revisão crítica de conteúdo intelectual importante e supervisão.

Todos os autores aprovaram a versão final a ser publicada

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REFERENCES

1. Bagot CN, Arya R. Virchow and his triad: a question of attribution. *Br J Haematol.* 2008;143:180-90. doi: 10.1111/j.1365-2141.2008.07323.x.
2. Rapp CM, Shields EJ, Wiater BP, Wiater JM. Venous thromboembolism after shoulder arthroplasty and arthroscopy. *J Am Acad Orthop Surg.* 2019;27:265-74. doi: 10.5435/JAAOS-D-17-00763.
3. Na SS, Kim DH, Choi BC, Cho CH. Incidence, characteristics, and risk factors of venous thromboembolism in shoulder arthroplasty-a systematic review. *Int Orthop.* 2022;46:2081-8. doi: 10.1007/s00264-022-05496-w.
4. Lung BE, Kanjiya S, Bisogno M, Komatsu DE, Wang ED. Risk factors for venous thromboembolism in total shoulder arthroplasty. *JSES Open Access* 2019;3:183-8.
5. Kashanchi KI, Nazemi AK, Komatsu DE, Wang ED. The Impact of Preoperative Anemia on Complications After Total Shoulder Arthroplasty. *J Am Acad Orthop Surg Glob Res Rev.* 2021;5:e20.00136. doi: 10.5435/JAAOSGlobal-D-20-00136.
6. Zhang D, Dyer GSM, Earp BE. Venous Thromboembolism After Total Shoulder Arthroplasty: A Database Study of 31,918 Cases. *J Am Acad Orthop Surg.* 2022;30:949-56. doi: 10.5435/JAAOS-D-22-00352.
7. Sperling JW, Cofield RH. Pulmonary embolism following shoulder arthroplasty. *J Bone Joint Surg Am.* 2002;84:1939-41. doi: 10.2106/00004623-200211000-00005.
8. Sperling JW, Cofield RH. Pulmonary embolism following shoulder arthroplasty. *J Bone Joint Surg Am* 2002;84:1939-41.
9. Jameson SS, James P, Howcroft DW, Serrano-Pedraza I, Rangan A, Reed MR, et al. Venous thromboembolic events are rare after shoulder surgery: analysis of a national database. *J Shoulder Elbow Surg.* 2011;20:764-70. doi: 10.1016/j.jse.2010.11.034.
10. Lung BE, Kanjiya S, Bisogno M, Komatsu DE, Wang ED. Risk factors for venous thromboembolism in total shoulder arthroplasty. *JSES Open Access.* 2019;3:183-8. doi: 10.1016/j.jses.2019.07.003.
11. Farnig E, Zingmond D, Krenek L, Soohoo NF. Factors predicting complication rates after primary shoulder arthroplasty. *J Shoulder Elbow Surg.* 2011;20:557-63. doi: 10.1016/j.jse.2010.11.005.
12. Kunutsor SK, Barrett MC, Whitehouse MR, Blom AW. Venous thromboembolism following 672,495 primary total shoulder and elbow replacements: Meta-analyses of incidence, temporal trends and potential risk factors. *Thromb Res.* 2020;189:13-23. doi: 10.1016/j.thromres.2020.02.018.
13. Kunutsor SK, Barrett MC, Whitehouse MR, Blom AW. Venous thromboembolism following 672,495 primary total shoulder and elbow replacements: Meta-analyses of incidence, temporal trends and potential risk factors. *Thromb Res* 2020;189:13-23
14. Saleem A, Markel DC. Fatal pulmonary embolus after shoulder arthroplasty. *J Arthroplasty.* 200;16:400-3. doi: 10.1054/arth.2001.20546.
15. Madhusudhan TR, Shetty SK, Madhusudhan S, Sinha A. Fatal pulmonary embolism following shoulder arthroplasty: a case report. *J Med Case Rep.* 2009;3:8708. doi: 10.4076/1752-1947-3-8708.

16. Izquierdo R, Voloshin I, Edwards S, Freehill MQ, Stanwood W, Wiater JM, et al. American academy of orthopaedic surgeons clinical practice guideline on: the treatment of glenohumeral joint osteoarthritis. *J Bone Joint Surg Am*. 2011;93:203-5. doi: 10.2106/00004623-201101190-00012.
17. Heyer JH, Parker RL, Lynch T, Parry T, Neviasser AS. Rate of venous thromboembolism after surgical treatment of proximal humerus fractures. *Arch Orthop Trauma Surg*. 2021;141:403-09. doi: 10.1007/s00402-020-03505-4.
18. Tashjian RZ, Lilly DT, Isaacson AM, Georgopoulos CE, Bettwieser SP, Burks RT, et al. Incidence of and Risk Factors for Symptomatic Venous Thromboembolism After Shoulder Arthroplasty. *Am J Orthop (Belle Mead NJ)*. 2016;45:E379-E385.
19. Gowd AK, Agarwalla A, Amin NH, Romeo AA, Nicholson GP, Verma NN, et al. Construct validation of machine learning in the prediction of short-term postoperative complications following total shoulder arthroplasty. *J Shoulder Elbow Surg*. 2019;28:e410-e421. doi: 10.1016/j.jse.2019.05.017.