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Management of Venous Thromboembolism After Hip and Knee Arthroplasty: A Comprehensive Review

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ABSTRACT:

Background: Venous thromboembolism (VTE) remains a significant postoperative complication following total hip arthroplasty (THA) and total knee arthroplasty (TKA). Although modern surgical and rehabilitation advances have reduced overall incidence, VTE continues to pose morbidity and mortality risks. Patient needs to start early mobilization, and amulatory is advised for patients so in this review we have analysed the need for pharamalogical prophylaxis and patient related risk factor is analysed and a this short communication summarizes current strategies for VTE management highlighting prophylaxis options, diagnosis, and treatment considerations while emphasizing individualized, risk-stratified care.

INTRODUCTION

Total hip arthroplasty (THA) and total knee arthroplasty (TKA) are among the most and successful orthopedic procedures for alleviating pain and restoring function in degenerative joint disease. With global aging trends and increasing prevalence of osteoarthritis, demand for THA and TKA continues to rise. Although outcomes have improved substantially and patients mainly having difficulty in walking and movement due to pain in the hip and knee joints later patient is analysed and counselled and taken for surgery ,once surgery done pod 4-5 only patient can ambulate by non weight bearing with walker

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support so the main risk factor is stasis of blood in the vessels and due to surgery there is damage to vascular system which leads aggregation of platelet aggregating factors which can lead to VTE or DVT so in this review we will understand the concepts regarding this VTE, VTE remains a prominent cause of morbidity and mortality in the postoperative period. Arthroplasty patients show unique prothrombotic risk due to venous stasis, vascular injury, systemic inflammation, and postoperative immobility[1]

Hip and knee arthroplasty patients are at elevated risk of developing deep vein thrombosis (DVT) and pulmonary embolism (PE) due to venous stasis, hypercoagulability, and surgical trauma. Despite advances in perioperative optimization, VTE remains an important preventable complication. Management in the post operative period is very crucial in case of post op care using of stockings post op and other anti inflammatory drugs ,for reduction of inflammation ,post operation taking blood test for inflammatory markers like CRP ,ESR,PRO-CLACITONIN , Optimal management requires integrating pharmacologic prophylaxis, mechanical strategies, and early mobilization, along with prompt recognition and treatment of established VTE.

Given the increasing number of primary and revision arthroplasties, optimal VTE prevention strategies are essential.(3) Importance of using anticoagulants post operatively and prevention of VTE. This review outlines the current landscape of VTE management after hip and knee arthroplasty, giving the best idea for analysing the VTE prevention, highlighting evidence-based approaches and emerging advancements.(8)

VTE Prevention Strategies

First line prophylaxis

1. Pharmacologic Prophylaxis

Multiple anticoagulant classes are used following THA and TKA:

- **Low-Molecular-Weight Heparin (LMWH):** Long considered the standard due to predictable pharmacokinetics and efficacy.
- **Direct Oral Anticoagulants (DOACs):** Agents such as factor Xa inhibitors provide effective prophylaxis, convenient dosing, and no routine monitoring requirements.
- **Aspirin:** Increasingly used in low- to moderate-risk patients as part of multimodal protocols, particularly within enhanced recovery pathways.
- **Warfarin:** Used less frequently due to monitoring requirements but remains an option for selected patients.

Duration of prophylaxis varies based on individual risk, with extended courses often recommended following THA.

2. Epidemiology of VTE After Arthroplasty

Historically, DVT rates after THA approached 40–60% without prophylaxis. With modern chemoprophylaxis, symptomatic VTE rates have decreased dramatically but remain clinically significant.

2.1 Hip Arthroplasty

- DVT incidence with prophylaxis: 0.5–3%
- PE incidence: 0.2–1%
- Fatal PE is rare (<0.1%) but remains the leading preventable cause of postoperative death.(8)

2.2 Knee Arthroplasty

TKA has slightly higher DVT rates than THA due to greater surgical manipulation and slower early mobility.

- Symptomatic DVT: 1–4%
- PE: 0.3–1.5%

3. Risk Factors for VTE in Arthroplasty Patients

VTE risk arises from patient-related, surgery-related, and postoperative factors.

3.1 Patient-Related Risk Factors

- Prior VTE (strongest predictor)
- Thrombophilia (Factor V Leiden, protein C/S deficiency, antiphospholipid syndrome)
- Age > 60
- Obesity (BMI > 35)
- Malignancy
- Diabetes, cardiovascular disease
- Hormone therapy (OCPs, HRT)

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- Smoking

Diagnosis of VTE

When in daily rounds we need to check for danger signs in bedridden patients for VTE Timely diagnosis is critical due to potentially rapid progression to life-threatening PE.

- **DVT:** Diagnosed primarily through duplex ultrasonography. Clinical signs include calf swelling, pain, and tenderness, though these may be subtle postoperatively.
- **PE:** CT pulmonary angiography is the mainstay of imaging. Sudden dyspnea, chest pain, tachycardia, or unexplained desaturation should prompt urgent evaluation.
- Limited mobility / neurological disease ,diabetes ,HTN ,cardiac disorders ,Dyslipidemia (known case)

3.2 Surgical Risk Factors

- Revision arthroplasty
- Prolonged operative time (>90–120 min)
- Cemented fixation in TKA (slight increase due to embolic load)
- Bilateral arthroplasty,excessive blood loss
- Use of a tourniquet (TKA)

3.3 Postoperative Factors

- Delayed ambulation,old aged patients not having motivation to ambulate .
- Transfusion requirement,excessive blood loss ,damage to artery during surgery .
- Infection,SSI
- Persistent inflammatory response,raised wbc and other inflammatory markers

Risk stratification (e.g., Caprini score) helps individualize prophylaxis duration and intensity.

4. VTE Detection and Diagnosis(Tools)

4.1) Clinical Presentation

Looking for clinical signs and symptoms earlier can prevent VTE that is ,

DVT: unilateral swelling, calf pain, warmth, erythema. **PE:** dyspnea, tachycardia, hypoxia, chest pain, syncope.

However, postoperative changes often mimic VTE, necessitating confirmatory imaging.

4.2) Imaging and Laboratory Tests

- **Doppler ultrasonography**: first-line for DVT.
- **CT pulmonary angiography (CTPA)**: gold standard for PE.
- **D-dimer** is less reliable postoperatively due to elevated inflammation

5. Pharmacologic Thromboprophylaxis

5.1 Aspirin (ASA)

Increasingly used due to favorable safety profile and easily available with low cost .

Pros:

- Low bleeding risk
- Low cost
- Easy administration
- Effective in low-risk patients (several RCTs support noninferiority to LMWH/DOACs)

Cons:

- Less effective in very high-risk patients (prior VTE, hypercoagulable states)

Typical regimen: 81–325 mg BID for 4–6 weeks.

5.2 Low-Molecular-Weight Heparin (LMWH)

Historically considered the gold standard.(5)

Pros:

- Strong evidence for efficacy
- Predictable pharmacokinetics

Cons:

- Requires injection
- Moderate bleeding risk
- Cost higher than aspirin

Regimen: enoxaparin 30 mg BID (US) or 40 mg daily (Europe).

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5.3 Direct Oral Anticoagulants (DOACs)

Includes **rivaroxaban**, **apixaban**, **dabigatran**.

Rivaroxaban

- Potent factor Xa inhibitor
- Effective but may increase minor bleeding risk

Apixaban

- Safer bleeding profile than rivaroxaban
- Popular for elderly or frail patients

Dabigatran

- Comparable efficacy to LMWH
- Less commonly used due to GI side effects

Advantages:

- Oral dosing
- No lab monitoring
- Rapid onset

Disadvantages:

- Higher cost
- Careful use required in renal impairment

5.4 Warfarin

Less commonly used today.

Pros: effective when INR maintained 2.0–3.0 **Cons:** frequent monitoring, drug-food interactions, delayed onset.

5.5 Duration of Prophylaxis

Guidelines recommend:

- **THA:** 28–42 days
- **TKA:** 10–14 days (but many surgeons extend to 4 weeks)
- High-risk patients: full 6 weeks

6. Mechanical Thromboprophylaxis

6.1 Intermittent Pneumatic Compression Devices (IPCDs)

- Improve venous return
- Effective adjunct to chemoprophylaxis
- Useful in patients with high bleeding risk

6.2 Early Mobilization

Central to modern Enhanced Recovery After Surgery (ERAS) pathways.
Mobilizing within hours of surgery reduces VTE risk significantly.

6.3 Compression Stockings

Evidence less robust but still commonly used as adjuncts ,very useful method and non invasive method .

7. Surgical Strategies to Reduce VTE Risk

7.1 Anesthesia Type

- It is suggests that duration of anesthesia may be an important risk factor for postoperative VTE after orthopedic surgery(10).

7.2 Minimally Invasive Approaches

MIS THA/TKA techniques reduce soft-tissue trauma → less inflammation and faster mobilization.

7.3 Robotic-Assisted Arthroplasty

- Improved component alignment
- Reduced soft tissue damage
- Potentially shorter hospital stay and earlier ambulation
  Evidence suggests comparable or slightly lower VTE risk but more data is needed.

7.4 Tourniquet Use in TKA

Debated- Tourniquets increase venous stasis but reduce intraoperative bleeding.

Recent evidence favors limited or no tourniquet use.

8. Special Populations

8.1 High-Risk Patients

- Prior VTE
- Active cancer
- Known thrombophilia

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- Morbid obesity
  These groups typically require stronger prophylaxis:

  LMWH or DOAC for ≥6 weeks.

8.2 High-Bleeding-Risk Patients

- Recent GI bleed
- Severe liver disease
- Coagulopathy
- Revision surgery with high intraoperative blood loss
  Consider mechanical prophylaxis alone until bleeding risk stabilizes.

9. Future Directions

- Personalized medicine using genetic and biomarker profiling to tailor prophylaxis.
- Artificial intelligence risk prediction tools integrated into perioperative planning.
- Next-generation DOACs with shorter half-lives and improved safety.
- Advances in robotic and navigated surgery that minimize tissue trauma and accelerate recovery.

CONCLUSION

VTE remains a major concern following hip and knee arthroplasty, but advances in pharmacologic and mechanical prophylaxis have dramatically improved safety. The growing shift toward patient-specific, risk-stratified protocols paired with minimally invasive and robotic surgical advancements offers promising opportunities to further reduce VTE rates while minimizing bleeding complications, and reducing risk of pulmonary embolism and DVT and infraction in brain and heart leading to ischemia and leading to other major complications. No single prophylactic regimen is universally superior, rather, optimal management requires balancing VTE risk, bleeding risk, comorbidities, and surgical factors,patient factors. Continued research on individualized prophylaxis and technological innovations will shape the next generation of arthroplasty care and post operative risk will also reduce and further improving the quality of life of the patient.

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