



Methods for the Diagnosis and Treatment of Deep Vein Thrombosis after Hip Joint Endoprosthesis

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Annotation: Deep vein thrombosis (DVT) remains one of the most significant postoperative complications after hip arthroplasty, despite the widespread use of pharmacological and mechanical prophylaxis. Active thrombogenesis begins during surgery and may lead to early postoperative thrombotic events. Diagnostic methods such as Doppler ultrasonography, plasma D-dimer measurement, and ultrasound angioscanning (USAS) play a key role in early detection, although most cases are asymptomatic. Treatment duration for DVT is still debated: the American College of Chest Physicians recommends at least a three-month course of anticoagulant therapy, while some studies suggest shorter regimens for secondary distal DVT. Comprehensive thromboprophylaxis and timely instrumental diagnostics are essential to reduce morbidity and mortality associated with venous thromboembolism after hip arthroplasty.

Keywords: deep vein thrombosis, hip arthroplasty, venous thromboembolism, Doppler ultrasonography, thromboprophylaxis, anticoagulant therapy, LMWH, fondaparinux.

Аннотация: Тромбоз глубоких вен (ТГВ) остаётся одним из наиболее значимых послеоперационных осложнений после эндопротезирования тазобедренного сустава, несмотря на широкое применение фармакологической и механической профилактики. Активное тромбообразование начинается во время операции и может приводить к ранним послеоперационным тромбозам. Методы диагностики, такие как доплерография, определение уровня D-димера и ультразвуковое ангиосканирование (УЗАС), играют важную роль в раннем выявлении ТГВ, хотя большинство случаев протекает бессимптомно. Продолжительность лечения остаётся предметом дискуссий: рекомендации American College of Chest Physicians предусматривают минимум трёхмесячный курс антикоагулянтной терапии, тогда как при вторичном дистальном ТГВ возможны более короткие схемы. Комплексная тромбопрофилактика и своевременная инструментальная диагностика позволяют снизить частоту осложнений и смертность после эндопротезирования тазобедренного сустава.

Ключевые слова: Тромбоз глубоких вен, эндопротезирование тазобедренного сустава, венозные тромбозомболические осложнения, доплерография, тромбопрофилактика, антикоагулянтная терапия, низкомолекулярные гепарины, фондопаринукс.

Annotatsiya: Son bo'g'imi endoprotezlashidan keyingi chuqur vena trombozi (ChVT) farmakologik va mexanik profilaktikaning keng qo'llanilishiga qaramay, eng muhim operatsiyadan keyingi asoratlardan biri bo'lib qolmoqda. Faol tromboz jarayoni operatsiya vaqtida boshlanadi va erta operatsiyadan keyingi davrda trombotik holatlarga olib kelishi mumkin. Doppler ultratovush tekshiruv, plazmadagi D-dimer miqdorini aniqlash va ultratovush angiokuzatuv (USAS) kabi usullar erta tashxis qo'yishda muhim rol o'ynaydi, ammo aksariyat holatlar simptomsiz kechadi. Davolanish davomiyligi hali ham bahsli masala bo'lib, American College of Chest Physicians kamida uch oylik antikoagulyant terapiya kursini tavsiya etadi, ammo ikkilamchi distal ChVT uchun qisqaroq davolash sxemalari samarali bo'lishi mumkin. To'liq

tromboprofilaktika va o'z vaqtida instrumental diagnostika son bo'g'imi endoprotezlashidan keyingi venoz tromboembolik asoratlar bilan bog'liq o'lim va kasallanishni kamaytiradi.

Kalit so'zlar: Chuqur vena trombozi, son bo'g'imi endoprotezlash, venoz tromboemboliya, Doppler ultratovush, tromboprofilaktika, antikoagulyant terapiya, past molekulyar og'irlikdagi geparinlar, fondaparinuks.

Introduction. Patients after hip joint arthroplasty (HJA) are at high risk of postoperative complications, among which are life-threatening venous thromboembolic events (VTE), including deep vein thrombosis (DVT) of the inferior vena cava system and pulmonary embolism (PE) [1].

Timing of Thrombosis Formation. Active thrombogenesis begins during the surgical procedure itself. O.E. Dahl [2, 3] demonstrated that a significant number of vascular and pulmonary complications occur during femoral canal reaming and prosthesis implantation. This is associated with a massive release of tissue thromboplastin and other procoagulants from the bone marrow canal into the systemic circulation through drainage veins.

A study on the prevention of venous thromboembolic events (VTE) after hip arthroplasty (HA) revealed that deep vein thrombosis (DVT) developed in **50% of cases during the operation or on the first postoperative day**, and in **75% of cases within the first 48 hours** [4].

J.A. Hooker et al. performed **ultrasound angioscanning (USAS)** of the lower limbs in patients after HA at first on **day 6 and later**, and subsequently between **postoperative days 2–5** after protocol modification. They found no significant difference between the groups, leading to the conclusion that **DVT develops intraoperatively or in the early postoperative period** [5].

According to D. Warwick et al., in a cohort of **6,639 patients after HA**, the **average time of VTE onset was 21.5 days postoperatively** [6].

Table 1. Reported Timing of Deep Vein Thrombosis after Hip Arthroplasty

Author(s)	Study Population	Timing of DVT Onset	Key Findings
O.E. Dahl [2,3]	Hip arthroplasty patients	Intraoperative phase	Thrombosis linked to tissue thromboplastin release
Unspecified [4]	Post-HA patients	50% during surgery or 1st day; 75% within 48 h	Early thrombogenesis most common
J.A. Hooker et al. [5]	Post-HA patients	Days 2–6 after surgery	No significant timing difference → early onset
D. Warwick et al. [6]	6,639 HA patients	Mean 21.5 days post-surgery	Late symptomatic VTE detection possible

Clinical Features in Domestic Orthopedic Practice. Specific characteristics of orthopedic practice in the post-Soviet region include **prolonged conservative treatment** of patients with advanced coxarthrosis and **delayed hip arthroplasty** at later stages of deforming osteoarthritis. Moreover, **postponed surgical management** of elderly patients with femoral neck fractures (FNF) leads to an **increased incidence of DVT** due to **prolonged immobility**.

In our clinical experience, among patients with FNF, **DVT was detected in more than one-third of cases during preoperative preparation for hip arthroplasty**.

Need for Improved Thromboprophylaxis and Treatment Awareness. With the expansion of new pharmacological agents for VTE prevention and treatment, as well as the introduction of modern non-pharmacological methods of thrombosis prevention, **orthopedic surgeons must be familiar with both prophylactic strategies and therapeutic options**. In foreign practice, **distribution of educational materials or workshops for physicians is not recommended** as a method of improving adherence to thromboprophylaxis guidelines [7]. Instead, the **implementation of institutional protocols and mandatory thromboprophylaxis orders** is considered **more effective**—both to ensure patient safety and to provide **legal protection for treating physicians**. In the past decade, in the absence of preventive measures, **deep vein**

thrombosis (DVT) developed in **42–57%** of patients after hip arthroplasty (HA), **proximal DVT** in **18–36%**, **pulmonary embolism (PE)** in **0.9–28%**, and **fatal PE** in **0.1–2%** of cases [8-10]. The **most common site of thrombosis** was the veins of the lower leg. In **10–20%** of cases, the thrombus propagated proximally, and in **1–5%**, a fatal PE occurred. Notably, in patients who developed PE, **clinical manifestations of DVT in the lower extremities were observed in less than 20% of cases** [8]. These data confirm the necessity of mandatory **prophylaxis of venous thromboembolic events (VTE)**. An analysis of randomized clinical trials demonstrated a **progressive reduction in the incidence of lower-limb DVT** due to advances in preventive measures. For example, after **total hip arthroplasty (THA)** performed for **femoral neck fracture (FNF)**, the incidence of DVT without prophylaxis was **50%**, with **aspirin – 41.7%**, with **dose-adjusted warfarin – 22.3%**, with **low-molecular-weight heparins (LMWH) – 14.8%**, and the **lowest rate (4.7%)** was observed with **fondaparinux** use [10].

The **necessity of prophylaxis is beyond doubt**. The goal of prophylactic therapy is not only to **reduce the likelihood of DVT formation**, but also to **prevent further progression of VTE**.

Table 2. Incidence of DVT after Total Hip Arthroplasty depending on the prophylactic regimen

Prophylactic regimen	DVT incidence (%)	Source
No prophylaxis	50.0	[7]
Aspirin	41.7	[7]
Warfarin (dose-adjusted)	22.3	[7]
Low-molecular-weight heparins (LMWH)	14.8	[7]
Fondaparinux	4.7	[7]

Methods for Detecting Deep Vein Thrombosis after Hip Arthroplasty. It is impossible to completely prevent deep vein thrombosis (DVT) in all patients. According to D. Warwick, despite prophylaxis, **DVT was verified in 1.7% of patients** [6]. In major clinical trials such as **RE-NOVATE, RE-NOVATE II, RECORD1, and RECORD2**, when using existing thromboprophylaxis strategies with **enoxaparin, severe venous thromboembolic events (VTE)** — including proximal DVT, pulmonary embolism (PE), and death from VTE — were detected in **2.0–3.9% of patients** undergoing hip arthroplasty (HA) [12–15].

The **diagnostic value of clinical examination** for DVT in patients after HA is limited. The main symptoms of venous thrombosis — **limb edema, pain, and increased skin temperature** — often accompany the normal postoperative recovery process and may persist for **1–2 weeks**. As a result, **up to 85% of DVT cases in this patient population are asymptomatic** [11,12]. Therefore, it is crucial to consider the **asymptomatic nature of most DVTs** and perform **instrumental verification** to enable timely initiation of therapy.

Instrumental Methods of DVT Detection

Diagnostic Method	Advantages	Limitations / Remarks	Diagnostic Value
Doppler ultrasonography	Detects significant decrease in blood flow velocity	Does not provide precise information on thrombus location, extent, or embolic potential	Moderate
Plasma D-dimer level	High sensitivity; negative result reliably excludes DVT	Not reliable during first 2 weeks after HA due to fibrinolytic recovery and postoperative hematoma resorption [37]	Supportive (adjunct)
X-ray contrast venography	Considered the “gold standard” for DVT diagnosis	Invasive, technically complex, limited for routine use	High (reference method)

Ultrasound angioscanning (USAS)	Non-invasive, widely available, high resolution	Subjective; limited visualization of proximal veins post-HA; intestinal gas and obesity may obscure inferior vena cava	Practical “gold standard” for clinical practice [38]
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While Doppler ultrasound can reveal **reduced venous blood flow**, it cannot determine the **exact location or size of the thrombus** or assess its **embolization risk**. Measurement of **D-dimer levels** in plasma can **suggest the presence of DVT** or **exclude it with high probability** if negative [36]. However, in patients after hip arthroplasty, **D-dimer cannot serve as a reliable marker** during the **first two postoperative weeks** due to ongoing fibrinolysis and hematoma resolution at the surgical site [13,14]. **X-ray contrast venography** remains the **reference (gold standard)** for confirming DVT but is **invasive and technically demanding**. In contrast, **ultrasound angioscanning (USAS)**—despite being somewhat **operator-dependent** and sometimes limited in assessing proximal veins—remains the **most accessible and widely accepted diagnostic method** because of its **non-invasiveness, safety, and high resolution** [38].

Duration of Thrombosis Treatment. According to the **American College of Chest Physicians (ACCP) guidelines (2008)**, treatment of deep vein thrombosis (DVT) with **unfractionated heparin (UFH)**, **low-molecular-weight heparin (LMWH)**, or **fondaparinux** should be continued for **at least three months**. However, the recommendations do not specify different treatment durations depending on the **level or nature of the identified DVT** [15].

The need for such prolonged anticoagulant therapy in cases of **distal DVT** is still based on the study by National Clinical Guideline Centre, which included **51 patients** followed for three months using isotopic examinations, clinical evaluations, and venography [39]. The authors concluded that **vitamin K antagonists should be prescribed for three months** to all patients with **symptomatic distal DVT** [16].

Nevertheless, the **optimal duration of distal DVT treatment** remains a matter of debate. Clinical guidelines generally recommend **12 weeks** of anticoagulant therapy, although **six weeks** of treatment may be sufficient in some cases. **Moldovan et al.** concluded that patients with **idiopathic distal DVT** require **longer and more intensive therapy** than those with **secondary distal DVT** [18]. If idiopathic DVT does not regress after **four weeks of anticoagulant therapy**, a **full three-month course** should be administered. For patients with **secondary DVT**, a **four-week course of LMWH** (first week at therapeutic dose, followed by three weeks at prophylactic dose) appears to be more appropriate [20].

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