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Primary total knee arthroplasty in hemophilic arthropathy

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- Advanced hemophilic knee arthropathy is a frequent and devastating manifestation of severe hemophilia with significant implications for activities of daily living.
- Hemophilic arthropathy is caused by repeated bleeding, resulting in joint degeneration, pain, deformity and disability.
- In patients with hemophilia and advanced disease, total knee arthroplasty (TKA) has proven to be the most successful intervention, improves physical function and reduces knee pain.
- Hemophilic patients carry additional risks for complications and required specific pre/postoperative considerations. Expert treatment center should be used to improve patient outcome.
- Hemophilic patients present significant surgical challenges such as joint destruction, bone loss, severe ankylosis and oligoarticular involvement. The surgeon performing the arthroplasty must be experienced to manage such problems.

Keywords

- hemophilia
- total knee arthroplasty
- hemophilic arthropathy
- complications
- outcomes
- knee

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Introduction

Hemophilia is a hereditary X-linked recessive coagulopathy disorder resulting from blood clotting factor deficiency or dysfunction. There are two major types of hemophilia namely hemophilia A, deficiency of clotting factor VIII and hemophilia B, deficiency of clotting factor IX. These factors are involved in the intrinsic pathway of blood coagulation. The degree of severity is based on the plasma factor levels and can be classified into mild, moderate and severe, with either 5–40%, 1–5% or less than 1% of the normal factors level, respectively (1). The reported prevalence is 1/10 000, with hemophilia A being four times more frequent than hemophilia B (2). Since hemophilia is a X-linked disorder, it is predominantly seen in males. About 55% of the hemophilic population is mildly affected (2). Hemophilia is usually managed with lifelong factor replacement therapy that helps in reducing bleeding complication rates and prolonging life expectancy.

Hemophilic arthropathy

There is a great variety of clinical manifestations of hemophilia but one of the most frequent is spontaneous intra-articular bleeding. It accounts for more than 90% of serious bleeding in patients with severe hemophilia (3). Hemarthrosis mainly affects the ankle, elbow and knee (4). Hemophilic arthropathy (HA) is a blood-induced joint damage caused by repetitive intra-articular bleeding in the joint which leads to the deposition of hemosiderin in the synovial tissues inducing hypertrophy, neovascularization and fibrosis of the latter. The synovial inflammation and associated inflammatory reaction are responsible for cartilage damage and early joint degeneration (5). Hemarthrosis may occur as frequently as 20–30 times per year in severe cases (6), and it usually starts at a young age, leading to the advanced arthropathies seen in young adults (7). This can lead to significant joint pain and deformity, resulting in major limitations and poor quality of life (8) (Fig. 1). In severely affected knees, stiffness and flexion contracture are frequently found. In addition, important angular deformities (varus or valgus), external rotation of the tibia and leg length discrepancy can be observed (9, 10) (Fig. 2). Early (age 1–2) prophylactic recombinant factor administration can prevent or slow the progression of joint damage (1, 11).

Treatment options

HA is commonly seen in the knee joint secondary to repetitive hemarthrosis. In the early stage, knee

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Figure 1
Anteroposterior (A), lateral (B) and axial patellofemoral (C) radiographs of both knees in a 36-year-old male with severe hemophilia A.

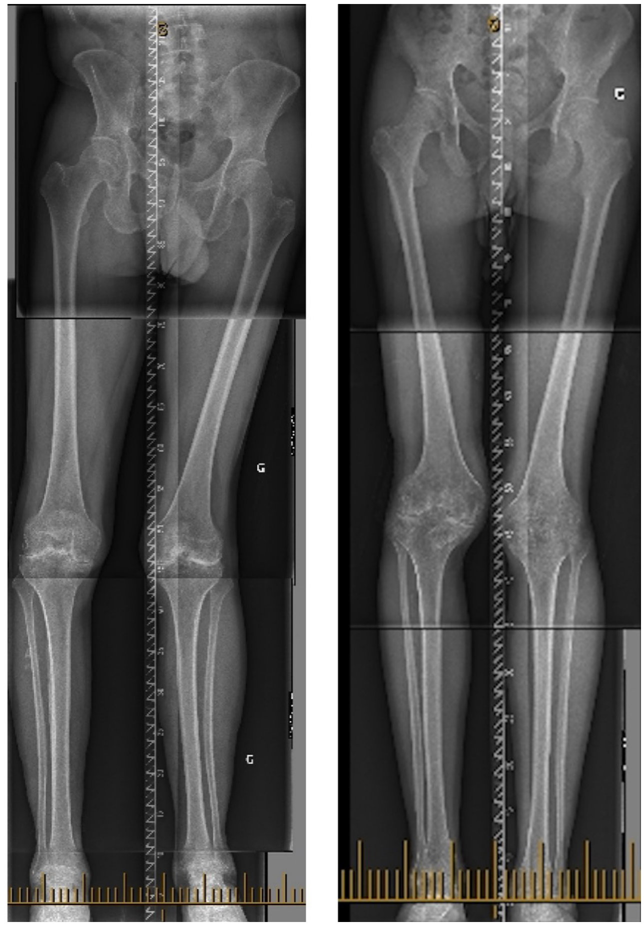

Figure 2
Example of long leg radiographs of two hemophilic patients with HA and severe musculoskeletal deformities.

arthropathy is treated with conservative management including physiotherapy and pain medications. However, as the degenerative changes progress, pain and disability increases and conservative management stops being effective (12). Depending on the severity of the disease, different elective procedures may be indicated such as arthroscopic or open synovectomy, arthrodesis and/or arthroplasty (13). A quick overview of these procedures is provided in this article.

Synovectomy

Patients with HA have an inflamed, hypertrophic and hyper-vascularized synovium which leads to intra-articular bleeding and pain. Therefore, the objective behind performing a synovectomy is to remove the inflamed and hypertrophic synovial tissue, consequently reducing bleeds and pain. This can be achieved either by surgery, chemical intra-articular injection of a fibrosing substance (such as rifampicin or oxytetracycline) or radioactive injection of radiopharmaceutical, beta-emitting radionuclide (14, 15, 16).

Surgical synovectomy is indicated in patients with subacute or chronic synovitis with moderate radiological score and no response to medical treatment for more than 6 months. Surgical synovectomy can be performed either open or arthroscopic. Open surgical synovectomy is mainly carried out using dual incision: anteromedial and posterolateral (17). It is effective in reducing the number of bleeding episodes by more than 80% (16, 17). However, postoperative loss of motion is an undesired consequence of this operation (16, 18), moreover it does not stop the progression of end-stage knee arthritis. Thus, it is not commonly recommended or performed.

On the other hand, arthroscopic synovectomy is a less invasive technique that is performed using the standard arthroscopic knee portals, allowing for faster recovery, shorter hospital stay and improved postoperative range of motion (ROM) (16). It also reduces the bleeding episodes and good outcomes have been reported (18, 19). Dunn *et al.* reported median reduction in bleeding episodes of 84% (20). Interestingly, according to Journeycake *et al.*, arthroscopic synovectomy should be considered early in young patients with hemophilia (PWH), as they could show more favorable outcomes (76% improvement in joint function) compared to older patients (19). In addition, it has been suggested that physiotherapy is a key element for the success of this procedure (16). Overall, arthroscopic synovectomy can delay but not stop the progression of end-stage arthritis and can be an interesting surgical option in young patients with chronic synovitis.

Knee arthrodesis

Arthrodesis is a procedure with good results in monoarticular disease. However, hemophilia may affect multiple joints, thus using this therapeutical solution on several affected joints might create complex biomechanical problems and disabilities in the daily activities. Moreover, with the current advancement in knee arthroplasty, knee arthrodesis is rarely recommended.

Total knee arthroplasty

Total knee arthroplasty (TKA) is considered the gold standard treatment for patients with end-stage HA. TKA has been shown to significantly improve knee function, reduce pain and provide high patient satisfaction rates (Fig. 3) (21). However PWH differ from patients with primary knee osteoarthritis (OA) as they carry additional risk for complications and therefore special attention and considerations is required in the preoperative, intraoperative and postoperative care. The rest of this article will focus on these special considerations and the outcome of TKA in HA patients.

Preoperative preparation and tips and tricks for TKA in HA knees

All elective surgical procedures in PWH should be managed in expert treatment centers (22). A multidisciplinary approach with effective communication and coordination between the orthopedic surgeon, hematologist, pharmacist, anesthetist and physiotherapist is essential to ensure the success of the surgical procedure.

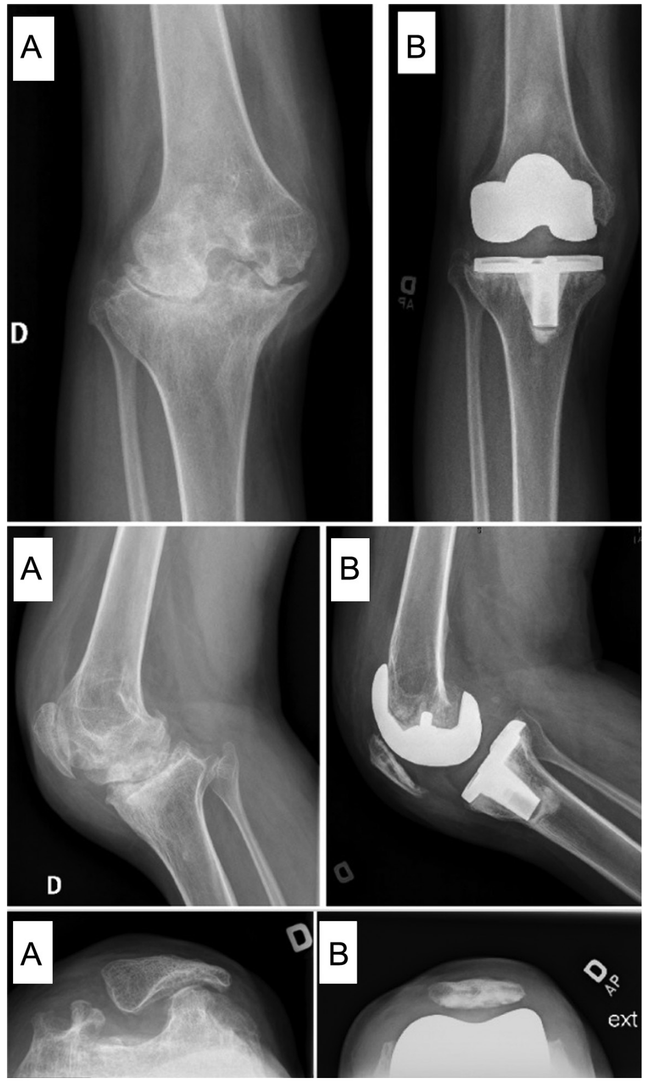

Figure 3
Anteroposterior, lateral and axial patellofemoral radiographs of a right knee (A: preoperative, B: postoperative). Forty-nine-year-old patient with severe hemophilia A who had a cemented total knee arthroplasty with patellar resurfacing for end-stage knee hemophilic arthropathy. At 5 years of follow-up, the patient is free of pain and satisfied with the surgery. He has a range of motion of 0–90 degrees.

Coagulation factor substitution therapy

Optimizing coagulation factor levels for patients undergoing surgery is a key element in the therapeutic management of PWH. Different protocols and suggestions have been published in the literature. The world Federation of Hemophilia recommends a desired preoperative factor level of 80–100% for major surgeries such as TKA in hemophilia A and 60–80% for hemophilia B, with postoperative levels gradually tapering to approximately 50% until the wound is healed (23).

Others recommend a level of 120% (corresponding to 60 UI/kg and 120–140 UI/kg, respectively, for factor VIII and IX deficiency) during induction of anesthesia and 60–80% for 72 h post-surgery (achieved by either continuous infusion or bolus) (24). Factor levels should be progressively tapered over the next 3–4 weeks postoperative (typically 50% for 2 weeks followed by 20–40% for two more weeks), while keeping the factors at 40% before each physical therapy session up to 6 weeks (24). Keeping an appropriate coagulation factors level is essential to decrease complication rates and ensure good outcomes. Figgie *et al.* showed a significant decreased in infection and failure rates following TKA in PWH with postoperative clotting factor levels of 100% (25).

Currently, there is no well-established clotting factor substitution protocol for PWH undergoing TKA.

Preadaptation

Conversely to the primary OA cases, preoperative physiotherapy does not improve the outcome in PWH (26, 27, 28).

Perioperative challenges in primary TKA in patients with HA

TKA in HA knees is very challenging and demands advanced expertise in knee arthroplasty and revision knee arthroplasty to be able to deal with altered anatomy, bony defects and other technical challenges that may be encountered during the surgery.

Although, it is generally recommended to perform TKA under spinal anesthesia in the non-hemophilia patients as it is associated with lower postoperative complications compared to general anesthesia (29), general anesthesia is still recommended by some for PWH (30, 31). This is due to the fact that PWH carry a higher risk of local hemorrhages and related permanent neurological damages with spinal anesthesia (30, 31). However, Moharrami *et al.* recently reported no difference in terms of complications between general and spinal anesthesia in PWH (32). Nevertheless, they still recommend general anesthesia for bilateral and long cases (32).

For PWH, prophylactic antibiotics with cefazolin 2 g preoperative then 1 g/8 h for 24–48 h or vancomycin for allergy cases is recommended (33).

Tourniquet use is still widespread for TKA in the hemophilic population. The tourniquet can be either inflated during the entire procedure, only during component cementing or until beginning of wound closure (34, 35, 36, 37).

To perform meticulous hemostasis, the authors prefer avoiding tourniquet. Moreover, tourniquet use may cause thigh bleeding secondary to microvascular damages (38).

As in the non-hemophilic population, skin incision depends on whether the patient had previous surgery or not. In case of previous scars, the most lateral incision is used to protect the blood supply to the skin and transverse scars should be crossed perpendicular to the scar. Large skin flaps may carry a risk of superficial hematoma and skin necrosis, dissection should be limited to prevent those. Otherwise, a standard midline incision is used followed by medial parapatellar approach (39).

HA knees are characterized by the presence of arthrofibrosis and limited ROM, which makes surgical exposure more difficult. Medial and lateral gutters are often scar down leading to decreased patello-femoral mobility (40). Thick fibrous tissues may also breach across the cartilage area, preventing motion. Extensive synovectomy is recommended to help with exposure and decrease the risk of future bleeding. Tissues crossing the femoro-tibial joint or patella-femoral joint should be excised. Extensile approaches including quadriceps snip, V-Y quadricepsplasty and tibial tubercle osteotomy might be required to allow adequate exposure of the knee joint in severe cases of arthrofibrosis in HA knees. Although in the authors' experience it is usually not necessary, quadriceps snip and V-Y quadricepsplasty, are performed in 10% and 39% of cases respectively, by some to achieve better exposure when necessary (34, 36, 37). Regarding tibial tubercule osteotomy, the authors attempt to avoid it, sharing Strauss *et al.* concerns on bad bone quality and soft tissue coverage linked to muscle atrophy (34).

Once sufficient exposure has been obtained, bone cuts should be performed according to the surgeon's preferred alignment philosophy and surgical workflow. The authors prefer using restricted kinematic alignment (rKA) principles since it decreases the need for soft tissues release and further bleeding (41, 42). Although the efficiency of navigation to decrease blood loss has not been proven in the general population, the authors consider that HA is a good indication for its use. Not opening the femoral canal seem advantageous in this subset of the patient.

Because of the abnormal shape of the distal femur (wide medial-lateral diameter, relatively narrow antero-posterior, wide femoral notch and large defects and osteophytes) and the frequent preoperative fixed flexion contracture, obtaining full extension is often difficult. As in the general population, increased distal resection and soft tissue release of the posterior capsule are both options to correct fixed flexion contracture. However, in PWH, posterior release needs to be done with extreme caution as any bleeding in this area would be very difficult to control.

In the authors' opinion, when the patella is subluxed (thus the extensor mechanism at a side), good flexion is usually obtained, and the knee can be balanced.

However, once the patella is reduced (and thus the extensor mechanism), there is often a significant decrease in the ROM due to quadriceps fibrosis following multiple intramuscular bleeding. However, it is still not advised to release the quadriceps muscle because it increases the risk of bleeding without bringing any benefit. Since muscle fibrosis is in cause, some postoperative improvement is possible and has been noted with physiotherapy.

Different authors have reported on using different types of bearings with good outcomes including cruciate retaining (CR) prosthesis and posterior stabilizing (PS) prosthesis (25, 43).

As with the general population, the aim is to obtain a balanced TKA with the least constraint (44). Increasing the constraint level leads to greater contact stresses on the implant interface (45), potentially resulting in premature implant loosening (46).

However, due to muscular atrophy and knee angular deformities (varus or valgus) found in PWH, achieving prosthetic stability with standard TKA implants can be challenging.

For these reasons a semi-constraint implant and rotating-hinge implant should be available as a backup when severe preoperative deformities are present and in case of collateral ligament insufficiency (31, 44).

In our center, when possible, the authors use a standard cemented primary TKA, with a medial congruent polyethylene, following rKa principles. However, in many cases, severe ankylosis, soft tissue contractures and bone loss are present. Such anatomy modifications do not always allow to follow rKA principles, and increased bone resection and/or soft tissue releases are required (45, 46). Such cases can often be anticipated based on preoperative imaging, and mechanical alignment philosophy is applied. When more constraint is needed, the authors tend to use short cemented stems. In our experience, with rKA, those stems are not impinging within a defined range of varus/valgus 5°. If longer stems are needed or if bone anatomy is too altered, we follow a pure mechanical alignment philosophy.

Performing patella resurfacing remains controversial (47). Whether or not the patient has hemophilia, the authors perform selective patella resurfacing depending on the status of the patella cartilage surface. Because of the erosive nature of HA, it is often necessary (Fig. 4). Care must be taken to preserve sufficient bone thickness to avoid the risk of fracture.

Most authors agree that the use of cement is recommended in the hemophilia population (31, 37, 48). PWH are prone to high risk and prevalence of periprosthetic joint infection (PJI). Therefore, the authors recommend the use of antibiotic-loaded cement in PWH for precautionary reasons (31), the risk-balance benefit being clearly in favor, as for its use in TKA for primary OA, in many European countries. As an added benefit, cementing has been shown to decrease blood loss compared to uncemented TKA (49).

Figure 4
Anteroposterior, lateral and axial patellofemoral radiograph of a right knee (A: preoperative, B: postoperative). The patient is a 55-year-old male with severe type A hemophilia.

Furthermore, the authors place a Collatamp G (Schering-Plough, Stockholm, Sweden) with vancomycin powder to help with hemostasis, keep the gutter open, prevent exercise fibrosis and elude antibiotic over a few days. The literature is divisive on the potential benefits of vancomycin powder in non-hemophilic patients, and there is no recommendation for PWH undergoing TKA (50, 51).

Postoperative bleeding is a common complication of TKA in the hemophilic population. Administration of clotting factors and tranexamic acid (TXA) is proven to be effective to decrease blood loss and should therefore be administrated (24, 52, 53, 54). In addition, the authors recommend the use of topical TXA. Intraoperative bleeding is generally not very different than in the normal population since patients have normal levels of factors during the surgery. However, postoperative bleedings are usually increased. Careful hemostasis should be verified at the end of the procedure and additional adjunct to hemostasis can be used if needed.

Suction drains should be avoided, as Mortazavi *et al.*'s prospective randomized study demonstrated that the suction drain group had a statistically significant higher hemoglobin drop on day one compared to the no-drain group (55). Moreover, there was no difference regarding the functional outcomes between the two groups, which led them to conclude that the use of suction drain is of no benefit. To further diminish the bleeding, the use of extramedullary guides is recommended (56). The latter can be achieved using navigation-assisted TKA, robot-assisted TKA technology and patient-specific instrumentation (PSI) (57, 58). However, because of the limited perioperative adjustability of PSI, the authors don't recommend its use.

Closure should be done in a watertight fashion, and advanced dressing should be used in this high-risk population. The authors prefer using closed incisional negative pressure wound therapy to decrease subcutaneous hematoma and seroma and improve subcutaneous tissue perfusion.

Physiotherapy

Postoperative physiotherapy is essential in PWH as it focuses on regaining ROM, strengthening and helping the patient retrieve adequate gait. The authors recommend unrestricted mobilization of the knee with the help of a physiotherapist for 7 days, as long as coagulation factors level is around 100%. Because of the increased risk of bleeding when coagulation factor administration is reduced, mobilization is also temporarily reduced. In the first six postoperative weeks, it is recommended that patients receive a minimum of 40% factor correction before every physiotherapy session to minimize the risk of bleeding due to knee movement (24). Different postoperative rehabilitation regimes have been reported including starting physiotherapy on the same day of surgery (36), while others suggested to start on the third postoperative day and continue twice a day duration of the hospital stay (24). A specialized physiotherapist in an expert treatment center will adjust manual therapy according to signs of bleeding and will collaborate with a hematologist to fine-tune factor replacement therapy if needed. Evidence for continuous passive motion machines is unclear. Although infrequently associated with complications, some authors advised for its positive effects on soft-tissue healing, swelling, joint function and hemarthrosis (28, 59). Even though, it does not enhance ROM at 1 and 2 years postoperatively, it is still recommended by some (28, 60).

Outcomes

Range of motion

HA is often associated with severe restricted preoperative ROM. Unlike non-hemophilic population where ROM of 0–120° is usually achieved after TKA (61), the increase of ROM in PWH is more modest (21). Goddard *et al.* reported the range of flexion and flexion contracture improved from 68° to 79° and 9.6° to 4.7°, respectively (62). Similar results were published by Kubes *et al.* and Silva *et al.* where TKA surgery decreased the average flexion contracture from 17° to 7° and 18° to 8° and improved the average preoperative flexion range from 73° to 80° and 59° to 75°, respectively (35, 63). Finally, a meta-analysis by Moore *et al.* showed an average decrease of 9.7° in flexion contracture and an increase 15° in flexion after TKA surgery (53).

Patient satisfaction

TKA in PWH has been associated with a high satisfaction rate. Silva *et al.* observed that 97% of the patients reported excellent or good function (63). Major improvement in postoperative pain explained the increased quality of life and high patient satisfaction. In Carulli *et al.*'s retrospective study, all 18 patients reported a high satisfaction rate, pain reduction and improved functional ability after TKA surgery with a mean follow-up of 12.2 years (64). Wang *et al.* found similar results with reported satisfaction rates of 100% (65). Zingg *et al.* demonstrated that patient's satisfaction and the knee society functional score were very high after TKA in PWH (21).

Implant survival rate

Westberg *et al.* (66) observed a 5- and 10-year implant survival rate of 92% and 88%, respectively, in PWH. This is similar to other published results in which 5- and 10-year implant survivorship are 90–98% and 83–89%, respectively (62, 63, 67). These results are less favorable than non-hemophilic patients where 10-year implant survival rates oscillates between 92% and 95.5% (68, 69). However, Duffy *et al.* observed lower 10- and 15-year implant survival rate of 96% and 85%, respectively, in non-hemophilic patients younger than 55 years (mean age of 53 years) (70). The difference in implant survivorship between TKA in OA patients (usually older than 55 years) and PWH may be explained by the fact that the latter have different characteristics than the general population; usually younger males, often in their third or fourth decade, with higher activity level (63, 71). However, the higher implant survival rate reported in OA patients younger than 55 years when compared to PWH (usually younger than 55) could be explained by genetics, stiffness, poor bone quality and the complexity of the disease.

In terms of revision rate, Ernstbrunner *et al.* (72) reported 30% (18% for aseptic loosening and 12% for infection) at 18-year follow-up. They concluded that, with revision as an endpoint, the implant survival rate at 20 years was 59% (72). The high rate of aseptic loosening could be explained by micro-hemorrhages and reactive destructive reactions that first occur at the bone–cement interface, poor bone quality and younger age of the patients (72). The above-described low survival rate is in contradiction with Song *et al.*'s retrospective study on 131 TKA in a hemophilic population that reported 5- and 10- year implant survival rate to be 98.5% and 97.5%, respectively (43). Their explanation for the high discrepancy between those studies is the type of implant used (43).

Complications

The overall complication rate after TKA in PWH is 13–31.5% (43, 53, 65, 73), which is significantly higher than the rate after TKA in non-hemophilic patients, 7.1–8.7% (73). Some of these complications include infection, periprosthetic fracture, bleeding, neurovascular injury, loosening, patella complications and wound dehiscence. Aseptic loosening and infection are the most significant ones.

Postoperative intra-articular bleeding has been shown to be one of the most common complications following TKA in PWH. Song *et al.* showed a prevalence of 5.3–8.9% as well as Moore *et al.* in their meta-analysis (43, 53). Postoperative bleeding has been associated with increased blood transfusion, longer hospital stays, higher infection rate and worse clinical outcomes including stiffness (74, 75, 76). This led multiple authors to recommend keeping the factor levels at 100% postoperatively for up to 3 weeks following TKA (77, 78).

Blood loss is another common complication in PWH undergoing TKA. Recent studies have shown that the use of TXA can significantly reduce blood loss and therefore reduce the associated complications. Huang *et al.* reported on 34 PWH undergoing TKA. They showed that a combination of intravenous and intra-articular TXA significantly reduces perioperative blood loss, transfusion rates and postoperative knee swelling. Moreover, it improved joint pain and function postoperatively (79). Also, Rodriguez-Merchan *et al.* showed that PWH who did not receive TXA had a transfusion rate of 46.6% vs 0% in PWH who had TXA (80).

Wound dehiscence is another common complication. The latter is explained by edge bleeding, poor soft tissue quality and higher wound tension (73). In Li *et al.*'s retrospective study on 78 PWH, wound dehiscence was the second most frequent complication with a prevalence of 16.7% (73). Therefore, careful hemostasis and sufficient factor substitution after surgery is essential to prevent such complication.

Deep vein thrombosis (DVT) is another important complication that is usually easily prevented using chemical thromboprophylaxis after TKA in the general population. However, in PWH this practice is controversial, and the best treatment is still to be determined. Some authors including Cancienne *et al.* showed a high rate of DVT in PWH post-TKA with 3.2% compared to 1.4% in the general population (76). However, in contrast Botero *et al.* showed a 0.9% rate of DVT in the hemophilic population (81). Moreover, Peng *et al.* showed that the rate of bleeding in patients receiving low-weight molecular heparin post-TKA is estimated to be 50%, while the estimated overall incidence of major bleeding regardless of prophylaxis type is 39.1% (82). On the other hand, a retrospective single-center study by Holderness *et al.* found no increase in bleeding with enoxaparin in PWH undergoing hip and knee replacement (83). As the literature is contradictory, different authors have recommended different options. Goker *et al.* recommended the use of DVT chemoprophylaxis as they believe that since the patients are getting factor replacement then they should possess similar hemostasis characteristics as the general population (76). In contrast, Mortazavi *et al.* recommended to follow the AAOS and ACCP guidelines for patients with bleeding diathesis that recommends against the use of DVT chemoprophylaxis (37, 84). However, they recommend early ambulation and mechanical prophylaxis (37).

PJI is another major complication following TKA in PWH. The prevalence of PJI in the non-hemophilic population is around 1% (85, 86). However, most studies have shown significantly higher rates of PJI in PWH with prevalence ranging from 5% to 17% (21, 35, 66, 67). The reason behind the increased infection rate in the hemophilic population is still unknown (72); nevertheless, there are several explanations that have been proposed including poor skin condition caused by coagulation factor administration, immunosuppression, bacteremia from contamination during repeated intravenous self-administration of coagulation factor concentrate, increased incidence of postoperative hematoma or concomitant HIV or HCV infection (53, 87). Forty percent of PWH were found to have HIV (63). Literature is still contradictory on whether HIV increases the rate of postoperative infection in PWH. Some authors report similar infection rates in HIV-positive and HIV-negative patients (62, 67), while others found higher rates of infection in HIV-positive patients (62, 88, 89).

Simultaneous bilateral TKA

Simultaneous bilateral TKA (SBTKA) is a very interesting option for PWH as they often present with symptomatic bilateral knee HA (90, 91). SBTKA has multiple potential advantages including one admission, one operation, shorter overall hospital stay, one coagulation factor administration and cost-saving surgery compared to stage bilateral knee arthroplasty (92). Cost-effectiveness has been linked to the decreased consumption of the costly coagulation factors replacement therapy needed for surgery (91).

Mortazavi *et al.* reported a cost reduction of 45% in SBTKA when compared to staged bilateral TKA (90). Moreover, he showed that there was no statistically significant difference in knee society score, WOMAC score, short-form 36 score, complication rate, mean ROM and flexion contracture between the two groups (90). Their study concluded that SBTKA was safe and cost-effective for PWH with bilateral knee HA. Similar results have been published showing a decreased cost, ranging from 36% to 47% with SBTKA (91, 93, 94). In addition, Jiang *et al.* reported on 36 PWH with a mean follow-up of 6 years who underwent SBTKA. They found that SBTKA patients did not require increased coagulation factors replacement. Moreover, there were no significant differences in HSS score, ROM or implant survival rates when compared to unilateral TKA, which led them to conclude that SBTKA in PWH is a safe and cost-effective treatment with good mid-term outcomes (92).

Longer LOS, more difficult physiotherapy, increased transfusion rates and pain are commonly perceived drawbacks of SBTKA when compared to unilateral TKA. However, studies show no statistically significant difference in terms of LOS and transfusion rate (90, 92).

There is no literature to our knowledge, specifically focusing on physiotherapy and pain. However, in the general population, no difference between the two groups has been reported (95, 96).

Conclusion

TKA in PWH has been shown to significantly improve knee function and reduce pain, providing high patient satisfaction rates and good outcomes. However, PWH differ from patients with primary knee OA. ROM cannot always be fully restored and PWH carry additional risk for complications. To minimize complications and increase the success rate, special attention and consideration are required. It is essential that PWH are managed in expert treatment centers with a multidisciplinary approach.

ICMJE Conflict of Interest Statement
The authors declare that there is no conflict of interest that could be perceived as prejudicing the impartiality of the research reported.

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