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CASE REPORT

Spontaneous Hemorrhage Leading to Loosening of the Tibial Component after Total Knee Arthroplasty: A Case Report

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Abstract:
Total knee arthroplasty (TKA) is a common procedure for end-stage knee diseases. Postoperative complications such as infection, loosening, and joint instability are well-documented, but spontaneous hemorrhage leading to prosthetic loosening is exceedingly rare. This case report describes a 64-year-old female who developed loosening of the tibial component due to spontaneous hemorrhage 10 months after bilateral TKA. The patient presented with pain, swelling, and restricted mobility in the left knee. Intraoperative findings revealed massive hemarthrosis and complete loosening of the tibial component. Revision surgery was performed, resulting in significant symptom relief. This report, combined with a literature review, explores the etiology and adverse effects of spontaneous hemorrhage following TKA.

Keywords: Total knee arthroplasty; Prosthetic loosening; Spontaneous hemorrhage; Synovial hyperplasia; Revision surgery

Introduction

Spontaneous hemorrhage following total knee arthroplasty (TKA) is a rare but critical complication, with an incidence of 0.1%–1.6%. It may manifest months to years postoperatively as knee swelling, pain, and restricted mobility. Etiological factors include systemic causes (e.g., coagulopathy, anticoagulant therapy) and local factors (e.g., vascular injury, arteriovenous fistula, synovial hyperplasia) [1, 2]. Prosthetic loosening, defined as instability between the implant and surrounding bone leading to displacement [3], is typically associated with infection, mechanical wear, or osteolysis. This case report describes a novel mechanism of tibial component loosening secondary to spontaneous hemorrhage, a phenomenon not previously documented in the literature.

2. Case Report

The patient is a 64-year-old married woman who was admitted to the hospital due to "pain and swelling of both knees for 10 months after total knee arthroplasty, with the left knee condition worsening for 3 months". The patient underwent "total knee arthroplasty" in another hospital 1 year ago due to "bilateral knee osteoarthritis". The operation was successful, and the range of motion of both knees was 0-120 degrees. The postoperative recovery was satisfactory, and daily life was not affected.Ten months ago, the patient developed swelling and pain in both knees without obvious incentive, with slightly elevated skin temperature. There was no obvious limitation of knee joint movement. She visited another hospital again, and joint cavity puncture was performed, with 70 ml of bloody fluid aspirated. Blood culture showed no obvious abnormalities. After treatment for reducing swelling and relieving pain (the specific drugs and dosages were unknown), the pain was slightly relieved and

the swelling subsided. Today, the pain and swelling of the left knee suddenly worsened, accompanied by limited mobility. Therefore, she came to our hospital for treatment and was admitted to our department as "pain after left knee arthroplasty" in the outpatient department. X-ray examination showed that "the artificial joint was in place, well anastomosed, the space was of equal width, the distal end was basically filled in the medullary cavity, and the surrounding soft tissues were swollen. The relationships between the bilateral femurs, tibias, fibulas, hip joints and ankle joints were good. The bone structure was complete, the bone cortex was smooth and continuous, and the space was normal" (Figure 1).

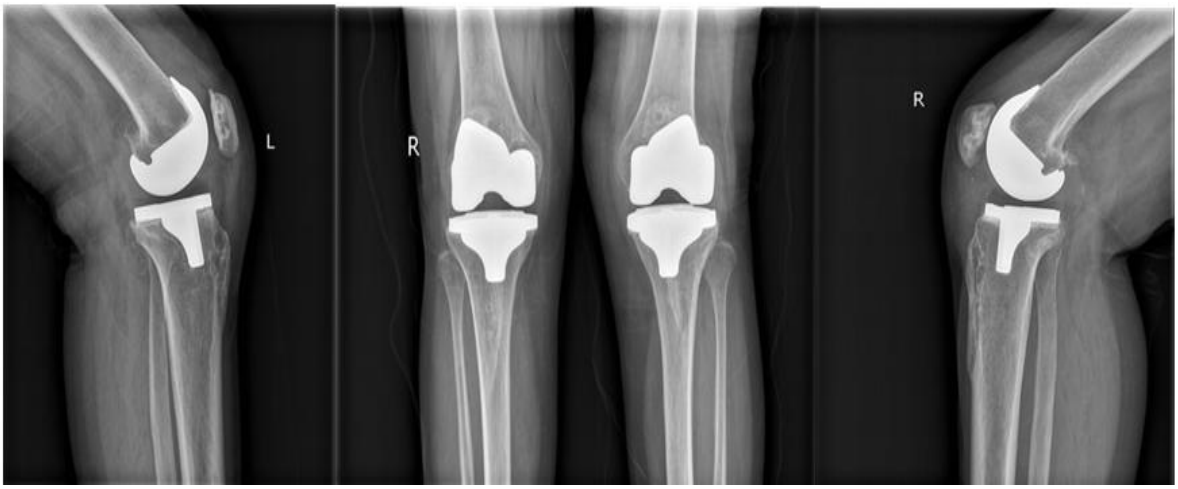

Figure 1 Preoperative anteroposterior and lateral radiographs of the left kne

On physical examination upon admission: There was a surgical scar about 15 cm long on the anterior side of both knees, with good local healing, no exudation or sinus tract; the skin temperature of both knees was elevated. The left knee was obviously swollen, with obvious tenderness on the medial and lateral sides of the left knee. The patellar float test of the left knee was positive (+). The range of motion of the non-weight-bearing joint flexion and extension of the right knee was 0°-110°, and that of the left knee was 0°-75°. The left knee was in valgus deformity, with a valgus angle of about 10°. In order to explore the cause of swelling and pain and carry out corresponding symptomatic treatment, on the 3rd day after admission, exploration of the left knee joint was performed, and spontaneous bleeding was found, and revision surgery was carried out.

On the 3rd day after admission, exploration of the left knee joint, removal of the left knee joint prosthesis, and revision of the left artificial knee joint were performed. Intraoperative findings: There was a large amount of blood accumulation in the left knee joint cavity, synovial hyperplasia could be seen, the tibial side prosthesis was completely loose, and there was bone defect at the distal end of the femur. When the lateral stress test of the knee joint was performed, the medial opening was about 10 mm.After successful anesthesia, the patient was placed in the supine position. An air pressure tourniquet was placed at the root of the left thigh, with the pressure set at 35 KPa and the time set at 90 minutes. After surface positioning, routine disinfection and draping were carried out. The original surgical incision of the left knee joint was extended to 15 cm. The skin, subcutaneous tissue, deep fascia and other tissues were incised in turn. The medial side of the quadriceps femoris tendon was incised longitudinally, and the patella was turned outward. A large amount of blood accumulation, about 60 ml (Figure 2), was found in the knee joint cavity. Part of it was taken for bacterial culture, and the synovial tissue of the affected knee was removed and sent for pathological examination.

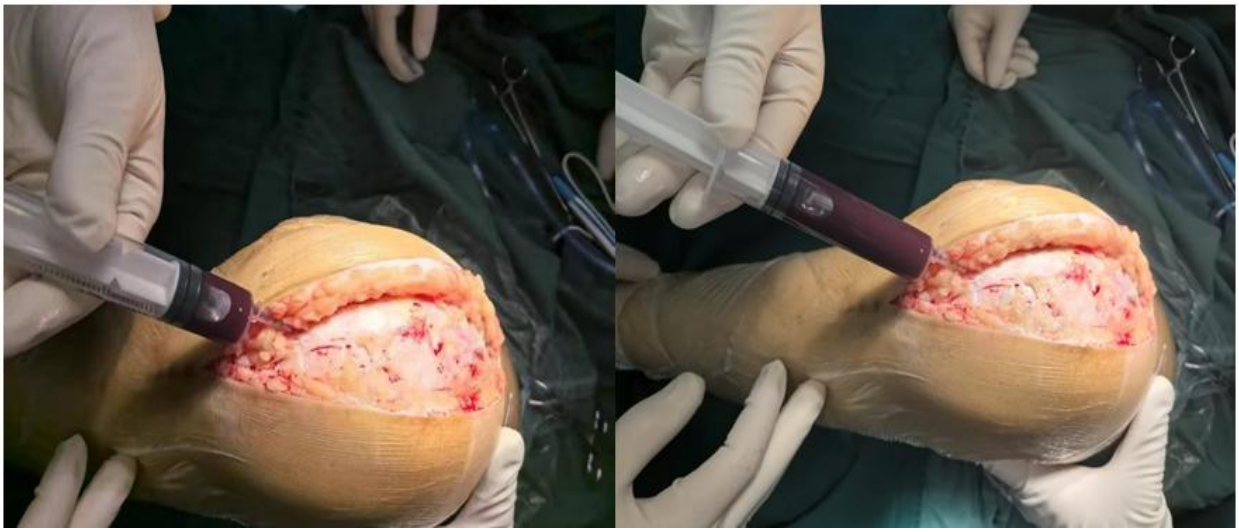

Figure 2 Intraoperative visualization of significant hemarthrosis

A large amount of hyperplastic synovial tissue around the knee joint was completely removed to achieve the "naked" degree. After cleaning, the wound was repeatedly irrigated 3 times with povidone-iodine, hydrogen peroxide and normal saline. The tibial side prosthesis was completely loose (Figure 3) and was removed by hand. On the femoral side, an elastic osteotome was used to remove the bone cement between the prosthesis and the bone, and the femoral prosthesis was removed.

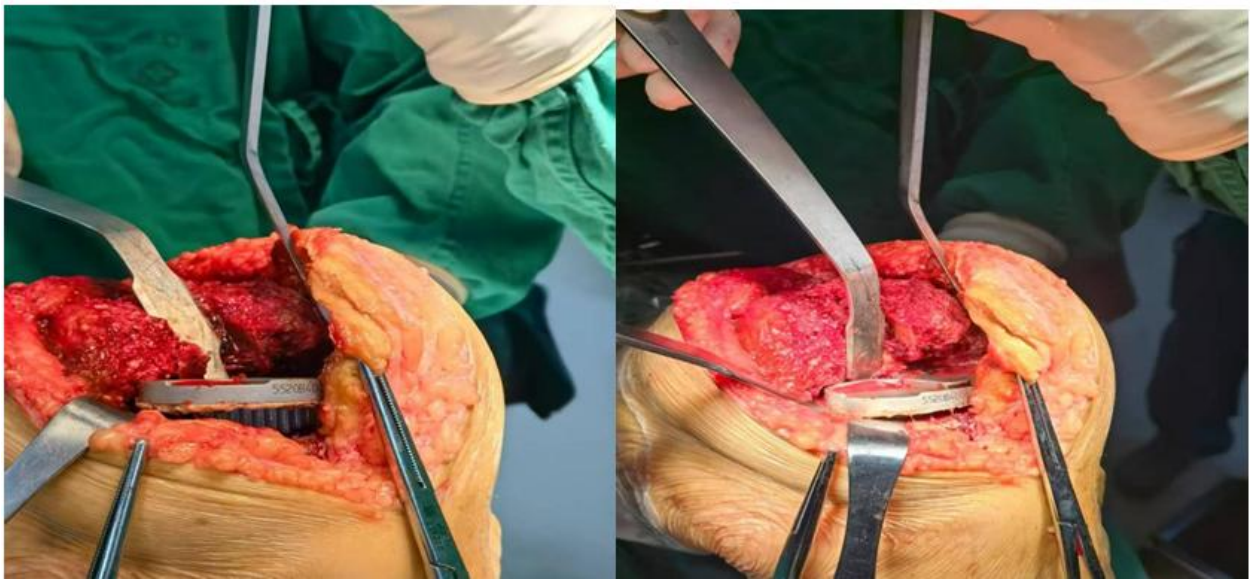

Figure 3 Intraoperatively, loosening of the tibial-side prosthesis caused by spontaneous bleeding in the knee joint was observed

The bone cement was thoroughly cleaned, and the bone surface was repeatedly irrigated again with hydrogen peroxide, diluted povidone-iodine solution and normal saline. A sterile surgical sheet was added.An intramedullary positioning rod was inserted after making an opening 1 cm in front of the origin of the posterior cruciate ligament of the femur. Osteotomy of the anterior and posterior condyles of the femur and the intercondylar fossa of the distal femur was performed at an external rotation of 3 degrees and a valgus of 6 degrees. The femoral prosthesis was measured to be size D. There was a large amount of bone defect at the distal end of the femur, and a 5-mm spacer was added to the lateral side. The trial femoral prosthesis and the spacer were installed, and it was found that the bone defect on the femoral side was well fitted and the trial prosthesis was stable. After the tibial extramedullary positioning rod was used to measure and determine the normal

alignment, the osteotomy bracket was installed. The depth gauge was placed on the medial condyle of the tibia. After osteotomy at a 7-degree posterior inclination, the alignment was measured again with the extramedullary positioning rod. It was found that the alignment passed from the medial side of the tibial tubercle to between the first and second toes. The tibial plateau was osteotomized with a swing saw, and the bone surface of the tibial plateau was leveled. It was found that there was a 5-mm defect on the medial and lateral sides of the tibial plateau. Then, an opening was made with a triangular file on the osteotomy surface. The osteotomy gaps in the flexion and extension positions were measured to be appropriate. The tibial prosthesis was measured to be size 2, and 5-mm spacers were installed on the medial and lateral sides of the tibia. The trial knee joint prosthesis was installed and the affected knee was moved. It was found that the flexion and extension movement of the affected knee joint was good, and the knee joint was stable on the medial and lateral sides.The trial prosthesis was removed, and the joint osteotomy gap was irrigated with diluted povidone-iodine and normal saline. One vial of vancomycin was sprinkled into the medullary cavity of the femur and tibia respectively to prevent infection. Then, after the bone cement was mixed, the bone cement was applied to the osteotomy surface of the femoral condyle and the inside of the femoral prosthesis. The femoral condyle prosthesis of size D made of cobalt-chromium-molybdenum alloy and the tibial plateau prosthesis of size 2 made of cobalt-chromium-molybdenum alloy were installed respectively. A 5-mm titanium alloy spacer was added to the lateral side of the distal end of the femur to supplement the bone defect at the distal end of the femur, and 5-mm titanium alloy spacers were added to the medial and lateral sides of the tibia. After the bone cement was allowed to set in the extended position, the wound was irrigated with a large amount of normal saline, concentrated povidone-iodine and one bottle of chitosan quaternary ammonium salt biological colloid solution to prevent wound infection. It was found that there was a large amount of bleeding from the soft tissues of the knee joint. An absorbable medical hemostatic membrane was used for hemostasis treatment on the bleeding wound surface. After checking that the number of dressings and instruments was correct, a negative pressure drainage tube was placed in the knee joint cavity, and an extension rod (used for injecting drugs into the joint cavity) was also placed. The joint capsule was sutured strongly at a flexion angle of 60 degrees, and the incision was sutured layer by layer. After suturing the wound, a piece of wound dressing was placed on the wound to promote wound healing. The patient was safely returned to the recovery room after the operation.Postoperative X-ray reexamination showed that "the prosthesis was in place, well anastomosed, the distal segment of the prosthesis was basically filled in the medullary cavity, the surrounding soft tissues were swollen and gas shadows were seen, the knee joint was slightly valgus, and the bone density of the patella was uneven. The relationships between the left femur, tibia, fibula, hip joint and ankle joint were good, and the space was normal" (Figure 4).

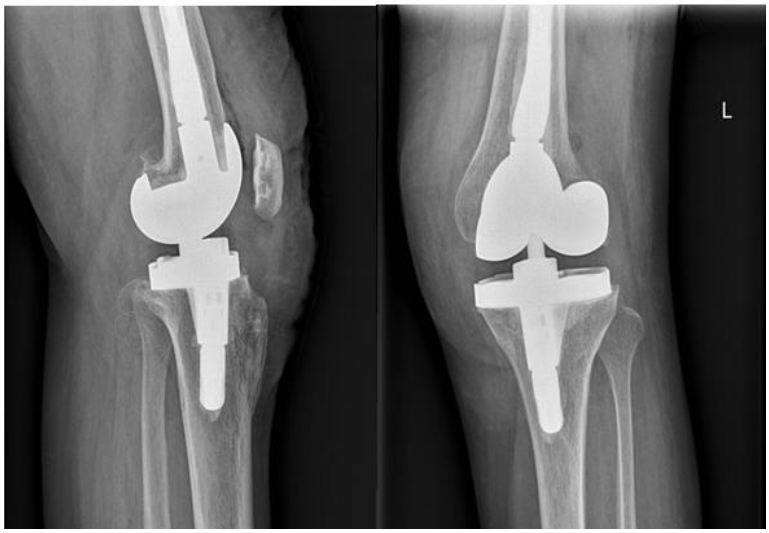

Figure 4 Postoperative radiograph following revision arthroplasty

2. Discussion

In this case, the patient had no significant coagulation dysfunction or history of anticoagulant use. The spontaneous bleeding following total knee arthroplasty (TKA) was considered potentially related to poor vascular repair after localized surgical trauma or occult vascular injury[4] . Common causes of prosthetic loosening after TKA include infection, mechanical wear, and osteolysis. However, spontaneous bleeding as a direct trigger has not been reported in the literature. This patient presented with knee swelling, pain, and restricted mobility 10 months postoperatively. Imaging and intraoperative findings revealed complete loosening of the tibial prosthesis with massive hemarthrosis. Combined with significant synovial hyperplasia and exclusion of infection, this suggests a multi-pathological mechanism of spontaneous bleeding-mediated prosthetic loosening. The following elaborates on these mechanisms in detail:First, mechanical pressure effects: Recurrent hemarthrosis creates a persistent high-pressure environment that severely disrupts the bone-prosthesis interface. Normally, bone cement tightly integrates with bone tissue to ensure prosthesis stability. However, the high-pressure state of hemarthrosis disrupts this equilibrium, interfering with normal bone-cement integration [5, 6]. Post-implantation, the bond between bone cement and bone is critical for stability. High pressure reduces contact area and weakens adhesion, leading to abnormally elevated shear stress at the cement-bone interface. Under daily activity-induced stress, the prosthesis becomes prone to micromotion. Early micromotion is a key precursor to loosening, and its progression damages the bone-cement bond while stimulating inflammatory reactions in surrounding tissues, accelerating loosening and compromising stability, thereby impairing patients' quality of life and joint function [7-9].Second, inflammatory osteolysis cascade: Hemarthrosis stimulates significant synovial hyperplasia. While synovium normally lubricates and protects the joint, hemarthrosis components provoke synovial cell proliferation and alter their morphology and function. Hyperplastic synovium releases pro-inflammatory factors such as IL-6 and TNF-α, triggering inflammation [10]. IL-6 and TNF-α activate the RANKL/RANK pathway, which abnormally enhances osteoclast activity and suppresses osteoblast differentiation. Enhanced osteoclast activity and impaired osteoblast differentiation lead to progressive bone resorption in the distal femur and tibial plateau, weakening the prosthetic foundation. Reduced bone mass and support further destabilize the prosthesis, creating a vicious cycle that compromises implant longevity and patient recovery [11-13].Third, hematoma organization-induced bone structural abnormalities: Fibrous scar tissue formed during hematoma organization replaces the normal trabecular bone network. This tissue exhibits inferior strength and elasticity, failing to provide adequate prosthetic support. Additionally, it disrupts local angiogenesis. Normal bone requires sufficient blood supply for metabolism and repair. Fibrous scar tissue impedes vascular growth, leading to insufficient local blood supply, impaired bone metabolism, and reduced regenerative capacity. This establishes a "hematoma-bone destruction-loosening" vicious cycle: fibrous scar tissue reduces prosthetic support, while impaired angiogenesis exacerbates bone metabolic imbalance and destruction, significantly increasing loosening risk and burdening patients with pain and financial costs[14, 15]

3. Conclusion

This case is the first to report a rare complication of tibial prosthetic loosening triggered by spontaneous bleeding after TKA, highlighting the research value of linking unique pathological mechanisms to diagnostic and therapeutic strategies. Pathologically, spontaneous bleeding-induced loosening via mechanical compression, inflammatory osteolysis, and hematoma organization reveals distinct pathological processes compared to infectious loosening or mechanical failure, emphasizing the need for multidimensional diagnostic evaluation. This study provides a novel pathological model for non-infectious prosthetic loosening and underscores the importance of early intervention for postoperative occult bleeding. It also offers fresh insights into the pathological mechanisms and clinical management of rare post-TKA complications, urging clinicians to recognize chronic bleeding's threat to prosthetic stability and improve postoperative follow-up systems.

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Authors' Contributions

LJH and MCH conceptualized the study, conducted the investigation, analyzed data, and wrote the manuscript. ZSH assisted in reviewing and editing the manuscript. ZKP ,WX and ZSJ participated in data collection and supervised manuscript drafting. All authors read and approved the final manuscript.

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Data and Materials Availability

All data generated or analyzed during this study are included in this published article.

Declarations

Ethics Approval and Consent to Participate

This study was approved by the Ethics Committee of the 940th Hospital of the Joint Logistics Support Force of the Chinese People's Liberation Army. We confirm that this study adhered to the 1964 Helsinki Declaration and its subsequent amendments. Written informed consent was obtained from all individuals for the publication of any potentially identifiable images or data.

Competing Interests

The authors declare no competing interests.

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