Delayed popliteal arteriovenous fistula after total knee arthroplasty

Peng Yufeng¹, Yao Ling¹, Cai Xinxin², Sha Yong^{1*}

¹Department of Orthopedics, 920th Hospital of Joint Logistics Support Force, Kunming, 650032, China

²Department of Anesthesiology, the First Affiliated Hospital of Kunming Medical University, Kunming, 650032, China

*Corresponding Author: Sha Yong

Keywords: Artificial knee replacement; Delayed popliteal arteriovenous fistula; Thrombus

Abstract: Objective: To investigate the incidence of delayed popliteal arteriovenous fistula after total knee arthroplasty. Methods: Twenty-four patients (30 knees) who had undergone total knee arthroplasty were retrospectively analyzed, and the diagnostic measures of delayed popliteal arteriovenous fistula after total knee arthroplasty were summarized. Results: One patient had swelling of the lower leg on the first day after operation, which was confirmed by Doppler ultrasound as gastrocnemius venous plexus thrombosis (distal thrombus), and no delayed popliteal arteriovenous fistula around the thigh was found. The swelling of limbs below groin occurred in 2 cases on the third day after operation, which was confirmed by Doppler ultrasound to form delayed iliac arteriovenous fistula. No case died of pulmonary embolism. Eight patients who only received anti-infection treatment were not effectively controlled after 8 weeks of treatment, and the patients showed signs of recurrence of infection; After debridement, 12 patients took out the prosthesis, and after anti-infection treatment, they were given knee replacement again, and the postoperative effect was good Infection was effectively controlled in 2 patients undergoing knee arthrodesis. Conclusion: The incidence of delayed popliteal arteriovenous fistula after total knee arthroplasty is high, so we should be alert to the occurrence of delayed popliteal arteriovenous fistula after total knee arthroplasty.

1. Introduction

Delayed popliteal arteriovenous fistula after total knee arthroplasty mainly includes deep vein formation of lower limbs and pulmonary embolism. Delayed popliteal arteriovenous fistula of lower limbs refers to abnormal coagulation of blood flowing in deep veins of lower limbs, blocking the lumen, resulting in venous reflux disorder, resulting in a series of pathophysiological changes and clinical symptoms [1]. Pulmonary embolism is often secondary to delayed popliteal arteriovenous fistula, which is one of the serious complications after major orthopedic surgery such as artificial knee replacement.

Total knee replacement is a safe and effective method to relieve pain and rebuild function for knee joint diseases which are ineffective in conservative treatment. Although the success of the operation is related to many factors such as the patient's health, prosthesis type, surgeon's technology and experience, surgical facilities, etc., it is generally an operation with low operation risk and very high success rate, and its 15-year success rate has exceeded 90% [2-3]. Therefore, it is particularly important to prevent and nurse the formation of delayed popliteal arteriovenous fistula after knee replacement. In order to prevent the occurrence of this complication, our department has taken a series of relevant effective preventive and nursing measures and achieved remarkable curative effect, which is reported as follows.

2. Materials and methods

2.1. General information

There were 24 patients (30 knees), including 11 males (14 knees) and 13 females (16 knees). The

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age ranged from 65 to 82 years, with an average of 70.5 years. There were 20 cases of senile osteoarthritis (24 knees) and 2 cases of rheumatoid arthritis (4 knees). Past medical history: 9 cases of diabetes, 10 cases of hypertension, 9 cases of coronary heart disease and 2 cases of cerebral infarction.

2.2. Surgical methods

2.2.1. Surgical approach

Medial para-skeletal approach, medial femoral muscle approach and median approach are often used. Two cases of serious valgus deformity of knee joint were treated by lateral paraskeletal approach. The joint part of quadriceps femoris was cut along the longitudinal axis in the medial 1/3 of quadriceps femoris leg, and wound around the inner edge of the skeleton near the bone stop point of the medial femoris muscle (pay attention to keep a little skeleton key tissue at the inner edge of the skeleton, so as to suture the joint capsule after operation, and extend distally along the inner edge of the skeleton ligament to the inner lower edge of the tibial tubercle to open the joint cavity. The advantage of this approach is that it can provide good exposure, and there are few complications of tibia and femur.

The lateral incision of joint capsule was made by lateral parasagittal approach: the tibial tubercle was 1.5cm away from the incision, and the distal end was 5cm away from the tibial tubercle. The tibial tubercle was amputated and everted together with the bones. After cleaning the synovium and osteophyte in the joint, osteotomy and soft tissue balance were performed according to different joint damage conditions, and the prosthesis was fixed with antibiotic bone cement.

2.2.2. Replacement of bones

There were 30 knees in 24 patients with bone replacement. Although it has not been reported that post-skeletal replacement increases the risk of fracture of bones, some studies have confirmed that if the thickness of bones is less than 14mm after operation, the tensile strength of bones will decrease by about 50%, so the risk of bone avulsion and fracture will increase obviously. Under the condition of current technical level, it is considered that for bones with good shape and good movement trajectory, better results can be achieved by using bone plasty instead of bone replacement, especially for bones of WibergI type and II type, which should be kept as much as possible, and whether to perform bone replacement should be decided after both femoral prosthesis and tibial prosthesis are implanted into knee joint.

2.2.3. Perioperative management

Full-length standing films of both lower limbs and frontal and lateral films of affected knees were taken before operation. Adequate preoperative design can guide accurate osteotomy during operation. Antibiotics were used two hours before operation, and there were no special cases until 7-10 days after operation. Please consult relevant departments for adjustment of accompanying diseases before operation. Return to ICU intensive care unit for 24 hours after operation. Drainage was pulled out 48 hours after operation, and it could be kept for 72 hours according to the situation. From the first day to the third day after operation, the patients were mainly rested. Step on your feet above the knee joint, bandage them with elastic bandage, and slightly raise your legs. At the same time, instruct the patient to do isometric contraction of quadriceps femoris, straight leg elevation exercise and pump stepping exercise.

2.3. Evaluating indicator

According to the symptoms of edema, pain, cyanosis, paresthesia and skin temperature decrease of the lower limbs after artificial knee replacement, and according to the auxiliary examinations such as color Doppler ultrasound of the lower limbs, it is comprehensively judged whether the patients have delayed popliteal arteriovenous fistula of the lower limbs. When chest pain, dyspnea, hemoptysis, cough, palpitation, fatigue, cyanosis, syncope, hypotension and even shock suddenly occur after delayed popliteal arteriovenous fistula, pulmonary artery angiography is performed to determine whether pulmonary embolism occurs.

2.4. Statistical method

Measurement data is expressed by mean standard deviation ($\overline{x} \times s$), and counting data is expressed by rate (%). T-test was used for comparison of sample mean, and χ^2 -test was used for univariate analysis.

3. Result

One patient developed leg swelling on the first day after operation, which was confirmed by Doppler ultrasound as gastrocnemius venous plexus thrombosis (distal thrombus), and no delayed popliteal arteriovenous fistula around the thigh was found. The swelling of limbs below groin occurred in 2 cases on the third day after operation, which was confirmed by Doppler ultrasound to form delayed iliac arteriovenous fistula. No case died of pulmonary embolism.

Eight patients who only received anti-infection treatment were not effectively controlled after 8 weeks of treatment, and the patients showed signs of recurrence of infection; After debridement, 12 patients took out the prosthesis, and after anti-infection treatment, they were given knee replacement again, and the postoperative effect was good Infection was effectively controlled in 2 patients undergoing knee arthrodesis.

4. Discussion

It is reported that the incidence of delayed popliteal arteriovenous fistula after total knee arthroplasty is as high as $40\% \sim 70\%$ without any preventive measures [4]. Data [5] showed that $55\% \sim 66\%$ of delayed popliteal arteriovenous fistula complicated with pulmonary embolism, while $80\% \sim 90\%$ of pulmonary embolism originated from delayed popliteal arteriovenous fistula. At present, the incidence of pulmonary embolism ranks the third in the world in the mortality rate of all diseases, second only to tumor and myocardial infarction [6], and the mortality rate of untreated or delayed treatment is $25\% \sim 30\%$ [7], so pulmonary embolism is a common disease with high mortality rate.

For patients with severe knee joint deformity, it is usually necessary to pay attention to whether it is caused by bone defect and bone deformity or ligament relaxation. Most severe deformities are multiplanar, and attention must be paid to correcting the full-length force line of lower limbs in total knee replacement. Only using compensatory osteotomy of tibia should pay attention to the balance of medial and lateral collateral ligaments of knee joint. The medial collateral ligament release should be considered for the deformity caused by ligament relaxation. If necessary, it is better to consider the slippage of lateral band bone. For tri-plane deformity, we must pay attention to whether the mechanical axis is offset, especially the influence of hip and ankle deformity on knee joint dynamics. If necessary, the femoral prosthesis should be placed by external rotation. To solve the problem of line alignment caused by partial mechanical shaft offset [8].

Arteriovenous fistula of lower limbs is usually closed by surgery, but in this case, due to poor local skin condition and two infected wounds, surgery can only amputate. After interventional therapy, the fistula was sealed, the circulation of left leg was improved, the wound healed, and the limb function was basically restored; The enlargement of heart caused by long-term hyperdynamic circulatory state gradually retracts, and mitral regurgitation caused by enlargement of left ventricle and expansion of mitral annulus also decreases. The popliteal artery is located behind the knee joint, and the popliteal artery stent has adverse effects on the flexion of the normal knee joint. Meanwhile, the flexion of the normal knee joint will also affect the stability of the stent shape and cause damage to the intima of blood vessels. In this case, the movement of left knee joint was limited due to trauma, which reduced the adverse effects of stent on blood vessels, and the clinical treatment effect was satisfactory.

The main causes of delayed popliteal arteriovenous fistula are blood hypercoagulable state,

venous blood stasis and venous intimal injury caused by activation of coagulation mechanism. The high incidence of delayed popliteal arteriovenous fistula after total knee arthroplasty is related to the following factors [9-10]: (1) Knee joint injury, lower limb movement decreased obviously, the application of balloon tourniquet in operation, long-term knee flexion operation, local swelling after operation and further reduction of limb activity caused blood stasis in lower limb veins. (2) Thermal polymerization of bone cement, which damages local vascular endothelial cells and activates various tissue factors related to coagulation mechanism. (3) After operation, antithrombin iii decreased and endogenous fibrinolytic system was inhibited. Therefore, how to avoid the above three causes during perioperative period is the key to prevent the formation of delayed popliteal arteriovenous fistula.

In the past, knee arthrodesis was considered as the best treatment for knee joint infection. Some studies have pointed out that knee arthrodesis and secondary revision surgery are comparable in curative effect and can effectively control infection; It is the key to the success of the operation to fully align the cancellous bone with blood supply when performing joint fusion; In order to avoid re-infection after arthrodesis, external fixation is generally used, but it is not very reliable, and internal fixation is relatively reliable, which improves the success rate of arthrodesis, depending on the patient's condition and economic level. In this study, 2 patients have low requirements on joint function and limited economic strength. After evaluating their condition, they were given arthrodesis to control infection, and the postoperative effect was good.

5. Conclusions

In a word, the incidence of delayed popliteal arteriovenous fistula after total knee arthroplasty is high, so we should be alert to its occurrence, diagnose as early as possible and treat it in time, so as not to delay the disease and cause serious consequences.

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