INFECTIONS AFTER RECONSTRUCTIONS OF ANTERIOR CRUCIATE LIGAMENT

Vladimir RISTIĆ1, Mirsad MALJANOVIĆ₁, Vladimir HARHAJI2,3, and Miroslav MILANKOV2,3

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General Hospital Subotica, Department of Orthopedics and Traumatology1
Clinical Centre of Vojvodina, Novi Sad, Department of Orthopedics and Traumatology2
University of Novi Sad, Faculty of Medicine3

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SUMMARY
Introduction. Infections after anterior cruciate ligament reconstructions are rare, but, on the other hand, they are difficult to be treated. The aim of this study was to analyze causes of infections, risk factors, diagnostics, and possibilities of their prevention. Material and Methods. Seventeen deep infections (1.2%) were found in 1425 patients who had undergone anterior cruciate ligament reconstructions. Fifteen patients were males and two were females. Out of 475 professional athletes nine (1.9%) had this postoperative complication. Eleven patients with septic arthritis had immunosuppressive diseases. Results. Staphylococcus aureus was isolated in eleven cases (65%), other Staphylococcus and Streptococcus groups were found in four and three patients, respectively; while one patient had infection although the punctate was negative. Out of 965 patients with the patellar tendon grafts, ten (1.03%) had this complication, while the incidence was 1.52% (7/460) in those with the hamstring grafts. Fifteen infections were acute with obvious symptoms within 14 days after surgery. Severe pain, limited range of motion, swelling of the knee joint and fever were the most common symptoms, while rubor and pus developed rarely. The infection was three times more frequent in the patients who had undergone surgery lasting more than 1.5 hour. Discussion and Conclusion. The following population groups are at risk of developing septic arthritis after anterior cruciate ligament reconstructions: professional athletes, those who are allergic to penicillin, and those with immunosuppressive diseases. Staphylococcus aureus is the most common cause of infection. The patients with the hamstring autografts have a higher risk than those with the patellar tendon grafts. Preventive measures that should be performed include aseptic conditions in operative rooms, irrigation of the graft before its placement into the bone tunnels, experience of surgeon and proper antibiotics.

Summary
Introduction. Uvod. Infekcije nakon rekonstrukcija prednjeg ukrštenog ligamenta predstavljaju retke, ali za lečenje teške postoperativne komplikacije, te je cilj studije analiza uzroka infekcija, definisanje faktora rizika, prikaz dijagnostike i mogućnosti prevenije navedenih komplikacija. Materijal i metode. Na uzorku od 1 425 pacijenata, kod kojih je izvršena artrskopска rekonstrukcija prednjeg ukrštenog ligamenta, zabeležili smo 17 infekcija kolenog zgloba (1,2%). Petnaest pacijenata je bilo muškog pola, a dva ženskog. Od 475 operisanih aktivnih sportista, kod njih devet (1,9%) nastala je postoperativna infekcija kolenog zgloba. Čak 11 pacijenata je bilo alergično na penicilin. Tri pacijenta imali su imunokompromitujuća stanja. Rezultati. U 11 slučajevima izolovana je bakterija Staphylococcus aureus (65%), u četiri slučaja ostale podgrupe stafilokoka, u tri streptokok, a jedan pacijent je imao duboku infekciju i pored negativnog biograma. Od 965 pacijenata gde je izbor kalema bio kost–čašična veza–kalem, njih 10 (1,03%) imalo je infekciju, dok je u grupi sa 460 operisanih kost–tetive polužilastog i vitkog mišić–kalem kalem zabeleženo 7 infekcija (1,52%). Petnaest infekcija su bile akutne, sa jasnim kliničkim znacima prvih 14 postoperativnih dana, u smislu: izrazitog bola u kolenom zglobu, ograničenja pokreta, otoka i povisene telesne temperature, a ređe su se javljali crvenilo kože i gnojni sekret. Pacijenti kod kojih je operacija trajala duže od 1,5 sata imali su tri puta češće infekcije od ostalih. Diskusija i zaključak. Rizičnu grupu pacijenata za infekciju, nakon rekonstrukcije prednjeg ukrštenog ligamenta, predstavljaju: aktivni sportist, alergični na penicilin, sa imunokompromitujućim oboljenjem. Staphylococcus aureus je najčešći uzročnik. Zabeležili smo češće infekcije kod pacijenata kojima su izbor kalema bile tetive polužilastog i vitkog mišića. Prevencija infekcija sastojala bi se od: dezinfekcije operativnog polja pre ulaska u operacionu salu, mera anti-sepske u sali, mehaničkog ispiranja kalema pre postavljanja u koštane tunele, iskustva hirurga i antibiotičke terapije.

Key words: Anterior Cruciate Ligament; Anterior Cruciate Ligament Reconstruction; Infection; Postoperative Complications; Risk Factors; Staphylococcus aureus

Sazetak
Uvod. Infekcije nakon rekonstrukcija prednjeg ukrštenog ligamenta predstavljaju retke, ali za lečenje teške postoperativne komplikacije, te je cilj studije analiza uzroka infekcija, definisanje faktora rizika, prikaz dijagnostike i mogućnosti prevenije navedenih komplikacija. Materijal i metode. Na uzorku od 1 425 pacijenata, kod kojih je izvršena arthroscopy rekonstrukcija prednjeg ukrštenog ligamenta, zabeležili smo 17 infekcija kolenog zgloba (1,2%). Petnaest pacijenata je bilo muškog pola, a dva ženskog. Od 475 operisanih aktivnih sportista, kod njih devet (1,9%) nastala je postoperativna infekcija kolenog zgloba. Čak 11 pacijenata je bilo alergično na penicilin. Tri pacijenta imali su imunokompromitujuća stanja. Rezultati. U 11 slučajevima izolovana je bakterija Staphylococcus aureus (65%), u četiri slučaja ostale podgrupe stafilokoka, u tri streptokok, a jedan pacijent je imao duboku infekciju i pored negativnog biograma. Od 965 pacijenata gde je izbor kalema bio kost–čašična veza–kost, njih 10 (1,03%) imalo je infekciju, dok je u grupi sa 460 operisanih kost–tetive polužilastog i vitkog mišić–kost kalem zabeleženo 7 infekcija (1,52%). Petnaest infekcija su bile akutne, sa jasnim kliničkim znacima prvih 14 postoperativnih dana, u smislu: izrazitog bola u kolenom zglobu, ograničenja pokreta, otoka i povisene telesne temperature, a ređe su se javljali crvenilo kože i gnojni sekret. Pacijenti kod kojih je operacija trajala duže od 1,5 sata imali su tri puta češće infekcije od ostalih. Diskusija i zaključak. Rizičnu grupu pacijenata za infekciju, nakon rekonstrukcije prednjeg ukrštenog ligamenta, predstavljaju: aktivni sportist, alergični na penicilin, sa imunokompromitujućim oboljenjem. Staphylococcus aureus je najčešći uzročnik. Zabeležili smo češće infekcije kod pacijenata kojima su izbor kalema bile tetive polužilastog i vitkog mišića. Prevencija infekcija sastojala bi se od: dezinfekcije operativnog polja pre ulaska u operacionu salu, mera anti-sepske u sali, mehaničkog ispiranja kalema pre postavljanja u koštane tunele, iskustva hirurga i antibiotičke terapije.

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Corresponding Author: Dr Vladimir Ristić, Opšta bolnica Subotica, 24000 Subotica, Izvorska 3, E-mail: ristic@tippnet.rs
Anterior cruciate ligament (ACL) injuries most frequently happen during sports activities by non-contact rotatory movement of the knee joint [1, 2]. The reconstruction of ACL is a very popular surgery in the world. Only in the United States of America, this procedure is performed more than 200 000 times per year [3], while in Vojvodina we perform around 300 reconstructions annually [4].

The percentage of these successfully performed surgeries is very high, between 80-90% [3-6]; however, the number of postoperative complications is getting higher with the increasing number of reconstructions. Septic arthritis of the knee is a rare complication after arthroscopic ACL reconstruction. It happens after less than 2% of all surgeries [3, 6].

The risk factors depend on [7]:
- the patient (immunity, diseases, allergy to antibiotics, former surgeries);
- the surgeon (choice of antibiotics, operative technique, graft manipulation, experience of early detection and choice of treatment);
- general preventive measures and treating of intrahospital (nosocomial) infections (aseptic conditions in hospitals, operating rooms, sterile surgical instruments, gloves etc.)

These infections can compromise the result of surgery and endanger the patient's health [8-11]. The importance of early diagnostics is even greater because improper diagnostics and treatment can lead to graft failure, instability, and limited range of motion of knee joint, as well as the life-threatening condition of patient [6].

The aim of this study was to determine the incidence of septic arthritis after ACL reconstructions and to analyze the symptoms, causes, and risk factors in our material.

Material and Methods

A multicentre, retrospective study, performed at the Clinical Centre of Vojvodina in Novi Sad and General Hospital of Subotica, dealt with infections after ACL reconstructions in the sample of 1425 patients. Out of 17 patients who developed infection after surgery, 15 were males (88%) and two were females (12%), their average age being 24.5 years (18-39). The infection was detected in both the left and the right knee, i.e. in nine and eight cases, respectively.

Bone-patellar tendon-bone (BTB) graft was applied in 965 patients and the choice for reconstruction in other 460 patients was bone-hamstring tendons-bone (BHB) graft.

All of the patients were treated with prophylactic antibiotics preoperatively and three days after surgery [12] (Cephalosporines of the first generation and Gentamicin).

The total sample and the sub-groups of the patients were analyzed for the causes of infection, time that lapsed from surgery to the development of clinical and laboratory sings as well as the predisposing risk factors (associated with the patient, surgical technique and preventive measures).

The results were analyzed and compared among the groups, and they are graphically presented in the further text.

Results

Septic arthritis of the knee joint developed in 17 out of 1425 patients included in the study sample (1.2%). Out of 475 professional athletes, nine (1.9%) had this postoperative complication. Eleven patients (64.7%) were allergic to penicillin. Although the majority of patients were young people, three of them had immunosuppressive diseases (infective mononucleosis, sarcoidosis and respiratory infection, each).

Ten out of 965 patients with patellar tendon grafts had this complication (1.03%), while the incidence was 1.52% (7/460) in those with hamstring grafts.

The surgeries performed by more experienced surgeons lasted on average 64 minutes. The incidence of infection was 1.1% in that group. When ACL reconstruction lasted more than 90 minutes, the incidence of infection was 3.3%.

Infections became clinically evident from three to twenty days after the surgery (the average being 7.5 days); they were acute in 15 cases within the first 14 postoperative days and sub-acute in two patients in 2-4 postoperative weeks. The most common symptoms were severe pain, limited range of motion, swelling of the knee joint, and fever (37.3-39.8 Celsius degrees), while rubor and pus from the wound occurred rarely. (Graph 1)

Laboratory screening test were performed after the symptoms had occurred. Erythrocyte sedimentation was high and ranged from 50-113 (average 87.33). C-reactive protein (CRP) ranged from 126-210 (the average being 155). The treatment of infection was discontinued when CRP was reduced to normal values (under 5).

Staphylococcus aureus was isolated in eleven cases (65%), other Staphylococcus groups and Streptococcus were found in four (epidermidis and lung-dunensis) and three patients, respectively, one patient had adenovirus infection, whereas one patient had infection although the punctate was negative.

Discussion

Anterior cruciate ligament reconstruction is a surgery with very rare complications [1]. Over the last 40 years, arthroscopic procedures have considerably reduced bleeding, scar size, operative

Abbreviations

ACL – anterior cruciate ligament
BTB – bone-patellar tendon-bone
BHB – bone-hamstring tendons-bone
CRP – C-reactive protein
MRSA – Methicillin Resistant Staphylococcus aureus

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time and provided faster rehabilitation, and return to everyday activities [1].

Infection following an ACL reconstruction is a rare postoperative complication owing to prophylactic administration of antibiotics and intra-operative drainage of the joint with a lot of fluid as well as young age of the patients and because arthroscopy is a minimally invasive technique. The prevalence of septic arthritis after ACL reconstructions is less than 2.0% [6, 13-16]. The incidence in our study sample was 1.2%, which was higher than the one reported by Indelli et al [13] (0.14%), but lower than in the sample of Ejerhed and Eriksson, which was 1.9% [15, 16]. The factors influencing infection are sterilization of the equipment, antibiotics, duration of surgery and immunological system of patients [7, 13, 14].

Initially, bacteria can be conveyed into the joint or the periarticular tissue via arthroscopy medium or instruments [7] and when they are deposited in the synovial membrane, they can cause an acute inflammatory response [17]. As the synovial membrane does not exhibit a limiting barrier, bacteria infiltrate the synovial fluid easily and cause purulent infection [17]. Therefore, the main problem is the imminent danger of infection dispersion throughout the complete joint, protracted synovitis as well as irreversible cartilage damage. An organism that is not immunocompetent, as it was the case in our three patients, is not capable of eliminating pathogens via phagocytosis by synovial cells [17]. Therefore, the influence of surgeons is limited to the choice of patients to be operated on. Fatal outcomes of ACL reconstructions are extremely rare and they are reported mostly after infections caused by Clostridium bacteria [18, 19], which was not the case in our study sample. If neglected, unsuccessfully treated, or not treated at all, infections can even endanger the patient’s life or cause severe damage to the affected joint in the form of cartilage damage, arthrofibrosis and graft failure [20].

According to a recently published study [21], professional athletes may be a part of a specific group of patients at higher risk of developing infection after ACL reconstruction. The prevalence of septic arthritis was 0.37% in the nonprofessional group and 5.7% in the professional athlete population (88 out of the total number of operated patients, which was 1957). Our results have also shown that active sportsmen are at risk of developing an infection for unknown reason, with the incidence of 1.9%. Sex was not the case in our study sample. If neglected, unsuccessfully treated, or not treated at all, infections can even endanger the patient’s life or cause severe damage to the affected joint in the form of cartilage damage, arthrofibrosis and graft failure [20].

Infections are most frequently induced by bacterium Staphylococcus, which is found in more than two thirds of cases [6, 13, 23]. This is particularly true for the subgroup Staphylococcus Aureus because it is usually found on the skin surface. This Gram-positive bacterium was the most common cause of infection in our sample as well. Its resistance to antibiotics is a serious problem nowadays [25]. Our patients were lucky not to have Methicillin Resistant Staphylococcus Aureus (MRSA). Cephalosporines of 1st or 2nd generation are sufficient to fight against Staphylococcus Aureus [25]. In case of allergy to Cephalosporines and/or incompatibility, Clindamycin can be used. Vancomycin is indicated only in terms of second line antibiotics and in case of Cephalosporine intolerance or MRSA colonization or infection [12]. From the pharmacodynamic point of view, the best moment to introduce the first antibiotic dose is 30 minutes before the skin incision [12]. In case of infection, a positive pathogen proof cannot always be found. As for our sample, the pathogen failed to be isolated only in one case, in other words, there were 94% of the positive smears and/or punctates, whereas literature data vary from 60% to 100% [7]. It is even more difficult to be found when the patient has been treated by antibiotics. Most authors [7, 12, 13, 23] agree that antibiotics therapy should be administered for at least 4-6 weeks after the antibiogram until the CRP-level is normalized [7, 10].

Analysis of erythrocyte sedimentation and white blood cell count (WBC) is only of limited diagnostic value because almost 40% of patients presenting with acute septic arthritis have normal leucocyte account [26]. In contrast, CRP is positive in more than 95% of the patients [26], which was also true for our study sample.
Proper hygiene conditions in hospital rooms and preventive aseptic measures during surgery and postoperative care can reduce infection rate. Studies self-critically reporting a system failure in sterilization technique as a cause of increased incidence of infection after ACL reconstruction (going from 0.3% to as high as 12.2%) are scarce [27]. Surgical masks, gloves, and insufficiently sterilized instruments can also be a source of graft contamination [28]. A graft implanted in the knee joint does not have initial vascularization, so antibiotics are not effective [28, 29]. Hantes et al [29] proved that seven out of 60 (12%) microbiologically examined grafts were initially contaminated, mostly with Staphylococcus, although a postoperative infection did not develop in any of these cases. Hamstring autografts do seem to have a higher risk of infection than patellar tendon grafts. The rate of contamination is higher for hamstring grafts because of the longer graft-preparation time (nineteen minutes) than for bone-patellar tendon-bone autografts (ten minutes). In hamstring group, cultures of graft tissue from four patients (13%) were positive for bacteria. In the bone-patellar tendon-bone group, cultures from three patients (10%) were positive.

Duration of surgery can affect the rate of septic arthritis, thus the incidence of infection was three times higher in our patients who had undergone surgery lasting more than 1.5 hour either because meniscus and cartilage were operated on at the same time or because the surgeons were less experienced. Other authors [15, 16, 23, 27] have also reported a higher incidence of infection in hamstring grafts than in patellar tendon grafts. Ejershed et al and Eriksson et al [15, 16] reported six cases of deep knee infections in 320 patients, five of them being among hamstring grafts and only one in patellar grafts.

Some of the authors tried to find the possibilities of preventing these infections [3, 30-32]. Molina et al [30] reported the incidence of positive cultures to be 58% when an ACL was accidentally dropped on the operating room floor. We also had two similar cases without ensuing infection because we treated those grafts in triple antibiotic solution followed by a sterile saline wash.

The similar results were recorded in another study [32] that surveyed leaders in sports medicine who perform ACL reconstructions to determine the preferred management when graft contamination occurs. Forty-seven of 196 (25%) surgeons reported at least one contamination during their career. Forty-three of 57 (75%) contaminated grafts were managed with cleansing of the graft and proceeding with reconstruction. Ten (18%) were managed by harvesting a different graft, and four (7%) were substituted with an allograft. No infections in any of the contaminated grafts were reported because cultures did not correlate with clinical infections [18]. Matava et al [31] recommended culture-specific antibiotics and surgical irrigation with graft retention as initial treatment and so did we. Irrigation is undoubtedly useful; otherwise, it would be difficult to explain why a patient without risk factors and graft contamination develops an infection while the patient having the graft, which was contaminated by being accidentally dropped on the floor of operative room, does not develop an infection.

Another report on contaminated rabbit patellar tendon grafts [3] found that a 30-minute soak in 4% chlorhexidine gluconate followed by a 30-minute soak in a triple antibiotic solution followed by a sterile saline wash was 100% effective in decontaminating grafts.

There are no proofs that fixation material affects infection [3, 33]. We fixed all grafts with titanium interference screws, because there is no difference between knee stability among bioabsorbable and metal screws. It has also been concluded that swelling of a knee joint is more common after the use of bioabsorbable screws [33].

If we know the causes and risk factors, we can try to prevent infections. Our experience shows that if the patients have the operative field disinfected in their rooms before surgery and if their graft is irrigated intraoperatively, they are less likely to develop an infection. After surgery, the surgeon must treat the wound properly and extract the drains applying all antiseptic measures.

The limitations of this study are connected with impossibility to explain why professional athletes, patients allergic to penicillin and hamstring grafts have higher rate of infections. We also have no data regarding the rates of bacterial inoculation during graft preparation. This study is comparable with other similar studies that make conditions for prevention of infections after anterior cruciate ligament reconstructions.

Conclusion

Infections after anterior cruciate ligament reconstructions are rare, but very serious postoperative complications which can result in a life threatening condition of the patients and compromise the final results of surgery.

The following population groups are at risk of developing septic arthritis after those procedures: professional athletes, those allergic to penicillin and the ones with immunosuppressive diseases. Staphylococcus aureus is the most common cause of infection. The incidence of infection is higher in patients with hamstring autografts than in those with patellar tendon grafts as well as in cases when the surgery is longer than 90 minutes.

Severe pain, limited range of motion, swelling of the knee joint and fever are the most common symptoms. The most reliable laboratory test is a high value of C-reactive protein.

The following preventive measures should be performed: aseptic preoperative treatment of operative field, aseptic conditions in operative rooms, irrigation of grafts before being placed into bone tunnels, experience of surgeon and proper antibiotics. Manipulation around the wound and extraction of drains should be performed by a surgeon.
References


