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Authors: Rocco Papalia, Andy O. Miller, Christopher Hadley

QUESTION 7: What is the optimal duration of antibiotic treatment after surgical debridement of an infected anterior cruciate ligament reconstruction (ACLR)? Should this be altered when autograft or allograft is retained?

RECOMMENDATION: Following surgical debridement of an infected anterior cruciate ligament (ACL), antibiotic treatment should be administered for four to six weeks and can be discontinued upon resolution of clinical signs and normalization of laboratory parameters. The available literature does not differentiate between retention or removal of autograft or allograft.

LEVEL OF EVIDENCE: Consensus

DELEGATE VOTE: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous, Strongest Consensus)

RATIONALE

ACLR surgery is an anatomically complex procedure with high success rates and low infection rates [1–3]. Nevertheless, the onset of an infection after reconstructive ACL surgery is a devastating complication that can cause, in a short period of time, a progressive degeneration of the articular cartilage, graft failure and loss of function of the knee [1–3]. A prompt diagnosis and correct management might reduce or even prevent these unfavorable outcomes [4]. The incidence of infection following ACLR ranges from 0.14% to 1.8% [5–8].

Arthroscopic debridement followed by antibiotic treatment is the preferred therapeutic approach in aiming to control the infection and save the graft. Indeed, satisfactory functional outcomes are achieved in several cases of septic arthritis following ACLR with a graft salvage rate of about 85% [9]. However, persistent infection, despite multiple arthroscopic debridements, requires graft removal and subsequent ACL revision surgery at a later stage [9]. The duration and the route of administration of antibiotic therapy, in particular when to switch from intravenous (IV) to enteral administration, remain controversial [4].

Even though the duration of antibiotic treatment can vary between 4 and 14 weeks, most authors agree that it should be administered for no less than 6 weeks [4,10–12]. IV administration is preferable for the first two to three weeks [3,8,13]. However, the microorganism cultured and the antibiogram together with the postoperative clinical and laboratory parameters dictate the precise duration of antibiotic treatment [14].

In a systematic review, Wang et al. [15] evaluated 17 articles that fulfilled the inclusion criteria of septic arthritis following ACLR. The authors found that the arthroscopic debridement with graft retention and IV antibiotics was the treatment of choice for infected ACLR in most studies, with delayed diagnosis and treatment being the greatest risk factors for graft removal and articular cartilage damage. Indeed, out of 176 patients included in all the studies, 86.9% (153/175) underwent arthroscopic debridement for septic arthritis. IV antibiotics were continued for an average period of 29.7 days [15]. IV antibiotics for an average of four to six weeks was recommended, which might then be changed to oral antibiotics as soon as the C-reactive protein (CRP) levels drop to nearly normal values (< 1 mg/mL) [3,10,11]. Oral antibiotics were then administrated for at least another 14 days until the CRP returned to normal [15].

Out of 176 patients present in all studies, 18.75% (33/175) underwent graft removal, but the optimal duration of antibiotic treatment was not clearly reported. In two studies, the revision surgery was performed 12 months or later after the infection had resolved [16,17]. However, in another study by Burks et al. the revision ACLR was performed within six weeks after the completion of the antibiotic therapy and after the laboratory values had returned to normal [18].

Mouzopoulos et al. [19] proposed the basic management protocol with graft retention based on IV antibiotic therapy over at least four weeks followed by oral antibiotic for two to four weeks. An extended IV antibiotic therapy was given only in patients who needed more arthroscopic lavages. However, the therapeutic management in case of graft removal or retention is not well distinguished.

Gobbi et al. [20] stated that serial arthroscopic lavages and IV antibiotics with graft retention remain the most effective treatment protocol, starting with empirical therapy at the time of presentation. IV antibiotics switch to culture-sensitive oral antibiotics as soon as the CRP levels have nearly normalized (< 1 mg/mL) for six weeks, or until normalization of clinical and laboratory parameters. The average duration of IV antibiotics ranges from 17.3 days to six weeks, followed by oral administration for up to 3.2 months [2,3,7,8,11,13,21–23].

Shuster et al. [24] created a detailed treatment algorithm in which the graft is preserved as long as possible. However, graft removal is considered in persistent infections after multiple revisions, in loosened fixation or in graft insufficiency. In patients undergoing debridement and irrigation, a chain of antibiotic (gentamicin) loaded beads was inserted, protruding through the wound to allow stepwise removal within approximately one week. Empiric antibiotic therapy (cephalosporin I or II combined with an aminoglycoside, clindamycin or rifampicin) is started and antibiotic treatment is re-evaluated every day and changed according to microbiological testing, if necessary. When patients show clinical

improvement over five to six days with consistent and substantial decreases in CRP levels, they are discharged with oral therapy and weekly follow-up examinations. The duration of antibiotic therapy is based on the individual course of each patient and antibiotic therapy is terminated when CRP levels are within normal range (< 5 mg/L) [25]. The mean duration of inpatient treatment was 16.5 ± 8.2 days (range, 4 to 45 days). The mean duration of antibiotic treatment was 5.4 ± 2.3 weeks (range, 2.1 to 12.9 weeks). In 13 patients (36%), the duration of antibiotic treatment was < 4 weeks. A maximum of two arthroscopic irrigation and debridement procedures (mean, 1.46 ± 0.52) was necessary for eradication of the infection in these patients [25].

The available evidence does not allow for drawing a conclusive recommendation regarding the optimal duration of antibiotic treatment after surgical debridement for infected ACLR. However, the literature suggests that antibiotic treatment should be followed for four to six weeks and continued until clinical conditions are improved. Moreover, the literature is still controversial on the duration of antibiotic treatment in case of graft and hardware retention or removal, focusing mainly on the former case. Furthermore, most of the authors do not differentiate between autograft and allograft, considering and treating them in the same manner.

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Authors: Giuseppe Calafiore, James Murray, Clare Taylor, Nimit Patel

QUESTION 8: Should the rehabilitation protocol be modified after surgical debridement of an infected anterior cruciate ligament reconstruction (ACLR)? If yes, what changes should be made with regards to range of motion and weightbearing status?

RECOMMENDATION: We recommend that rehabilitative treatment after surgical debridement of an infected ACLR with graft retention should not differ substantially from primary reconstruction; it should be focused on preventing stiffness and regaining motion through passive and active-assisted range of motion exercises before progressing.

LEVEL OF EVIDENCE: Limited

DELEGATE VOTE: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous, Strongest Consensus)