

### Postsurgical infection with an implant

There are many studies in this field regarding optimal treatment duration and agents in spinal implant-associated infections, but they are all retrospective with low levels of evidence. There are no up-to-date prospective and/or randomized studies published investigating the optimal duration of antibiotic treatment and the role of oral antibiotics in implant-associated spinal infections.

Most studies demonstrated successful treatment of spinal implant-associated infections with a total duration of six weeks [4–6]. If implants are not removed, reported durations of treatment are up to 12 weeks with intravenous treatment for six weeks, followed by oral antibiotic treatment for another six weeks [7,8].

Yet, regarding duration of intravenous treatment, there are no clear recommendations. Some studies treat intravenously for a prolonged time for up to four [8–10] or six weeks [4,11–13]. But there are also retrospective studies in which intravenous treatment was given for two weeks or less followed by oral antibiotics with good oral bioavailability [14]. Billieres et al. did a multivariate analysis on risk factors for relapse of infection and did not find an association with duration of total or intravenous antibiotic treatment [14]. Another study by Kowalski et al. also concluded that duration of intravenous treatment is not a risk factor for acute chronic infections [15].

### REFERENCES

- [1] Zimmerli W. Clinical practice. Vertebral osteomyelitis. *N Engl J Med*. 2010;362(11):1022–1029.
- [2] Roblot F, Besnier JM, Juhel L, et al. Optimal duration of antibiotic therapy in vertebral osteomyelitis. *Semin Arthritis Rheum*. 2007;36(5):269–277.

- [3] Bernard L, Legout L, Zurcher-Pfund L, et al. Six weeks of antibiotic treatment is sufficient following surgery for septic arthroplasty. *J Infect*. 2010;61(2):125–132.
- [4] Roehrborn AA, Hansbrough JF, Gualdoni B, Kim S. Lipid-based slow-release formulation of amikacin sulfate reduces foreign body-associated infections in mice. *Antimicrobi Agents Chemother*. 1995;39(8):1752–1755.
- [5] Viola RW, King HA, Adler SM, Wilson CB. Delayed infection after elective spinal instrumentation and fusion. A retrospective analysis of eight cases. *Spine*. 1997;22(20):2444–2450; discussion 50–51.
- [6] Kowalski TJ, Berbari EF, Huddleston PM, Steckelberg JM, Mandrekar JN, Osmon DR. The management and outcome of spinal implant infections: contemporary retrospective cohort study. *Clin Infect Dis*. 2007;44(7):913–920.
- [7] Mirovsky Y, Floman Y, Smorgick Y, et al. Management of deep wound infection after posterior lumbar interbody fusion with cages. *J Spinal Disord Tech*. 2007;20(2):127–131.
- [8] Collins I, Wilson-MacDonald J, Chami G, et al. The diagnosis and management of infection following instrumented spinal fusion. *Eur Spine J*. 2007;17(3):445–450.
- [9] Falavigna A, Righesso O, Traynelis VC, Teles AR, da Silva PG. Effect of deep wound infection following lumbar arthrodesis for degenerative disc disease on long-term outcome: a prospective study: clinical article. *J Neurosurg Spine*. 2011;15(4):399–403.
- [10] Sponseller PD, LaPorte DM, Hungerford MW, Eck K, Bridwell KH, Lenke LG. Deep wound infections after neuromuscular scoliosis surgery: a multicenter study of risk factors and treatment outcomes. *Spine*. 2000;25(19):2461–2466.
- [11] Chen SH, Lee CH, Huang KC, Hsieh PH, Tsai SY. Postoperative wound infection after posterior spinal instrumentation: analysis of long-term treatment outcomes. *Eur Spine J*. 2014;24(3):561–570.
- [12] Chaichana KL, Bydon M, Santiago-Dieppa DR, et al. Risk of infection following posterior instrumented lumbar fusion for degenerative spine disease in 817 consecutive cases. *J Neurosurg Spine*. 2013;20(1):45–52.
- [13] Maruo K, Berven SH. Outcome and treatment of postoperative spine surgical site infections: predictors of treatment success and failure. *J Orthop Sci*. 2014;19(3):398–404.
- [14] Billieres J, Uckay I, Faundez A, et al. Variables associated with remission in spinal surgical site infections. *J Spine Surg*. 2016;2(2):128–134.
- [15] Kowalski TJ, Berbari EF, Huddleston PM, Steckelberg JM, Osmon DR. *Propionibacterium acnes* vertebral osteomyelitis: seek and ye shall find? *Clin Orthop Relat Res*. 2007;461:25–30.



Authors: Gregory Schroeder, Mayan Lendner

## QUESTION 6: How long should antibiotics be continued when spinal wounds are left to heal by secondary intention?

**RECOMMENDATION:** Only standard perioperative antibiotic prophylaxis is recommended.

**LEVEL OF EVIDENCE:** Limited

**DELEGATE VOTE:** Agree: 93%, Disagree: 0%, Abstain: 7% (Super Majority, Strong Consensus)

### RATIONALE

Following spine surgery, surgical wounds are normally closed via primary intention where all tissue is fastened closed with sutures, staples, glue or some other form of closure material. In rare cases, however, wounds are left to close naturally via secondary intention. Normally, this is done in cases where the risk of persistence of infection is high or when a large gap in soft tissue exists as a result of tissue loss.

Antibiotic prophylaxis has been shown to be useful in preventing infection following spine surgery. However, no specific agent or schedule has been identified as superior over any other [1].

In a randomized, blinded, controlled study, Gupta et al. found that topical antibiotics, specifically sucralfate, increased wound healing in patients at four weeks following hemorrhoidectomy left to heal via secondary intention when compared to placebo (78% compared to 52%) [2]. In contrast, Doung et al. found that the use of trimethoprim-sulfamethoxazole in pediatric skin abscess treatment

compared to placebo did not significantly affect the recurrence of new lesions in the long term [3].

A systematic review by Norman et al. found that no robust evidence exists on the relative effectiveness of any antibiotic preparation in cases where surgical wounds have been left to heal by secondary intention [4]. There is no high-level evidence directly related to spine surgery for this topic. In general, if there is hardware present, patients often should receive at least six weeks of intravenous antibiotics and continued suppressive antibiotics until the wound heals.

### REFERENCES

- [1] Watters WC, Baisden J, Bono CM, Heggeness MH, Resnick DK, Shaffer WO, Toton JF. Antibiotic prophylaxis in spine surgery: an evidence-based clinical guideline for the use of prophylactic antibiotics in spine surgery. *Spine J*. 2009;9(2):142–146. doi:10.1016/j.spinee.2008.05.008.

- [2] Gupta PJ, Heda PS, Kalaskar S, Tamaskar VP. Topical sucralfate decreases pain after hemorrhoidectomy and improves healing: a randomized, blinded, controlled study. *Dis Colon Rectum*. 2008;51(2):231-234. doi:10.1007/s10350-007-9092-4.
- [3] Duong M, Markwell S, Peter J, Barenkamp S. Randomized, controlled trial of antibiotics in the management of community-acquired skin abscesses in the pediatric patient. *Ann Emerg Med*. 2010;55(5):401-407. doi:10.1016/j.annemergmed.2009.03.014
- [4] Norman G, Dumville JC, Mohapatra DP, Owens GL, Crosbie EJ. Antibiotics and antiseptics for surgical wounds healing by secondary intention. *Cochrane Database of Syst Rev*. 2016;3. doi:10.1002/14651858.cd011712.pub2.

● ● ● ● ●

**Authors:** Susana Núñez-Pereira, Rabih Darouiche

## QUESTION 7: What is the optimal duration of antibiotic treatment following spine infection in patients within whom hardware is retained? Is the antibiotic treatment different for those with spine infection without hardware?

**RECOMMENDATION:** There are no case-control studies allowing for an evidence-based recommendation on the optimal length of antibiotic treatment following spine infections in the presence of retained hardware. The most commonly implemented antibiotic regime is three months. However, duration of treatment was highly variable among all studies. Patients with non-instrumented surgeries did well with a shorter course of antibiotics.

**LEVEL OF EVIDENCE:** Consensus

**DELEGATE VOTE:** Agree: 93%, Disagree: 7%, Abstain: 0% (Super Majority, Strong Consensus)

### RATIONALE

After searching PubMed, CINAHL and Embase (with MeSH terms “surgical site infection,” “spine” and “antibiotic”) and reviewing 381 abstracts, a final 14 studies included treatment of spinal surgical site infection (SSI) with retained implants (including data on antibiotic treatment regimens) [1-14]. There were no studies analyzing or comparing different antibiotic regimens. Most of these studies were retrospective in nature, however one study was a prospective observational study. There were no studies comparing different antibiotic treatment regimens. There was also a wide variation in the duration of treatment among the studies ranging from 42 to 597 days in 1 study, and ranging between 89 and 1,673 days in a separate study [9,11]. These variations were usually related to treatment failure or poor control of the infection. Of 14 studies, 7 reported mean antibiotic treatments of 12 weeks or 3 months [3-6,10,13,14]. All but three studies reported on time of intravenous (IV) and oral antibiotics. The most reported mean time for IV antibiotic administration was an average of four to eight weeks in eight studies. One study reported on 81 SSIs, of which 39 were treated with suppressive antimicrobial therapy [2]. At final two-year follow-up, seven patients were still under antibiotic treatment.

Three studies reported data on patients with early and late infection [2,5,10]. Also, there were significant variations regarding the onset of infection. Some studies only reported ranges and gave no mean or median values. Of the nine studies with available mean data, mean time to onset of infection was 103.2 days. Removing an outlier with 778 days for late infection, mean time to onset of infection was 18.98 days (range of mean values was 2.9 to 54)

There was only one retrospective study analyzing the antibiotic treatment regimen in a series of 74 patients, all with implant removal (IR) [15]. Patients had a median duration of IV antibiotics of four weeks and an additional five weeks of oral antibiotic treatment. There were no comparative studies regarding different antibiotic regimens.

Regarding IR, there were two very different settings in which implants had to be removed. Of 729 SSI cases recorded in the 15 studies, implants were removed in 195 patients (26.74%). In 114 cases (15.6%), IR was performed as part of SSI treatment during the

first debridement procedure. In the remaining 81 cases (11.1%), IR was performed because of treatment failure after several debridement procedures. The fact that IR can be split into two differentiated groups makes it more difficult to compare treatment regimens. Usually, when IR was performed as the initial treatment, antibiotic regimens tended to be shorter [15]. On the other hand, when IR was performed because of treatment failure, antibiotic treatments were longer.

With regards to non-instrumented spine surgeries, Maruo et al. compared 59 non-instrumented infections with 166 instrumented cases [8]. They reported longer antibiotic treatment for instrumented cases (mean 40 days IV vs. 25.4 in non-instrumented and mean 255 days oral vs. 42). Only 10% of the non-instrumented cases needed more than one debridement compared to 28% for instrumented spine procedures. Of the non-instrumented spine surgeries, 20% were successfully treated without surgical debridement compared to only 6% of instrumented spine procedures.

### REFERENCES

- [1] Falavigna A, Righesso Neto O, Fonseca GP, Nervo M. [Management of deep wound infections in spinal lumbar fusions]. *Arq Neuropsiquiatr*. 2006;64:1001-1004.
- [2] Kowalski TJ, Berbari EF, Huddleston PM, Steckelberg JM, Mandrekar JN, Osmon DR. The management and outcome of spinal implant infections: contemporary retrospective cohort study. *Clin Infect Dis*. 2007;44:913-920. doi:10.1086/512194.
- [3] Mirovsky Y, Floman Y, Smorgick Y, Ashkenazi E, Anekstein Y, Millgram MA, et al. Management of deep wound infection after posterior lumbar interbody fusion with cages. *J Spinal Disord Tech*. 2007;20:127-131. doi:10.1097/01.bsd.0000211266.66615.e5.
- [4] Hong HS, Chang MC, Liu CL, Chen TH. Is aggressive surgery necessary for acute postoperative deep spinal wound infection? *Spine*. 2008;33:2473-2478. doi:10.1097/BRS.0b013e3181894ff0.
- [5] Sierra-Hoffman M, Jinadatha C, Carpenter JL, Rahm M. Postoperative instrumented spine infections: a retrospective review. *South Med J*. 2010;103:25-30. doi:10.1097/SMJ.0b013e3181c4e00b.
- [6] Dubée V, Lenoir T, Leflon-Guibout V, Briere-Bellier C, Guigui P, Fantin B. Three-month antibiotic therapy for early-onset postoperative spinal implant infections. *Clin Infect Dis*. 2012;55:1481-1487. doi:10.1093/cid/cis769.
- [7] Ahmed R, Greenlee JDW, Traynelis VC. Preservation of spinal instrumentation after development of postoperative bacterial infections in patients undergoing spinal arthrodesis. *J Spinal Disord Tech*. 2012;25:299-302. doi:10.1097/BSD.0b013e31821fbf72.