Sweat Contamination Induced Surgical Site Infections After Spine Surgery: Three Case Reports and Literature Review

Yuhang Ma
Second Affiliated Hospital of Soochow University https://orcid.org/0000-0001-7519-0564

KELV SHEN
Second Affiliated Hospital of Soochow University

DUANRONG WU
Second Affiliated Hospital of Soochow University

ZHENGFENG LU (lzf@suda.edu.cn)
Second Affiliated Hospital of Soochow University https://orcid.org/0000-0001-9644-6039

Case report

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Abstract

Background:

Surgical site infection (SSI) is one of the most intractable complications following spine surgery during the early postoperative stage. Elderly (age > 70 years), body mass index > 30, smoking, diabetes mellitus, coronary artery disease, chronic obstructive pulmonary disease, anemia, low serum albumin, operation time > 3h, and perioperative blood loss > 500 ml are the common risk factors of SSI after spine surgery. However, there are few published reports about sweat contamination induced surgical site infections with *Staphylococcus epidermidis* up to date. *Staphylococcus epidermidis* is a permanent member of the normal human microbiota and has emerged as an important opportunistic pathogen in SSI. We aim to detect the influence of sweat infiltration on SSI with *Staphylococcus epidermidis* and effective management.

Case presentation:

A 73-year-old male, a 54-year-old male and a 73-year-old female were admitted to our hospital. All of them underwent posterior compression and fusion surgery with internal fixation and got surgical site infection after primary surgery. Two of them suffered moderate surgical site infection while the third patient with comorbidities suffered severe surgical site infection. Antibiotic therapy and debridement with internal fixation retained were utilized during which microbiological culture were taken. The moderate infection patients got fully recovered after debridement and primary suture while the serious one had recurrence after the first debridement, and then the second operation was performed. SSI, however, relapsed after three days. Vacuum-assisted closure (VAC) system was replaced in the third debridement. The severe patient got well recovered and discharged after displacement of VAC system.

Conclusion:

Sweat-contaminated is an inducement of SSI with *Staphylococcus epidermidis* that should attract surgeons' attention. For mild infection, changing dressing and infrared treatment can achieve good results. For moderate infection, one debridement and primary suture are enough. For severe infection, early application of VAC system can reduce the number of debridement and achieve good clinical outcome.

Background

Surgical site infection (SSI) is one of the most intractable complications following spine surgery during the early postoperative stage. SSI rates have been reported to be 0.7%-12.0%[1,2]. SSI is divided into superficial, deep, and organ/space infection according to the United States Center for Disease Control and Prevention. Deep and organ/space SSI after posterior spinal instrumentation presents a treatment dilemma for surgeons in terms of how to completely eliminate bacteria and retain spinal instrumentation[3]. Despite efforts to reduce spinal surgery-related infection rates, complications are

common and significantly increased by patient comorbidities. With the advent of implanted medical devices, *Staphylococcus epidermidis* has emerged as an important opportunistic pathogen in patients receiving medical devices, causing approximately 20% of all orthopedic device-related infections (ODRIs). Elderly (age > 70 years), body mass index > 30, smoking, diabetes mellitus, coronary artery disease, chronic obstructive pulmonary disease, anemia, low serum albumin, operation time > 3h, and perioperative blood loss > 500 ml are the common risk factors of SSI after spine surgery. However, there are few published reports about sweat contamination induced surgical site infections with *Staphylococcus epidermidis* up to date. *Staphylococcus epidermidis* is a permanent member of the normal human microbiota, commonly found on skin, and mucous membranes[4]. In this report, 3 cases are presented in which sweat contamination may be the main cause of surgical site infection with *Staphylococcus epidermidis* and hypoproteinemia, diabetes mellitus, electrolyte disturbance can aggravate infection.

The patients were informed that data concerning the three cases would be submitted for publication, and they provided consent.

Case Reports

2 Moderate SSI cases:

A 73-year-old male with lumbar disc herniation and a 59-year-old male with spinal cord injury were admitted to our hospital for posterior spine surgery. The two patients received 2g intravenous Cefazolin intraoperatively. Their index surgeries were uneventful and stable fixation was achieved. Pedicle screws were utilized. The wound was irrigated and closed in a routine fashion. Following the surgery, the patients received antibiotic therapy for 48 hours and discharged six days later. The patients returned 1 weeks after discharge and their incision presented delayed healing. The 73-year-old patient's dressing was soaked by sweat on the way home and did not change in time. The 59-year-old patient did not change the dressing in time due to limited physical activity caused by spinal cord injury. There were purulent secretions within the incision but no redness, swelling, heat and pain. Laboratory investigations indicated that white blood cell, neutrophils and C-reactive protein were elevated but not significant, and culture was taken immediately. The patients underwent operative irrigation and debridement with retention of hardware under general anesthesia. Specimens for microbiological culture were taken intraoperatively from infected tissue. A small amount of necrotic tissue and edema granulation tissue were found in the wound during debridement which were removed followed by irrigation of povidone iodine, hydrogen peroxide, saline and promethazine and the fixation system was clean. After placing the drainage, the wound was sutured. The Gram staining procedure identified gram-positive cocci, while microbiological culture from the preoperative and intraoperative revealed the same strain of methicillin-sensitive *Staphylococcus epidermidis*. Intravenous cefoperazone was administered. CRP and ESR levels were normal level at 1 week after the surgical treatment for SSI and the incision healed well. Both of them maintained a good

clinical outcome of the initial surgery after discharge until the final follow-up at 6 months postoperatively without recurrence of SSI.

1 Severe SSI case:

A 73-year-old female with lumbar spinal stenosis, hypertension and diabetes mellitus was admitted to our hospital. She reported persistent pain in her waist and intermittent claudication. Magnetic resonance imaging revealed lumbar spinal stenosis of L4-5. We performed TLIF and immediately after the surgery, her preoperative clinical symptoms improved. The patient, however, developed serious hypokalemia and hypoalbuminemia due to vomiting. She discharged 1 week later during which sweat soaked dressing because of hot weather.

At two weeks postoperative, spontaneous dehiscence of the surgical wound and purulent exudate from the opened portion of the wound were observed. Laboratory investigations were notable for 41 mm/h Erythrocyte sedimentation rate, with 172.4 mg/L CRP, 84% neutrophils,13.2◊10^9/L white blood cell count and 0.055 ng/ml procalcitonin. She subsequently underwent operative irrigation and debridement with retention of hardware under general anesthesia. There were large amounts of necrotic tissue and edema granulation tissue and the infected tissues and pus were taken for culture. Intravenous vancomycin was administered postoperatively until the culture results showed the strain of methicillin-sensitive *Staphylococcus epidermidis* and the sensitive antibiotics was administered to replace vancomycin. Potassium supplement, nutritional therapy and anti-infection were performed at the same time. the purulent exudate from the opened portion of the wound was observed again and the second debridement was performed. Three days after second debridement the patient's wound still had purulent secretion. We decided to perform the third debridement with placement of VAC system. During the operation, the surgical site was adequately exposed and then the infected tissues and pus were taken for culture. After a complete removal of infected and necrotic tissues, the wound was repeatedly irrigated with large amounts of hydrogen peroxide, normal saline, and iodine volt solution. After thorough debridement and irrigation with implant retention, two inflow tubes were placed under the deep fascia for continuous irrigation, and the other two outflow tubes were placed for drainage. A VAC foam was applied to fully cover the surgical site area with inflow and outflow tubes come out of the skin, followed by placement of an occlusive transparent film over the incision and surrounding wound area to make an airtight wound seal. The suction tube attached to the VAC foam was then connected to a suction device with a continuous negative pressure of 75 mmHg. 3000 ml normal saline was applied for irrigation per day after surgery. Intravenous levofloxacin was administered postoperatively based on the results of previous bacterial culture and antibiotic susceptibility testing. Meanwhile, the patient's diabetes mellitus, hypokalemia, and hypoproteinemia were also corrected. Postoperative laboratory investigations showed the patient's procalcitonin, white blood cell count, erythrocyte sedimentation rate gradually returned to normal. Two weeks after the third debridement, the drainage was clear and the bacterial culture of the drainage was negative for three consecutive times, the VAC system was removed, the continuous irrigation was terminated, and the inflow tubes were transformed into drainage tubes, and then the incision was second-stage sutured. Two days after the operation, the 24h drainage volume was less than

50 ml, all the tubes were removed. 1 week after the third debridement the patient's hypokalemia and hypoalbuminemia got corrected. The patient discharged and maintained a good clinical outcome of the initial surgery until the final follow-up at 6 months postoperatively without recurrence of SSI.

Discussion

According to previous reports, there are several risk factors of SSI. Hang Shi et al. investigated 21 patients with SSI and found that elderly (age > 70 years), body mass index > 30, smoking, diabetes mellitus, coronary artery disease, chronic obstructive pulmonary disease, anemia, low serum albumin, operation time > 3h, and perioperative blood loss > 500 ml were the risk factors of SSI after spine surgery[5]. Lin Zhang et al suggested that female sex, diabetes, obesity, BMI, pronged operation time, prolonged hospital stay, hypertension, and previous surgery were risk factors for SSI in patients who had undergone lumbar spinal surgery, whereas, current smoking, ASA grade > 2, increased age, COPD, cardiovascular disease, rheumatoid arthritis, and osteoporosis were not[6]. Bcc-R et al showed that open wound, wound drainage, wound contamination and a long hospital stay may increase the risk of wound infection[10]. All of the three patients we studied had at least one of the above risk factors, like diabetes mellitus or hypertension, but the mainly predisposing factor was sweat infiltration. If the patient has multiple risk factors, he may suffer more severe infection such as the severe case of the report. The serious diabetes mellitus, hypokalemia, and hypoproteinemia can increase the recurrence rate and severity of SSI. Striving to correct these disorders is crucial to prevent and treat SSI.

SSI is divided into superficial, deep, and organ/space infection according to the United States Center for Disease Control and Prevention[1]. In our opinion, superficial SSI can be considered as mild infection which can get well recovery by changing dressing and infrared treatment. Moderate and severe infection are deep wound SSI and can be classified by the infected tissues and pus observed in the debridement. A small amount of necrotic tissue and edema granulation tissue were found in the wound during debridement of moderate cases while there were a large amount of necrotic tissue and edema granulation tissue in severe case. The fixation systems of all three cases were clean and no pus attached. Implant retention may prevent bacterial eradication because of the presence of biofilm on metal hardware, which diminishes the effect of antibiotics[7]. The 3 cases in this article, we all performed surgical debridement with the retention of hardware which had few influences on debridement and prognosis. It is not recommended to remove the internal fixation in early SSI. There were no necrotic tissues adhesion and recontamination on internal fixation system. We advocate that debridement with retention of internal fixation may not increase the risk of recurrence of SSI and can achieve good curative effect on primary disease. If the hardware is removed before graft fusion, in an attempt at infection control, the result may be spinal instability, causing clinical symptoms of backache, radicular pain, or neurologic deficits[8].

Staphylococcus epidermidis is a permanent member of the normal human microbiota and has emerged as an important opportunistic pathogen in SSI. *Staphylococcus epidermidis* is weak, and the patient has

no redness, swelling, heat and pain[4]. Laboratory investigations indicated that white blood cell, neutrophils and C-reactive protein were elevated but not significant. The infected wound after debridement was sutured for one stage in these moderate infection patients. For these patients having risk factors, we advocate that VAC system should be placed in the first surgical debridement to decrease reoperation rates. VAC system can improve local microcirculation, remove necrotic tissues and inflammatory factors, decrease the bacterial adhesion and recontamination[9]. Such as the severe infection patient, we performed debridement and sutured for one stage according to past experience. The infection, however, relapsed in three days after debridement. Potassium supplement, nutritional therapy and anti-infection were performed after analyzing the risk factors. The second debridement was performed in 1 week after the first one. The infection recurred again unexpectedly. We were in trouble to solve the problem. The third debridement was performed in 1 week and the VAC system was applied which achieved good clinical outcome.

Conclusion

Sweat contamination is an inducement of SSI with *Staphylococcus epidermidis*. hypoproteinemia, diabetes mellitus, electrolyte disturbance can aggravate infection.

For mild infection, changing dressing and infrared treatment can achieve good results. For moderate infection, one debridement and primary suture are enough. For severe infection, early application of VAC system can reduce the number of debridement and achieve good clinical outcome. Striving to correct comorbidities is crucial to prevent and treat SSI.

Abbreviations

SSI: surgical site infection

TLIF: transforaminal lumbar interbody fusion

VAC: vacuum-assisted closure

Declarations

Ethics approval and consent to participate:

The patients were informed that data concerning the three cases would be submitted for publication, and they provided consent.

Availability of data and materials:

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests:

The authors report no conflicts of interest in this work.

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Authors' contributions:

YHM was a major contributor in writing the manuscript.

KLS substantively revised the work.

DRW made contributions to acquisition and analysis of data.

ZFL designed of the work and is the corresponding author of the work.

All authors read and approved the final manuscript.

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