Vacuum-Assisted Closure in Patients with Post-operative Infections after Instrumented Spine Surgery: A Series of 12 Cases

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Abstract

Introduction: Post-operative wound infections after spinal surgery is a very serious problem, leading to a risk of significant morbidity which may even lead to prolonged hospitalization. Various treatment protocols have been recommended for debridement, antibiotic, and soft-tissue management, but with mixed results. However, the risk of morbidity is still high with these treatment options. Vacuum-assisted closure (VAC) system has been gaining popularity recently in the management of subacute, acute, and chronic wounds. This study aims to review the use of the indigenous VAC in the management of deep infections after spinal instrumentation surgery.

Case Series: Between 2010 and 2015, 12 out of 514 patients who developed a deep infection after spinal surgery, were selected and reviewed retrospectively at multiple centers (MGM Hospital, Kamothe and Center for Orthopaedic & Spine Surgery, New Panvel, Navi Mumbai, India). Out of 12 patients, one of the patients needed a partial implant exchange although none of the cases needed complete implant removal. All patients had achieved clean closed wounds along with a retention of the instrumentation. There was no need for flap surgery to cover wound defect in any case. However, antibiotic treatment was necessary in all cases. None of the patients showed a new infection after the treatment.

Conclusion: The study demonstrates the usefulness of VAC therapy as an alternative management for wound conditioning of a back wound with the high complexity in nature after instrumented spine surgeries as it eliminates complex secondary surgeries, prolong use of antibiotics and removal of the implants.

Keywords: Spinal infection, wound closure, vacuum-assisted closure.

Author’s Photo Gallery

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Introduction

Post-operative wound infections after spinal surgery is a very serious problem, leading to a risk of significant morbidity which may even lead to prolonged hospitalization. The rate of post-operative infections after spine surgery observed in literature is between 0.4% and 20% [1, 2, 3, 4, 5]. Furthermore, this rate is found to be increased with an increase in complexity of the performed procedure [6, 7, 8].

Till date, many treatment protocols have been recommended for debridement, antibiotic, and soft-tissue management, but with mixed results [9, 10, 11, 12]. However, the risk of morbidity is still high with these treatment options.

With that said, the use of the wound vacuum-assisted closure (VAC) procedure (Triage Meditech) has been gaining popularity recently, in the management of subacute, acute, and chronic wounds (Fig. 1) [13, 14, 15, 16, 17]. The controlled application of subatmospheric pressure dressing (SPD) in the VAC, not only helps the formation of granulation tissue but also, assists in the debridement of necrotic tissue and acts as a sterile barrier. Increasing usage of the VAC procedure for the complex soft tissue injuries has shown an accelerated wound healing as compared to that of traditional methods [16, 18, 19, 20].

This study aims to review the use of the indigenous VAC system in the management of deep infection after spinal instrumentation surgery. It retrospectively analyzes a series of deep subfascial infection after instrumented spine surgeries operated over a period of 5 years which have been managed by VAC. This is primarily based on the concept of temporary tissue coverage and reduction of dead space and secondary closure of the wound. It demonstrates the usefulness of VAC therapy as alternative management for wound conditioning of back wound after instrumented spine surgeries. It eliminates the need of implant removals and helps to salvage instrumented spine. It may also avoid the necessity for complex plastic surgeries and reoperation later.

Case Series

Materials and methods

Between May 2010 and 2015, spinal surgeries were performed in 514 patients at our institution. The ethical approval was done from the Institutional Ethics Committee. Indications for surgery were spine fractures, spinal fusion procedures for spondylolisthesis in degenerative diseases, instrumentation for Koch’s spine, and sagittal and coronal spinal deformity correction procedures.

A total of 12 patients developed a deep infection (2.3%) and were reviewed retrospectively in this study. The physical and medical notes, history of previous surgeries, pre-operative admission history, risk factors, and comorbidities of all 12 patients were recorded. The time interval between the surgery and the occurrence of infection was noted. In addition, the other data - such as duration of the surgery, the operative surgical and anesthetic reports, estimated blood loss and transfusion number, and pre-operative antibiotic prophylactics which were given - were also noted. The infection was monitored throughout by microbiological analysis of the etiological organism and by the number of debridement.

Average duration of the post-operative antibiotic treatment and the time required for secondary closure from the day of VAC application was also recorded. All cases of VAC applications were done under aseptic condition in operation theater. Decision was made to close wound secondarily after adequate granulation tissue formation on wound. Delayed suture removal was done at an interval of 3 weeks.

All patients were received intravenous antibiotics (amikacin 750 mg and cefuroxime 1.5 g) after indexed surgery as prophylactic antibiotics. Antibiotic therapy was continued without changing to different doses or drugs until culture and sensitivity reports were obtained from intraoperative samples. Specific antibiotic therapy was then given based on reports of culture and sensitivity. The decision to use the VAC system was done by the surgeon (author) on basis of the underlying disease and the macroscopic appearance of the wound.

The VAC system includes black polyurethane soft foam which is cut to fit the cavity of the wound and then placed to fill the entire wound area, i.e., dead space in various layers if necessary. A transparent adhesive fluid- and gas-impermeable plastic film is pasted over the foam and about of the wound surroundings to make a wound seal. A hole is then cut in the center, and a specific designed adhesive TRAC-PAD is fixed over it. The latter is then attached to a suction tube through a container with a suction pump which is adjustable. A negative pressure of 125 mmHg is continuously generated which leads to a uniform negative pressure all over the collapsed foam which brings the wound fluid into the foam and the container from the wound (Fig. 1 and 2) [21].

Results

Of the 514 patients, 12 were patients treated for surgical site infections suggesting an incidence rate as 2.3%. The mean age of the infected patients

![Figure 1: Wound vacuum-assisted closure system (Triage Meditech).](image1)

![Figure 2: Vacuum-assisted closure system generated negative pressure helping in closure.](image2)
### Table 1: Wound management with VAC in post-operative infections

| Case No. | Sex/Age (years) | Diagnosis | Initial procedure | Organism isolated | Post-operative day of infection | VAC duration days | Number of VAC changes and number of debridement | Initial IV antibiotic therapy (after culture and sensitivity) | Oral antibiotic therapy | Duration of IV antibiotic therapy (weeks) | Duration of oral antibiotic therapy (weeks) |
|----------|-----------------|-----------|-------------------|-------------------|-------------------------------|-----------------|-----------------------------------------------|-------------------------------------------------|---------------------|------------------------------------------|------------------------------------------|
| 1        | M/55            | Spinal stenosis | TLIF+posterior fusion | MRSA             | 14                            | 9               | 2                              | Cefuroxime linezolid                                  | Linezolid            | 1                                        | 2                                        |
| 2        | M/38            | Spondylolisthesis | TLIF posterior fusion | E. coli          | 14                            | 5               | 1                              | Cefuroxime moxifloxacin                                | Linezolid, moxifloxacin | 1                                        | 2                                        |
| 3        | M/45            | Kyphosis/ank spond | PSO with posterior instrumentation | E. coli, Azonobacter | 14                            | 21              | 3                              | Meropenem                                           | Linezolid            | 2                                        | 2                                        |
| 4        | F/13            | Congenital scoliosis | VCR with posterior fusion | E. coli          | 14                            | 7               | 2                              | Imipenem                                             | Linezolid            | 1                                        | 2                                        |
| 5        | M/55            | L1 chance fracture | Posterior fixation | MRSA             | 14                            | 14              | 2                              | Meropenem                                             | Linezolid            | 1                                        | 2                                        |
| 6        | M/50            | PID with instability | TLIF posterior fusion | E. coli          | 7                             | 7               | 1                              | Cefuroxime                                           | Rifampicin           | 1                                        | 2                                        |
| 7        | M/70            | Koch’s spine | Posterior instrumentation | E. coli          | 10                            | 7               | 1                              | Linezolid                                            | Rifampicin, Linezolid | 1                                        | 3                                        |
| 8        | M/55            | Pid with instability | TLIF+posterior fusion | E. coli          | 7                             | 7               | 1                              | Meropenem                                             | Ferropenam           | 1                                        | 2                                        |
| 9        | F/49            | Spondylolisthesis | TLIF+posterior fusion | MRSA             | 9                             | 12              | 1                              | Pipracillin linezolid                                  | Linezolid            | 2                                        | 6                                        |
| 10       | F/60            | Koch’s spine | Posterior decompaction and fusion | MRSA             | 19                            | 12              | 4                              | Ampicillin/sulbactam                                   | Teicoplanin          | 7                                        | 5                                        |
| 11       | F/54            | Koch’s spine | Posterior decompaction and fusion | MRSA             | 15                            | 21              | 3                              | Meropenem                                             | Rifampicin           | 2                                        | 6                                        |
| 12       | F/51            | D12 brust fracture spine | Posterior pedicular screw fixation | E. coli          | 45                            | 24              | 4                              | Meropenem                                             | Rifampicin, Ferropenam | 2                                        | 3                                        |

IV: Intravenous, MRSA: Methicillin-resistant Staphylococcus aureus, TLIF: Transforaminal lumbar interbody fusion, VAC: Vacuum-assisted closure. Initial antibiotic therapy before culture and sensitivity was cefuroxime and amikacin. E. coli: Escherichia coli
was 48 years (range 18-75 years). There were 5 females and 7 males. Other factors associated with increased risk of infection were chronic renal failure, malnutrition, smoking, diabetes, rheumatoid arthritis, and alcohol abuse were also recorded.

Indication for posterior spinal instrumentation and nature of operation performed is listed in Table 1. Deep drains were used in the primary procedure in all cases and removed about 48 h postoperatively. The average surgery time was 2.5 (range 1.5-3.25) h. The infection presented on a mean of 15 days after surgery. The average time of the previous spinal surgery to first revision surgery was 12 (range 7-18) days, and VAC duration of patients was 12.16 (range 5-24) days. The mean follow-up of the infected patients was 15 (range 12-18) months.

One of the cases needed a partial implant exchange although none of the cases needed complete implant removal. All patients achieved clean closed wounds with retention of the instrumentation. There was no need for flap surgery to cover wound defect in any case. Antibiotic treatment was necessary in all cases. The mean duration of parenteral and oral antibiotic therapy was 1.83 (range 1-7) weeks and 3 (range 2-6) weeks, respectively. Normalization of laboratory markers were observed at an average of 4.2 (range 3-6) weeks. Average two cycles (14 days) of VAC therapy were required before secondary closure. A mean of 2.1 (range 3-8) debridement and irrigation procedures were conducted before the wound closure operation as per definition. None of the patients showed a new infection after treatment. The mean follow-up period was 13 (range 12-16) months.

### Discussion

VAC is a technique which helps in healing of infected wounds resistant to treatment by established methods. It is been widely used in infected and post-operative wounds. As stated above, VAC has been gaining popularity in the management of acute, subacute, and chronic wounds. It act as a sterile barrier and prevents further contamination of wound and its negative suction pressure helps in debridement of the necrotic tissue and enhance neovascularization [20]. Blum et al. reviewed 229 open tibial fractures with 72% receiving negative pressure wound therapy (NPWT) and 28% conventional dressings respectively. They found a significantly reduced deep infection rate in the NPWT group (8.4% vs. 20.6%, \( P = 0.001 \)) [22]. In another study conducted by Sinha et al. in which random 30 open musculoskeletal injuries were either subjected to NPWT dressings changed every 3-4 days or standard dressings daily. While dressings were changed, measurements were taken each time, and at day 4 and 8 post-initial debridement, tissue biopsies were done for histopathological analysis. They concluded a significantly reduced wound size in the NPWT group over the period of 8 days (mean 13.24 mm vs. 3.02 mm, \( P = 0.0001 \)), significantly increased angiogenesis, granulation tissue and fibrosis (Wilcoxon signed-rank test \( P < 0.05 \)), and a reduction in bacterial growth by day 8 (60% no growth vs. 20%). All patients healed without infection, one required a free flap [23]. Hence, the backbone of VAC is its negative pressure. However, the heart of the VAC system is a microprocessor-controlled vacuum unit that is capable of providing controlled levels of either intermittent or continuous SPD ranging from 25 to 200 mmHg with 125 mmHg as being generally used [24].

VAC is also known by many other names such as topical negative pressure, SPD, vacuum sealing technique, and sealed surface wound suction [25]. VAC can be used in almost any type of wounds including pressure ulcers, acute/trauma wounds, diabetic wounds, burns, dehisced surgical wounds, leg ulcers, rotational/free flaps, and post-surgical infectious wounds [26].

Post-operative infections after instrumented spine surgery have been reviewed previously in literature in terms of occurrence rate, microbiology, complications, and surgical technique [27, 28, 29]. The risk factors which compromise local perfusion and thus leading to an infection are smoking, diabetes, alcohol abuse, morbid obesity, immune deficiency in the case of malignancy, cardiovascular problems, and radiation before surgery [12].

The flap coverage is yet a standard treatment of infected wounds after instrumented spine surgery [30, 31, 32]. However, flap closure is accompanied with significant morbidity, blood loss, including extended operative time, recurrent infection, seroma, dehiscence, flap failure, donor site morbidity, significant comorbidities, and poor tissue characteristics which can complicate the wound healing or even compromise the chosen flap [33, 34, 35]. Recently, various studies have been conducted which concludes that successful management of post-operative infection after spinal instrumentation surgery without flap coverage is possible [9, 12, 36, 37]. Such treatment includes repetitive debridement, antibiotic medications, delayed closure, local irrigation system, and maintenance of the instrumentation system. Nevertheless, this method was considered as inappropriate in one of the study in which 13 of 19 patients developed wound complications, chronic infection, wound dehiscence, and hematoma [38]. Debridement without replacement or removal of the implant combined with prolonged intravenous and oral antibiotic treatment has a failure rate between 32% and 86% [39].

Deep infection which is persistent, often necessitates the removal of hardware [40, 41]. One of the study has observed that the removal of hardware rates in patients with deep spinal infection was up to 35% [40]. Richards et al. in his study had removed the hardware in all of his 10 patients with deep infections after scoliosis surgery [42]. Fig. 3 depicts serial images of post-operative wounds treated with VAC.

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**Figure 3:** Serial images of post-operative wound treated with vacuum-assisted closure.
In reality, the main purpose of any method is to manage the infections appropriately and shorten the duration of hospitalization with a reduction in the need of antibiotics intake and the implantation removal. This study showed that VAC therapy has been successful in preventing the need of long-term antibiotic therapy and removal of implants as compared to the old methods.

**Conclusion**

The study demonstrates the usefulness of VAC therapy as alternative management for wound conditioning of back wound with the high complexity in nature after instrumental spine surgeries. It eliminates need of implant removal and help to salvage instrumented spine. There was no need for long-term antibiotic therapy and use of higher antibiotic was prevented when therapy was used in conjunction with VAC therapy. The use of the VAC system is specifically appealing in patients with two or more comorbidities since it may not only avoid the need for complex plastic surgery but also, reoperation later.

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