

Negative pressure wound therapy with vancomycin wound instillation: a case report

Negative pressure wound therapy (NPWT) supports the healing process by removing fluid and drawing out the infection from a wound, promoting the growth of new tissue. The device works by providing and distributing negative pressure evenly across the wound bed, either through the application of an open cell foam or a gauze dressing. NPWT provides a warm, moist wound bed while removing wound fluid that contains factors that inhibit cell growth, enhances wound oxygenation and improves the flow of blood and nutrients to the wound. NPWT also creates mechanical forces that influence the wound macroscopically, inducing cell proliferation, cell migration to the wound and angiogenesis. For infected wounds, the device can be used to instil antibiotics. In this article, a 57-year-old Caucasian woman with respiratory failure developed sepsis secondary to an intra-abdominal infection with abscess. Vancomycin 1mg/mL wound instillation, instilled as 100mL every 3 hours with a dwell time of 10 minutes, was administered concomitantly with intravenous vancomycin in the successful management of this patient.

Application of negative pressure wound therapy (NPWT) to an injured site is widely used to improve the healing of wounds, as described in Vikatmaa et al (2008). As several references have shown (Vikatmaa et al, 2008; Hasan et al, 2015), NPWT aids in the healing process by reducing oedema and encouraging new tissue formation, or granulation, at the wound site. Although the benefits of NPWT are well established, the risk for infection with this therapy remains an area of ongoing concern, as described in Armstrong and Lavery (2005). Some fairly recent studies (Armstrong and Lavery, 2005; Gabriel et al, 2008; 2012; Kim et al, 2013; Anghel et al, 2016) have investigated the impact of antiseptics, antimicrobials and antifungal solutions via wound instillation on both patient and hospital outcomes.

The ideal methods for utilising wound instillation in patient care is also not clear. Guidance published by Kim et al (2013) suggests an appropriate dwell time for wound instillation is between 10 to 20 minutes; however, the optimal dwell time remains unclear and, in the case of antimicrobials, may depend on the pharmacodynamics of the instilled product. Specific recommendations for instillation volume are even less precise, given variations in wound size and quality. It is important to apply enough volume to bathe the surface of the wound, but not so much as to inhibit maintaining a seal with the occlusive

dressing. There are presently no guidelines that recommend dwell times or drug concentration of the instillation specific to vancomycin.

Given the lack of literature describing vancomycin wound instillation with NPWT, the following case report seeks to describe the clinical course of one patient receiving NPWT with vancomycin instillation. Secondly, it is our intention to describe the process improvement that was implemented to ensure patient safety due to the limited guidance for providers and pharmacists monitoring of vancomycin wound instillation.

Case presentation

A 57-year-old Caucasian female weighing 128kg arrived in our intensive care unit (ICU) in respiratory failure secondary to suspected aspiration and sepsis, following recent cholangitis with a modified early warning score of five. She was intubated prior to arrival at an outside long-term care hospital (LTCH). A propofol infusion was initiated at 40 mcg/kg/minute shortly after arrival to the ICU and titrated to Richmond Agitation Sedation Scale of -1. As a result of the decline in blood pressure associated with the propofol infusion, a phenylephrine infusion was initiated at 0.8mcg/kg/minute and titrated to a mean arterial pressure of >65mmHg. Initial arterial blood gas measurement revealed a pH of 7.22, a partial pressure of carbon dioxide of 84 mmHg, and a bicarbonate of 34mEq/L. The patient's

Alison Bunnell

Doctor of Pharmacy
Candidate 2022, North
Dakota State University,
Fargo, ND, USA

Erin Beauclair

Doctor of Pharmacy
Candidate 2022, North
Dakota State University,
Fargo, ND, USA

Breanna Jones

Doctor of Pharmacy,
Pharmacy Department,
Sanford Medical Center
Fargo, Fargo, ND, USA

Emily Greenstein

Advanced Practice
Registered Nurse
and Certified Nurse
Practitioner, Wound Care,
Sanford Medical Center
Fargo, Fargo, ND, USA

Justin M Jones

Doctor of Pharmacy,
Pharmacy Department,
Sanford Medical Center
Fargo, Fargo, ND, USA

Andrea R Clarens

Doctor of Pharmacy
Pharmacy Department,
Sanford Bemidji Medical
Center, Bemidji, MN, USA

Key words

- Acute kidney injury
- Computed tomography
- Kidney Disease
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Declaration

Emily Greenstein reports she has been a consultant for Urgo medical, 3M and Coloplast. 3M manufactures V.A.C VeraFlo. None of these manufacture or distribute vancomycin instillation described in this manuscript.

Table 1. Case Summary.

Hospital day	Antibiotics				Laboratory parameters		
	Levofloxacin IV	Meropenem IV	Vancomycin IV	Vancomycin Instillation (1mg/dL)	Vancomycin level (mcg/dL)	Serum Creatinine (mg/dL)	Creatinine clearance (mL/min)
10	750mg q 24hr		2g	100 mL x 10min q 3hr		1.13	112
11			2g			0.97	130
12			2g		26.7	0.91	138
13			2g		32.0	1.12	113
14					33.6	1.05	126
15					22.2	1.23	102
16			1.5g		15.0	1.25	101
17			1.5g		19.9	1.24	102
18			1.5g		19.8	1.23	102
19			1.5g			1.28	98
20				50 mL x 30min q 3hr	20.6	1.26	100
21				25mL x 30min q 3hr		1.13	112
22		500mg q 6hr				1.26	100
23					19.9	1.13	112
24						0.94	134
25					21.1	0.87	145
26			2g			0.86	147
27			2g		18.6	0.77	164
28						0.76	166
29					23.8	0.80	158
30			2g			0.85	148
31						1.15	110
32					30.9	1.59	79
33					23.7	1.62	78
34					16.9	1.35	93

past medical history included hypertension, hyperlipidemia, type 2 diabetes mellitus, depression, gastroesophageal reflux disease and morbid obesity.

Chest computed tomography (CT) revealed infiltrates suggestive of aspiration pneumonia with empyema, for which she was empirically started on cefepime 2,000mg intravenously (IV) every 8 hours and vancomycin 1,750mg IV every 12 hours. Five days later, a CT scan of the abdomen showed significant ascites and interventional radiology drainage revealed purulence. On hospital day (HD) 5, an exploratory laparotomy was performed for abscess drainage and enterolysis. Cultures of the pleural fluid grew methicillin-resistant *Staphylococcus aureus* (MRSA) sensitive to vancomycin and *Stenotrophomonas maltophilia* sensitive to levofloxacin on HD six. Cefepime was discontinued and levofloxacin was initiated at a dose of 750mg IV every 24 hours.

On HD 10, an exploratory laparotomy was performed, revealing an intra-abdominal abscess measuring 8.7cm in length and 5.5cm in width. Vancomycin 1 mg/mL wound instillation was ordered for the intra-abdominal wound and administered as 100mL with a dwell time of 10 minutes every 3 hours. Throughout the course of the patient's stay, IV vancomycin was ordered concomitantly with vancomycin wound instillation on HD 10, 19, 26, and 30 (Table 1). On HD 20, the intra-abdominal wound size decreased, allowing for the reduction of the vancomycin instillation volume to 50mL. On HD 21, the vancomycin instillation volume could be decreased to 25mL. Duration and frequency remained the same on these days. Intravenous vancomycin doses were adjusted per facility treatment protocol, with a goal trough of 15–20 mcg/mL. Supra-therapeutic trough levels were observed for the first 6 days of concomitant vancomycin IV and instillation therapy. On HD 32, the patient developed KDIGO Stage 2 AKI in the setting of significant third spacing, which resolved after administration of a sodium chloride 0.9% 500mL bolus followed by dextrose 5% plus sodium chloride 0.45% at 100mL/hour. The patient progressed to the point of discharge on HD 54 to a LTCH without vasopressor support and was able to undergo spontaneous breathing trials during the day. The first 34 HDs are explored in more detail in Table 1.

Case summary

This patient received vancomycin wound instillation with NPWT for an intra-abdominal related wound. Vancomycin 1000 mg was mixed in 1000 mL of sodium chloride 0.9% (1

mg/mL) and initially instilled at 100 mL with a dwell time of 10 to 30 minutes. The vancomycin was instilled in cycles every 3 hours, alternating with a suction of low intermittent 125 mmHg pressure continuously. The patient received IV vancomycin concomitantly on days 10–19 and 26–30. During both treatment timeframes, supra-therapeutic vancomycin troughs were observed. The patient developed an AKI on HD 32 following 5 days of concomitant IV and instilled vancomycin.

In response to concerns for potential systemic absorption of instilled vancomycin following extended therapy, Sanford Medical Center Fargo developed a structured approach for administering and monitoring patients on NPWT with vancomycin instillation. Although there are presently no guidelines directing drug concentration of vancomycin instillation, studies have looked at the toxic effects of vancomycin when exposed to *in vitro* skeletal cells via local delivery systems. Antoci et al (2007) concluded concentrations of vancomycin less than or equal to 1mg/mL had little impact on cell proliferation and reported concentrations greater than 1mg/mL were associated with impaired osteoblast proliferation. A standardised order panel now allows physicians to prescribe vancomycin 1,000mg in 1,000mL of 0.9% sodium chloride (1mg/mL) for instillation via V.A.C VeraFlo™ to prevent topical administration of vancomycin at concentrations greater than 1mg/mL due to concern for local cell toxicity. The order panel sends a consult for pharmacy to monitor random vancomycin levels at the discretion of the pharmacist while the patient is receiving vancomycin instillations. This consult additionally allows pharmacy to discontinue concomitant IV vancomycin pending indication and cultures to prevent duplicate therapy.

Conclusion

Vancomycin wound instillation via V.A.C VeraFlo may be a beneficial approach in treating open wounds. Structuring our approach to vancomycin wound instillation has helped us better establish the management of antimicrobial wound instillation with NPWT at our institution and promote patient safety through close monitoring for renal impairment. Additional studies are required to establish and quantify the efficacy and safety of vancomycin wound instillation with NPWT. ●

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