Case Report

Current Trends in Ophthalmology

Management of Periorbital Necrotising Fasciitis Utilising Negative Pressure Wound Therapy: A Case Report

Waldie AM^{1,2}, Lau FS^{1,2}, Hepschke JL^{1,3}, Francis IC^{1,3} and Wilcsek G^{1,3*}

¹Ocular Plastics Unit, Department of Ophthalmology, Prince of Wales Hospital, New South Wales, Australia

²The University of Sydney, New South Wales, Australia

³The University of New South Wales, New South Wales, Australia

***Correspondence:** Geoffrey Wilcsek, Ocular Plastics Unit, Department of Ophthalmology, Prince of Wales Hospital, High Street, Randwick, Sydney, New South Wales, 2031, Australia, Tel: +61 2 9525 8669; Fax: +61 2 9525 3086; E-mail: geoff@wilcsek.com

Received: January 26, 2019; Accepted: March 05, 2019; Published: March 11, 2019

Abstract

Necrotising fasciitis is a fulminant, rapidly progressive infection associated with extensive tissue destruction and significant mortality. Given the robust blood supply of the face, periorbital necrotising fasciitis is rare in this region. Traditional management consists of prompt initiation of antibiotics and adequate surgical debridement. This report documents the outcome of Type 2 periorbital necrotising fasciitis in a 49-year-old, immunocompetent man, in whom negative pressure wound therapy, was combined with conventional measures. The negative pressure wound therapy was applied directly to the involved orbit, suggesting its safety and efficacy in relation to use over the orbit. Negative pressure wound therapy may be a useful adjunct to the armamentarium of the oculoplastic surgeon for the reconstruction of periorbital defects produced by the surgical debridement of periorbital necrotising fasciitis.

Keywords: Periorbital necrotising fasciitis, Negative pressure wound therapy, Periorbital reconstruction

Abbreviations: BP-Blood Pressure; CT-Computerised Tomography; IOP-Intraocular Pressure; NF-Necrotising fasciitis; NPWT-Negative Pressure Wound Therapy; PNF-Periorbital Necrotising Fasciitis; PPM- mean Perfusion Pressure; SBO-Small Bowel Obstruction; VA-Visual Acuity

Introduction

Necrotising Fasciitis (NF) is severe life-threatening infection characterized by a progressive inflammatory infection of the deep fascia with secondary necrosis of subcutaneous tissues and overlying skin [1,2]. NF is most commonly caused by the bacterium *Streptococcus pyogenes* rapidly progressing within the subcutaneous plane. NF commonly affects the trunk, groin/perineum, lower limbs and postoperative wound sites. Despite being rare in the periorbita, periorbital NF (PNF) is frequently associated with delayed diagnosis and under-treatment [1,2]. Prompt diagnosis and initiation of high-dose

antibiotics with adequate tissue debridement reduce hospital length of stay and mortality.

Negative pressure wound therapy (NPWT) is a safe and effective adjunct to antibiotics and surgical debridement in the management of PNF. NPWT was first introduced 20 years ago for the management and treatment of difficult wounds [3]. It has since been employed successfully in a variety of clinical settings to promote wound healing by facilitating debridement, enhancing perfusion, bolstering complex skin grafts, draining exudate, and minimizing bacterial load [4,5]. NPWT is indicated in the following clinical settings; acutely and chronically infected wounds,

contaminated wounds, diabetic wounds, traumatic wounds, decubitus wounds, wounds with exposed bone, wounds with underlying osteomyelitis, infection wounds in the presence of orthopedic hardware, painful wounds, and wounds that are a bridge between staged/delayed amputation. This broad scope of acceptable indications has rendered NPWT an important therapeutic option in the setting of difficult-to-treat wounds [6].

NPWT is a sealed wound-care system consisting of an electronically controlled pump and wound filler (foam) that is contoured to the wound and sealed with an occlusive airtight drape. A suction tube connected to a vacuum device via a canister is applied to the wound to deliver controlled negative pressure to the wound bed [4,7].

A case is presented where NPWT was applied directly to an acutely infected periorbital wound as a therapeutic adjunct in the surgical management of PNF. The patient achieved satisfactory functional and cosmetic outcomes, without adverse sequelae to the ocular structures. This case may suggest that NPWT is a safe and effective adjunct in the management of PNF.

Case Presentation

A 49-year-old man with a history of recurrent sinusitis, and laparotomy for intussusception in childhood, presented to the Emergency Department with right-sided periorbital pain and erythema, but associated with abdominal discomfort, and constipation. The patient was febrile and tachycardia. His uncorrected visual acuity (VA) was 20/15 bilaterally. Ocular motility and pupils were normal. Right periorbital swelling and erythema were noted, with greater involvement of the upper eyelid. The right orbital margin and maxillary sinus were tender. The patient's abdomen was soft to palpation, but with a tender right upper quadrant.

Pathology revealed an elevated C-reactive protein of 195 mg/L (normal < 10 mg/L), with neutrophilia, and mildly cholestatic liver function tests, thought to be related to his suspected abdominal pathology. Computerised Tomography (CT) of the orbits disclosed bilateral preseptal and periorbital oedema, and paranasal sinus opacification (Figure 1).

Immediate Ophthalmological consultation was delayed because of the patient's suspected abdominal pathology. The patient was then transferred to our tertiary referral hospital with a preliminary diagnosis of small bowel

obstruction (SBO). A CT abdomen ruled out SBO and the abdominal symptoms resolved spontaneously.

Figure 1: Non-contrast CT of the face and orbits; a) Bilateral preseptal and periorbital soft tissue swelling, more marked on the right side; b) Opacification of right ethmoid sinus suggestive of sinusitis.

Over the subsequent 48 hours, the patient became increasingly unwell, with worsening periorbital symptoms and signs. The right upper eyelid skin became gangrenous, with the development of a necrotic eschar (Figure 2a). Ocular Plastics consultation was sought and PNF was confirmed. The patient underwent immediate right upper eyelid surgical drainage with extensive tissue debridement. In conjunction with the General Plastic surgical team, a decision was made to apply NPWT to minimize the amount of tissue debridement required, and to support wound healing and granulation tissue formation.

Intraoperatively, the right upper eyelid demonstrated widespread subdermal necrosis and pus distributed superficially, but limited posteriorly by orbicularis oculi. The right lower eyelid exhibited moderate necrosis superficial to orbicularis oculi (Figure 2b). The necrotic areas were debrided down to orbicularis muscle. The right conjunctiva was not inflamed.

A protective temporary tarsorrhaphy was fashioned in order to facilitate right corneal protection (Figure 2c). NPWT was applied to the anterior orbit using a sealed wound dressing, consisting of a piece of foam tailored to the wound and an occlusion dressing, connected to a vacuum pump and set to continuous vacuum at 75 mmHg (Figure 2d).

Figure 2: Intraoperative photographs of patient undergoing surgical debridement; a) Preoperative evidence of erythema of right eyelids, with necrotic eschar and underlying tissue necrosis of the upper eyelid; b) Intraoperative appearance of the patient's right upper and lower eyelids following debridement of the necrotic tissue; c) Appearance of right eyelids at conclusion of debridement and following central marginal tarsorrhaphy (note that upper eyelid is depicted inferiorly in this photograph); d) Appearance following application of negative-pressure wound therapy (NPWT) dressing (Vacuum port remains to be connected to dressing).

Staphylococcus aureus was cultured from the right upper and lower eyelid swabs, and *Streptococcus pyogenes* was grown exclusively from the right upper eyelid swab. The Infectious Diseases team was consulted and the patient was commenced on oral clindamycin and cephalexin.

Forty eight hours after the initial debridement, the patient returned to the Operating Room for further debridement of residual necrotic tissue on his right upper and lower eyelid wounds (Figure 3a and 3b). Intraoperatively, NPWT was replaced to support the debrided wounds. The patient underwent right upper and lower eyelid reconstruction four days later. Healthy granulation tissue enabled support of a full thickness skin graft harvested from the uninvolved left upper eyelid (Figure 3c). The NPWT dressing was removed. There was no further necrosis. The residual right upper eyelid defect was closed primarily.

Postoperatively, the periorbital pain resolved and the patient was able to open his eye without difficulty.

After three further days of inpatient antibiotics, the patient was discharged home on a two-week course of oral cephalexin. Continued improvement was observed at outpatient follow up. The patient's visual acuity was maintained, and the periorbital findings improved (Figure 3d).

Figure 3: Intraoperative photographs and clinical progress; a) Intraoperative findings after 48 hours of NPWT; b) Intraoperative image after four days of NPWT; c) Right upper eyelid appearance following reconstruction using full thickness eyelid skin grafts from the left upper eyelid; d) Patient one week postoperatively with reestablishment of normal eyelid anatomy.

Discussion

NF is a fulminant, rapidly progressive infection of fascial tissue with subsequent necrosis of subcutaneous tissues and overlying skin, and is associated with high mortality [1,2]. NF infections are classified into two types based on microbiology. Type 1 is a polymicrobial infection caused by a mixture of aerobic and anaerobic bacteria, usually following abdominal surgery. Type 2 is caused by group A streptococci and is associated with minor cutaneous injuries in previously healthy individuals with a predominance for the head, neck and extremities [8]. If not recognised and treated promptly, especially in the periorbital region, local tissue destruction, blindness, severe disfigurement, or intracranial extension leading to meningitis and venous sinus thrombosis, may ensue [7,9]. The overall mortality rate of PNF is 8.5%, secondary to septicæmia, shock, and multi-organ failure [1]. Without immediate surgical intervention, nearly all cases are fatal [1,2,10].

NPWT promotes wound healing by enhancing vascular perfusion, bolstering complex skin grafts, draining exudate, and minimizing bacterial load by increasing tissue perfusion [3,4,11]. This case provides additional evidence to the literature for the reported safety of NPWT applied directly to orbital and periorbital structures [5,12].

The physiological events of the raised intravascular arterial and venous pressures during periorbital application of NPWT have not yet been entirely elucidated. While the air pressure in the foam decreases with NPWT, the underlying tissue pressure on which the foam is placed paradoxically increases [13].

Indeed, Kairinos et al. [13] recorded an interstitial hydrostatic pressure increase of 8mmHg at a NPWT setting of 75 mmHg [5]. This increase in tissue pressure could theoretically translate to an increase in intraocular pressure (IOP), with resultant occlusion of the ocular vascular structures.

Orbital and ocular vascular physiology

As background, the ocular blood supply is derived from two vascular systems-the central retinal vessels, and the long and short posterior ciliary vessels [14]. Mean perfusion pressure (PPm) is the mean blood pressure (BP) in the ophthalmic artery minus the BP in the central retinal vein (which can be approximated to IOP). In the sitting or standing position, PPm is approximately 2/3 of the mean brachial artery BP, due to the reduction in BP between the heart and the ophthalmic artery [15]. Assuming an average mean brachial artery BP of 120 mmHg, PPm is approximately 80 mmHg. The normal physiological IOP ranges from 10 to 20 mmHg. Retinal and optic nerve head vessels have the capacity to auto regulate to maintain constant ocular blood flow despite changes in perfusion pressure [15].

The authors hypothesize that, at a pressure setting of 75 mmHg of NPWT, the increase in tissue pressure of 8 mmHg beneath the NPWT dressing will equate to similar increase in pressure at the foam-eyelid-conjunctival interface. Therefore, this small pressure increase transmitted to the globe should not have deleterious effects on PPm due not only to the relatively small pressure increase, but also to the capacity of the retinal circulation to auto regulate. In this case, while a tarsorrhaphy was placed to safeguard the ocular surface during NPWT application, it did not appear too clinically increase intraorbital pressure as orbital palpation demonstrated normal orbital resiliency.

Normal orbital pressure ranges from 3 to 6 mmHg. Retinal ischemia results when orbital pressure exceeds retinal artery pressure (90 mmHg). If ocular pressure increases to the 30 to 50 mmHg range, the central retinal venous circulation could theoretically become occluded [5]. However, with an 8 mmHg increase in orbital pressure from 6 to 14 mmHg, the authors hypothesise that this pressure increase is not significant enough to pose a risk to the ocular vascular circulation.

In this study, while a pressure setting of 75 mmHg was used to promote wound healing, normal visual performance could be retained. The authors were encouraged by the report by Semlacher et al. in 2012, where the successful application of NPWT applied directly over orbital structures in the management of PNF was documented [5]. As in the current case, Semlacher *et al's* patient achieved excellent functional and cosmetic results, with no injury sustained to orbital and ocular structures from NPWT.

Conclusion

This report documents a 49-year-old male with Type 2 PNF who was managed not only with the customary modalities, but in whom NPWT was placed directly over the orbit as part of the management of PNF. NPWT minimized the extent of tissue debridement required, and afforded enhancement of the development of granulation tissue it appears that satisfactory functional and cosmetic results were achieved while maintaining all aspects of the patient's systemic recovery and visual outcome. Our group considers that surgeons managing PNF should be aware of the potential safety of NPWT to orbital structures, as it may confer numerous benefits.

Declarations

The authors have no financial or conflicts of interest to disclose. The authors alone are responsible for the content and writing of the article and each author made substantial contributions to the creation of this manuscript. There is no funding to disclose for this work. The patient provided consent for publication and further clinical material may be provided if required.

References

1. Amrith S, Hosdurga Pai V, Ling WW. Periorbital necrotizing fasciitis-a review. *Acta Ophthalmol.* 2013;91(7):596-603. Doi: <http://dx.doi.org/10.1111/j.1755-3768.2012.02420.x>

2. Gelaw Y, Abateneh A. Periocular necrotizing fasciitis following retrobulbar injection. *Clin Ophthalmol*. 2014;8:289-292. Doi: <http://dx.doi.org/10.2147/OPTH.S58259>
3. Argenta LC, Morykwas MJ. Vacuum-assisted closure: a new method for wound control and treatment: clinical experience. *Ann Plast Surg*. 1997;38(6):563-576; discussion 577.
4. Lalezari S, Lee CJ, Borovikova AA, et al. Deconstructing negative pressure wound therapy. *Int Wound J*. 2017;14(4):649-657. Doi: <http://dx.doi.org/10.1111/iwj.12658>
5. Semlacher RA, Taylor EJ, Golas L, et al. Safety of negative-pressure wound therapy over ocular structures. *Ophthalmic Plast Reconstr Surg*. 2012;28(4):e98-101. Doi: <http://dx.doi.org/10.1097/IOP.0b013e318236859c>
6. Kim PJ, Attinger CE, Steinberg JS, et al. Negative-pressure wound therapy with instillation: international consensus guidelines. *Plast Reconstr Surg*. 2013;132(6):1569-1579. Doi: <http://dx.doi.org/10.1097/PRS.0b013e3182a80586>
7. Contreras-Ruiz J, Ramos-Cadena A, Solis-Arias P, et al. Negative pressure wound therapy in preseptal orbital cellulitis complicated with necrotizing fasciitis and preseptal abscess. *Ophthalmic Plast Reconstr Surg*. 2015;31(1):23-28. Doi: <http://dx.doi.org/10.1097/IOP.0000000000000163>
8. Lancerotto L, Tocco I, Salmaso R, Vindigni V, Bassetto F. Necrotizing fasciitis: classification, diagnosis, and management. *J Trauma Acute Care Surg*. 2012;72(3):560-566. Doi: <http://dx.doi.org/10.1097/TA.0b013e318232a6b3>
9. Raja V, Job R, Hubbard A, Moriarty B. Periorbital necrotising fasciitis: delay in diagnosis results in loss of lower eyelid. *Int Ophthalmol*. 2008;28(1):67-69. Doi: <http://dx.doi.org/10.1007/s10792-007-9108-z>
10. Lazzeri D, Lazzeri S, Figus M, et al. Periorbital necrotising fasciitis. *Br J Ophthalmol*. 2010;94(12):1577-1585. Doi: <http://dx.doi.org/10.1136/bjo.2009.167486>
11. Kairinos N, Voogd AM, Botha PH, et al. Negative-pressure wound therapy II: negative-pressure wound therapy and increased perfusion. Just an illusion? *Plast Reconstr Surg*. 2009;123(2):601-612. Doi: <http://dx.doi.org/10.1097/PRS.0b013e318196b97b>
12. Skillman J, Kirkpatrick N, Coombes A, et al. Vacuum Assisted Closure (VAC) dressing for skin graft application following exenteration of the orbit. *Orbit*. 2003;22(1):63-65.
13. Kairinos N, Solomons M, Hudson DA. Negative-pressure wound therapy I: the paradox of negative-pressure wound therapy. *Plast Reconstr Surg*. 2009;123(2):589-598; discussion 599-600. Doi: <http://dx.doi.org/10.1097/PRS.0b013e3181956551>
14. Kaufman P, Alm A. Adler's physiology of the eye. *Tenth ed: Mosby*; 2003.
15. Pournaras CJ, Rungger-Brändle E, Riva CE, Hardarson SH, Stefansson E. Regulation of retinal blood flow in health and disease. *Prog Retin Eye Res*. 2008;27(3):284-330. Doi: <http://dx.doi.org/10.1016/j.preteyeres.2008.02.002>

Copyright: © **Waldie et al.** This is an Open Access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.