

Utilizing Variable Flow Rate Continuous Diffusion of Oxygen* (CDO) to Modulate Exudate and Iterate Pain in Chronic Wounds



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ABSTRACT

Exudate and pain are variable factors which can significantly impact wound healing. CDO Therapy* has been shown to significantly decrease pain and increase healing. Some CDO devices have the ability to adjust oxygen flow from 3-15 mL/hr based on wound size and response.

Eight wounds were analyzed to examine oxygen flow rates and wound response with regards to exudate and pain.

Exudate and pain levels were tracked at CDO placement and weekly for the first six weeks. Exudate was measured as high, medium, low or scant. Pain was measured from 0-10, 10 being highest. Sharp debridement was performed before placement of oxygen diffusion dressing and CDO therapy. Oxygen settings for all wounds were 8 mL/hr at initiation. Once exudate moderated, an increase of flow rate by 4 mL/hr weekly was delivered. Dressing changes were performed 2-3 times per week.

Each wound responded with increased exudate between weeks 1-3. Exudate levels then moderated regardless of increase in oxygen thereafter, for all but two patients. Those patients required a decrease in oxygen until exudate levels were stabilized.

Three of eight wounds presented with pain, one of which had a pain level of 10. Two of the three patients were pain free by week two. The final wound took until four weeks prior to closure to achieve 0 pain.

The ability to modulate flow rate of oxygen as a response to exudate and pain is essential. Though an increase in exudate during weeks 1-3 is expected, heavy exudate can be managed by decreasing oxygen levels.

Conversely, increasing flow rates resulted in an overall decrease in pain. Oxygen flow rates appear to have direct impacts on wound response for both pain and exudate control.

INTRODUCTION

Oxygen delivery is a compounding issue facing most chronic wounds. Oxygen plays a critical role within wound healing process and has been extensively documented.³ Yet the ability to, and rationale behind, modulating the flow of oxygen based on wound response and pain levels has not yet been thoroughly researched.

The authors lead the wound care team at the largest physician owned MCO in San Antonio. The team has been utilizing CDO therapy for chronic and unresponsive wounds. In addition, the largely Hispanic elderly population often presents with pain associated with their wounds. Experience with CDO therapy has resulted in successful outcomes with similar results: exudate increases within the first 1-3 weeks and the need to manage this response. Our goal in this study was to examine the effect of varying oxygen flow rates on the wound response with regard to exudate and pain.

METHODS

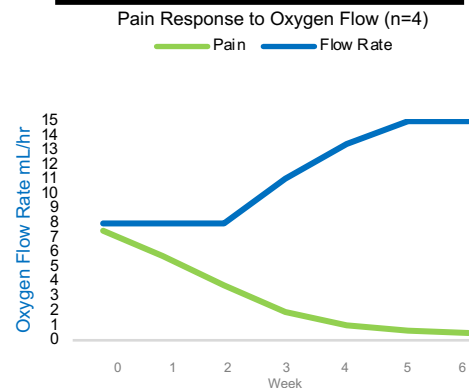
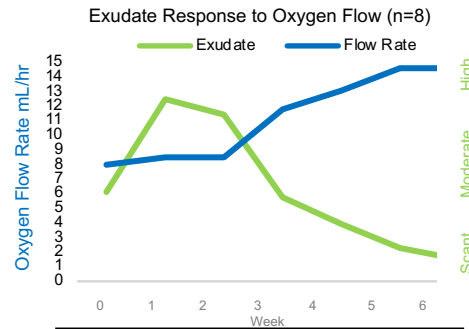
- 8 elderly Hispanic patients were identified with chronic or non-healing wounds
- Each wound underwent sharp debridement prior to CDO Therapy
- CDO Therapy consisted of applying an oxygen diffusion dressing (multilayer foam with oxygen distribution channels) and connecting to an oxygen generator via a tubing extension set
- Zinc based ointment used on periwound area
 - Leg ulcers followed the same protocol listed above with the addition of total contact cast (TCC)

- Exudate and pain levels were tracked at CDO placement and weekly for the first six weeks
 - Exudate was measured as high, medium, low or scant
 - Pain was measured from 0-10, 10 being highest
- Oxygen settings for all wounds were 8 mL/hr at initiation
- Once exudate moderated at medium or low levels, the oxygen flow rate was increased in increments of 4 mL/hr weekly the maximum flow of 15 mL/hr was achieved
- Dressing changes were performed 2-3 times per week, once per week in clinic

DEMOGRAPHICS

Average Wound Duration	421 days
Wound Types	4 DFU 2 Post Surgical 1 VLU 1 Trauma
Average Pain Prior to CDO Placement (n=4)	7.5/10

RESULTS



Average wound duration for this group was 421 days, all patients healed completely with an average time to healing of 98 days.

DISCUSSION

A recent article by Lavery *et al*⁴ illuminated the cellular response of oxygen when applied continuously to a wound. The group showed that certain cytokine and growth factors significantly increased within one week of CDO therapy. For example, VEGF increased by 430% at week 1 and IGF-1 increased a total of 660%. VEGF has been shown to stimulate angiogenesis, collagen deposition and epithelialization and IGF-1 has been shown to stimulate protein production, cell proliferation and migration. As cellular functions increase, the byproduct often is increased exudate. Furthermore, newly forming capillaries are leaky until fully formed. In this study, exudate levels in all patients peaked at week one and became moderate to scant by week 3, roughly corresponding with the cytokine/growth factor increases shown by Lavery et al. As exudate levels moderated oxygen flow rates were increased by 4 mL/hr per week up to the max flow rate of 15 mL/hr. Even as the oxygen levels were increased after week one, exudate levels did not respond in kind after the noticeable primary response. We hypothesize that the rise in exudate is the wound response to the increased oxygen availability and the cells ability to move into the proliferative phase as described in Lavery et al.

Wound pain can be linked to regional ischemia. We have found that CDO therapy is highly effective at eliminating pain and allowing patients to cease utilization of narcotics.⁵ However, with increased exudate during the first few weeks of CDO application, we find a conservative approach to increasing oxygen flow rates are necessary. Though there appears to be a direct correlation between increased oxygen and decreased pain, the trade-off in our opinion is based on exudate management. Once exudate has reached moderate to scant levels we feel comfortable addressing the pain more aggressively by increasing oxygen flow rates.

The ability to modulate flow rate of oxygen as a response to exudate and pain is essential. Though an increase in exudate during weeks 1-3 is expected, heavy exudate can be managed by decreasing oxygen levels. Instead of taking this approach, we chose to maintain or increase oxygen levels and manage the exudate using additional dressings or by increasing the frequency of dressing changes. This clinical decision is based on the decreased pain scores patients report when higher levels of oxygen are administered.

CONCLUSION

Oxygen flow rates appear to have direct impacts on wound response for both pain and exudate control. We continue to utilize this therapy for our at risk patient population and anticipate more learnings as we do.

Wound Progression (Patient Wound Series)

Patient A: Post Surgical, DM, VI, Duration 30 Days
4.5x1.5 cm
Day 0



Day 34



*CDO Therapy supplied by EO2 Concepts, San Antonio, TX

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2. Niederauer, MQ, Michalek, JE, Liu, Q, Pappas, KK, Lavery, LA & Armstrong, DG 2018. "Continuous diffusion of oxygen improves diabetic foot ulcer healing when compared with a placebo control: A randomised, double-blind, multicentre study" *Journal of wound care*, vol. 27, pp. S30-S45.
3. Schreml S, Szeimies RM, Prantl L, Karrer S, Landthaler M, Babilas P. Oxygen in acute and chronic wound healing. *Br J Dermatol*. 2010;163(2):257-268.

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