

Use of a New Pulsatile Irrigation-Suction Device in Wound Care

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Hill RK, Hill ES. Use of a new pulsatile irrigation-suction device in wound care. *J Hyperbaric Med* 1990; 5(3):193-198.—As the delivery of wound care becomes increasingly common in hyperbaric departments, it is necessary to look for more efficient and effective methods of providing such care. In this retrospective study of the use of the Pulsavac, a pulsatile irrigation-suction device used for cleansing and debridement of wounds, we compared the outcomes of 30 patients treated with the Pulsavac to outcomes for 30 similar patients not treated with the Pulsavac. The Pulsavac group required fewer hyperbaric treatments and had a shorter stay in the hospital or hyperbaric department. An economic analysis shows this to be a cost-effective adjunct to hyperbaric oxygen therapy.

wound care, irrigation, cost effectiveness

Introduction

Wound care is of increasing importance to departments of hyperbaric medicine. In addition to providing technical services, we are growing into specialties devoted to, among other aspects, care of problem wounds. We must continually search for new and better ways of caring for those wounds. Pulsatile irrigation has long been employed in oral surgery (1), general and military surgery (2-4), and orthopedics (5), but its use in hyperbaric medicine is relatively new, particularly when used with concurrent suction.

Since early 1989 we have added the Pulsavac to our wound care resources at Our Lady of the Lake Regional Medical Center (Fig. 1). The Pulsavac is a pulsatile irrigation device with a coaxial suction. Originally designed for surgical use, as in clearing bone channels during orthopedic surgery, its use has spread to the emergency department, to the ward, and to the hyperbaric department.

The Pulsavac delivers pulses of irrigant, at a fixed rate of 26 pulsations per second. There is a continuously variable pressure of from 1 to almost 3 atm abs depending on the pressure set on the panel-mounted control and the type of lavage-suction tip chosen for use, with fan spray-type tips providing the lowest pressure and single orifice, the highest pressure. The pump is a 110-V linear motor that drives a disposable single piston pump. A pressure sensor provides a continuous feedback control on the maximum pressure delivered



FIG. 1—The Pulsavac is a free-standing unit capable of being readily wheeled between treatment rooms and suitable for use with a wide variety of irrigants.

by the handset. The fluid is delivered through a disposable, sterile fluid path and can be normal saline, our usual fluid of choice, or an antibiotic solution as desired. Flow rate depends on tip type, pressure setting, and the type of fluid, but can be as great as $1 \text{ liter} \cdot \text{min}^{-1}$.

The unit can be setup quickly and is easily operated by the hyperbaricist; it is free-standing and readily wheeled into the treatment room. Once the

selected sterile-fluid bags are hung, they are perforated by the intake spikes, and the pump assembly is slid into the pump chamber. The pump door is latched, the suction is connected, the pump is turned on, and the device is purged via the handgun controls. Pressure, suction, and direction are all controllable from the handgun (Fig. 2). A variety of lavage-suction tips are available for attachment to the handgun. Initially we used both the fan-spray tips and the single-orifice tips, using the former on large sensate wounds and the latter on smaller, deeper, or eschar-covered wounds. After shower-type tips were developed, we began using them virtually exclusively because they are gentle at low pressures yet retain the capacity to debride a stubborn eschar at higher pressure. The use of a single tip reduces our number of stocked items.

Pulsavac debridement is initiated in those patients who would normally undergo repeated minor sharp debridements. Wounds that require major debridement are referred for operative care, and an initial sharp debridement often precedes the use of the Pulsavac. The pressure used initially is set low

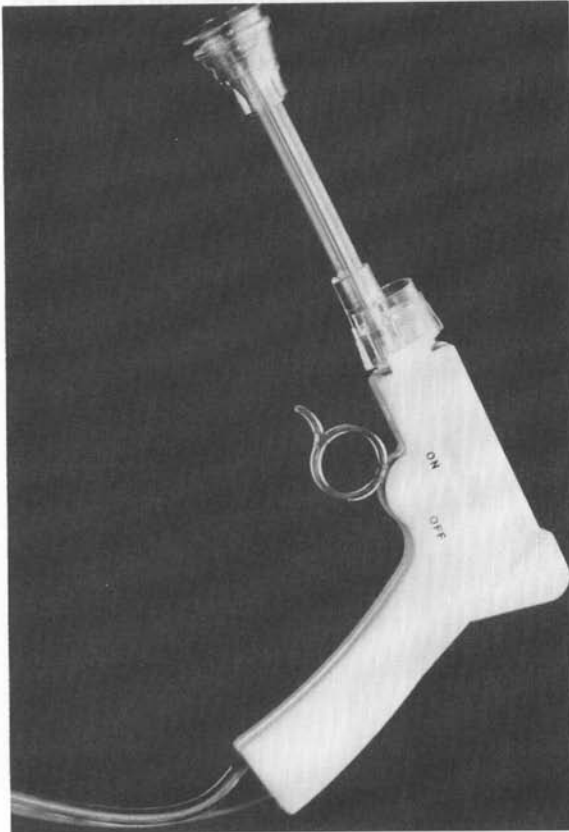


FIG. 2—The handset allows the operator to control with one hand both the fluid flow and the suction.

enough to not cause discomfort to the patient, and then raised to the level of tolerance of the patient or the level of maximally effective debridement, whichever is the lower pressure. Care must be taken to use the appropriate pressure because the device is more than capable of full-thickness debridements, and is often used for such debridements. Warmed fluids are used whenever possible to minimize the patient's discomfort. The coaxial suction cone (Fig. 3) can be applied directly to the wound in areas of little sensation or to an adjacent towel to control the build-up of irrigation fluid. One of the main advantages of the unit is the ability to use large quantities of fluid without the attendant flooding problems that this usually creates.

Suction irrigation is particularly useful in three types of wounds: those with a large amount of drainage, those with diffuse eschar or foreign material, and wounds with large cavities. In wounds with a large amount of drainage, such as in pyoderma gangrenosum, one can gently remove the viscid exudate and debride the wound at the same time, with minimal discomfort to the patients. Wounds with areas of eschar can be softened readily and then debrided with a high pressure stream (though care must be used to avoid damaging either the underlying or adjacent tissues), and those with foreign materials, such as roofing tar or road grit, are more effectively cleansed by this than by any other method. One class of foreign materials we frequently remove from the wounds are the dressing materials themselves, particularly those that were present on referral and were inappropriate for that type of wound, or during therapy

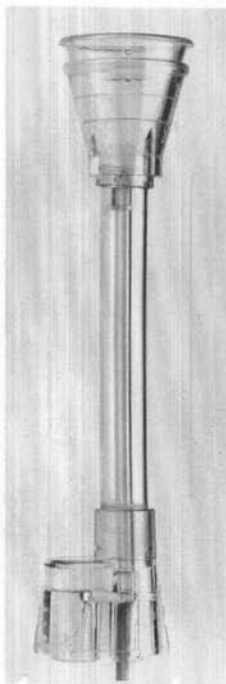


FIG. 3—The suction cone surrounds the coaxial fluid path and minimizes flooding.

when the patient is treated with one of the alginate dressings with their resultant mucoid masses. In deep cavitory wounds, such as the abdominal wound shown in Fig. 4, the Pulsavac allows for a good debridement of areas that could not be reached by other instruments.

Method and Results

To verify our impression that patients treated with the Pulsavac responded to treatment more rapidly than those treated with more conventional wound care, we undertook a review of 30 cases treated before the institution of the Pulsavac, and the first 30 similar cases treated under the same parameters with the device. We were limited in the groups' size because both before and after the review period we had used different hyperbaric oxygen therapy profiles. All patients in the study were treated at 2.2 atm abs for two 45-min O₂ periods separated by 5-min air breaks on a twice-a-day schedule (before this study period we had used 2.4 atm abs once or twice a day and currently we use 2.0 atm abs twice a day). Wound status at discharge from hyperbaric care was determined from the hyperbaric discharge summary's description of wound status. Both groups showed similar progress to "healed" status, 93%, but the Pulsavac group required fewer hyperbaric treatments to obtain the same result: 22.1 treatments for the Pulsavac group vs. 31.3 treatments for the non-Pulsavac group. These differences were significant at the $\chi^2 P = 0.091$ level, limited by the size of each group. As patients were generally treated twice per day, this resulted in a shorter hospital or outpatient stay as well. An animal study is planned using a larger number to look more closely at these results.

Discussion

We have found that the Pulsavac augments our wound care procedures. Even including the time required for set-up, little or no extra time is required for the use of the Pulsavac when compared to a similar level of sharp or scrub-



FIG. 4—In this deep, purulent abdominal wound the Pulsavac cleared debris well.

brush debridement. We have found the Pulsavac to be both more effective and easier to use than dental sprays or syringe irrigation. With the Pulsavac one can deliver a greater volume of irrigation fluid without grossly soaking the patient or the staff, at a wider range of pressures, and at a controlled maximum pressure when compared to the aforementioned alternatives. The coaxial suction combined with the pulsatile flow visibly improves the removal of debris, while granulation buds are spared.

Use of the Pulsavac on initial analysis seems to have economic drawbacks, but they are illusory. Each sterile set-up is expensive, approximately \$45, and each can only be used once (reuse is common in the veterinary community, but it is not the standard in the human one). This cost may not be reimbursable by third-party payers if the patient is under a prospective payment plan, such as the Medicare DRG system or HMO per diem arrangements, but the cost is more than made up under such systems by the savings in the number of treatments delivered and the shortened hospital stay. Each hyperbaric treatment that is not performed covers the cost of four Pulsavac treatments, based on a national average of more than \$400 per treatment. The savings from shortening an inpatient stay by even 1 day will pay for many Pulsavac treatments, based on current hospital costs per day. Additionally, when patients are undergoing Pulsavac debridements we generally discontinue whirlpool treatments because they become redundant, an additional economic benefit.

Our use of the Pulsavac is performed only by physicians because we believe this to be an instrument with the potential to do harm as well as good. At the higher pressure settings the Pulsavac performs full-thickness debridement, and it is our position that such should be done by a physician. Other facilities allow its use by trained nonphysicians, but it is our feeling that all debridements should be done by physicians.

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