

# Negative-Pressure Therapy in the Postoperative Treatment of Incisional Hernioplasty Wounds: A Pilot Study

Carles Olona, PhD; Enric Duque, MD; Aleidis Caro, PhD; Andrea Jiménez, MD; Félix Moreno, MD; Jose M. Coronas, MD; and Vicente Vicente, PhD

## ABSTRACT

Negative pressure therapy has proven useful in the treatment of the complex complications of surgical wounds. In this pilot study, the authors found that the negative pressure system can be used safely in the postoperative period of incisional hernia surgery and reduces the number of days of drainage.

**KEYWORDS:** negative pressure therapy, incisional hernioplasty, seroma

ADV SKIN WOUND CARE 2014;27:77-80

An incisional hernia is a common and debilitating complication of abdominal surgery, with a reported incidence of between 10% and 25% of laparotomies performed.<sup>1</sup> Despite advances in surgical techniques for incisional hernias, surgical intervention remains problematic, and no consensus has been reached as to the best surgical technique for treatment. The use of the open technique and prostheses is recommended in cases involving large incisional hernias, although there are several different techniques for the placement of these prostheses. These can be summarized as onlay or prefascial and sublay or retromuscular. A Cochrane review concluded that there is insufficient evidence to recommend one method over the other as yielding the best results.<sup>2</sup>

Relapse rates ranging from 5% to 63% have been documented in patients who have undergone incisional hernia surgery,<sup>3</sup> and there have been reports of other serious complications such as seromas, hematomas, and wound infections. The development of seromas is a common complication, occurring in up to 16% of cases.<sup>4,5</sup> When combined with inflammation, the disruption of lymphatic function and the continuous irritation of a foreign body (the prosthesis) can lead to the accumulation of fluid, particularly as the reduction of the hernia leaves a space for the fluid to po-

tentially accumulate.<sup>6</sup> Another complication that is cause for concern is the infection of the surgical wound, which occurs in 7% of patients on average and, in many cases, leads to the necessary removal of the prosthesis.<sup>2,7,8</sup>

The use of negative-pressure therapy (NPT) has been prescribed for the treatment of open and complex wounds since 1997.<sup>9</sup> Over the years, the advantages of the technique have been confirmed, as it improves healing times by increasing blood flow, extracting secreted fluids, protecting the edges of the wound, and protecting the wound from contamination.<sup>10</sup> Negative-pressure therapy was also later used for the treatment of closed wounds. The Prevena Incision Management System (Kinetic Concepts Inc, San Antonio, Texas), which has recently appeared on the market, is specifically designed for the treatment of closed wounds and has proven to be effective in preventing seromas and hematomas in sternotomic<sup>11,12</sup> and traumatologic<sup>13,14</sup> wounds.

Because similar complications are common during postoperative recovery following incisional hernia surgery, the authors conducted a pilot study to evaluate the treatment of posthernioplasty abdominal wounds using Prevena as a new postoperative therapy.

## MATERIALS AND METHODS

The authors conducted a pilot study on 5 patients diagnosed and operated on in the General and Digestive Surgery Department of the Joan XXIII University Hospital with incisional hernias with diameters exceeding 10 cm. These hernias are associated with an elevated risk of postoperative wound complications. All patients were duly informed about the study and signed informed consent releases.

In all cases, the Chevrel<sup>15</sup> hernioplasty surgical technique was used with a 30 × 30-cm PP light prosthesis (Cousin Biotech Inc, Wervicq-Sud, France). Two Redon-type subcutaneous suction drains were used in each patient. The subcutaneous plane was

Carles Olona, PhD, is a Surgeon Specialist; and Enric Duque, MD, is a Resident at the General and Digestive Surgery Department, Joan XXIII University Hospital, Tarragona, Spain. Aleidis Caro, PhD, is a Surgeon Specialist at the General and Digestive Surgery Department, Parc Taulí University Hospital, Sabadell, Spain. Andrea Jiménez, MD, is a Surgeon Specialist at the General and Digestive Surgery Department, Joan XXIII University Hospital, Tarragona, Spain. Félix Moreno, MD, is a Resident at the General and Digestive Surgery Department, Joan XXIII University Hospital, Tarragona, Spain. Jose M. Coronas, MD, is a Surgeon Specialist at the General and Digestive Surgery Department, Joan XXIII University Hospital, Tarragona, Spain. Vicente Vicente, PhD, is Head of the General and Digestive Surgery Department, Joan XXIII University Hospital, Tarragona, Spain. **Acknowledgment:** The authors would like to thank the Language Service of the Rovira I Virgili University for translating the original text of the article. The authors have disclosed that they have no financial relationships related to this article. Submitted September 13, 2012; accepted in revised form January 17, 2013.

sutured with simple Vicryl 3-0 stitches, and the skin secured with surgical staples in keeping with the standard technique. The drains were removed when drainage dropped less than 50 mL in 24 hours.

The Prevena Incision Management System (Kinetic Concepts Inc) was immediately applied to the closed wound in the operating theatre. The dressing was left in place for 7 days.

The Prevena Incision Management System consists of a sponge dressing on an adhesive sheet with a suction drain with a small tank for collecting fluids. When the system is applied, it holds the wound in place, isolates the wound from the exterior, and extracts fluids from the wound by applying negative pressure of 125 mm Hg.

The authors recorded all postoperative complications, length of time that the drains were left in place, and any adverse reactions to the dressing. Abdominal computed tomography scans were performed to confirm the presence or absence of postoperative seromas.

The study was an observational, cross-sectional pilot study comparing cases and controls. The control group consisted of 37 patients who had undergone surgery for incisional hernias with the same characteristics (nonrecurring, midline, and diameter >10 cm) and on whom the same surgical technique (Chevrel<sup>15</sup>) was used in the last 2 years.

The standard descriptors of categorical variables were used in the descriptive analysis: absolute (N) and relative (%) frequencies. The average and the 25th and 75th percentiles (P25 and P75) were used for quantitative variables, as the sample size was small. A  $\chi^2$  test was used to determine intergroup association with another categorical variable, and the Mann-Whitney U test was used for the independent NPT and control groups. Statistical significance was set at  $P < .05$ . The analysis was conducted with SPSSv20 software (Armonk, New York).

## RESULTS

A Prevena dressing was applied to 5 patients during the postoperative period following hernioplasty. The group included 3 women and 2 men with an average age of 68.6 years (range, 59–78 years). The average body mass index (BMI) of the subjects was 28.3 kg/m<sup>2</sup> (range, 23.4–36 kg/m<sup>2</sup>). Two participants had insulin-dependent diabetes mellitus, and 1 patient had ischemic heart disease. All patients studied required a 30 × 30-cm hernioplasty prosthesis.

All patients tolerated the negative-pressure dressing until the end of the 7-day treatment. No adverse reactions to the dressing were observed, and it was not necessary to remove the NPT dressings until the indicated treatment period was complete.

The average number of drainage days in patients with NPT dressings was 4, with a range of 3 to 5 days. The average volume of fluid collected in the Redon drains was 270 mL (range, 150–350 mL). No drainage of fluid through the NPT dressings was observed, and the amount of fluid collected by the suction unit was negligible.

Patients treated with the NPT dressings showed no evidence of seromas, hematomas, or infections of the wound.

For the control group, 37 patients who had undergone surgery for the same type of incisional hernias as the case group in the 2 previous years were selected. These patients had nonrecurrent and midline hernias of more than 10 cm in diameter that were surgically repaired by means of the Chevrel<sup>15</sup> technique. No statistically significant differences between the groups were found in terms of the demographic variables of age and BMI (Table 1).

The postoperative complication rate of the control group consisted of 13.5% seromas, 13.5% wound infection, and 5.4% hematomas. These differences were not statistically significant in the comparison of postoperative complications (Table 2).

Patients in the NPT group showed a statistically significant decrease in the number of days required for drainage, with an average of 7 days in the control group compared with an average of 4 days in the NPT group (Table 3).

## DISCUSSION

The onlay technique for the treatment of large incisional hernias is very popular among surgeons because it prevents direct contact with abdominal viscera and tension in the wound. Its disadvantage is that it requires large incisions in the preaponeurotic plane, which can lead to the development of complications such as seromas, hematomas, and infections of the wound. The reduction of the hernia leaves a space in which fluid can potentially accumulate. This accumulation combined with inflammatory stimuli, the disruption of lymphatic vessels, and the continuous irritation caused by the reaction to foreign bodies (the prosthesis) may favor the appearance of seromas in the wound.<sup>16</sup> In order to prevent seromas, drains are placed in the subcutaneous plane to allow the fluids generated to be aspirated, and elastic compression

Table 1.

### AGE AND BMI IN BOTH GROUPS

	Prevena				Control				Mann-Whitney U Test <i>P</i>
	n	Average	P25	P75	n	Average	P25	p75	
Age, y	5	71	62	73	37	62	53	74	.273
BMI, kg/m <sup>2</sup>	5	28.10	28.10	29	37	30.02	27.06	32.44	.258

Table 2.

## POSTOPERATIVE COMPLICATIONS IN BOTH GROUPS

		Prevena		Control		$\chi^2$ Test
		n	%	n	%	
Hematoma	Yes	0	0	2	5.41	1
	No	5	100	35	94.59	
Seroma	Yes	0	0	5	13.51	1
	No	5	100	32	86.49	
Infection	Yes	0	0	5	13.51	1
	No	5	100	32	86.49	

bands are applied during postoperative recovery. The authors always use 2 subcutaneous suction drains for large incisional hernia surgeries, and in order to follow the same technique in this study, the authors inserted 2 drains in the patient group treated with the Prevena dressing at the same time as those used to assess the volume of liquid produced.

Despite these measures, seromas can form that are then not reabsorbed and require surgical or puncture drainage. These procedures can promote the infection of the wound.<sup>3</sup> Recently published evidence has also indicated that a high BMI, lower protein and albumin blood concentrations, and high interleukin 1 receptor antagonist serum concentrations are associated with a greater risk of developing postoperative seromas.<sup>17,18</sup>

The use of NPT for treating open and complex wounds<sup>19,20</sup> has increased notably in the past few years and has even been used in open abdomen treatments.<sup>21,22</sup> Negative-pressure therapy has been shown to induce healing by activating fibroblasts and removing exudates while reducing the accumulation of inflammatory mediators.<sup>19</sup> However, Wackenfors et al<sup>23</sup> have also demonstrated that negative pressure of 125 mm Hg increases blood flow by a factor of 4, which improves the partial pressure of oxygen and lactate levels in the wound. All these mechanisms combined with the stability of the wound are considered to be related to decreased seromas and wound infections in closed sternotomic wounds in which Prevena has been applied.<sup>11,12</sup>

The authors' group decided to use the Prevena dressing to prevent postoperative wound complications in large incisional hernias, that is, for the same reason it is used in cardiac surgery, because the 2 procedures give rise to similar complications and no other studies describing this application have yet been published.

López-Cano and Armengol-Carrasco<sup>24</sup> applied a conventional vacuum-assisted closure dressing as the postoperative treatment of 3 hernioplasties, advancing the possible protective effect of NPT in the appearance of postoperative seromas after hernioplasty.

In this case, the authors chose to use the Prevena dressing because it is specially designed for use with closed wounds. In accordance with other studies, the authors also observed an absence of seromas (0% compared with 13%) and other postoperative complications. These differences were not statistically significant, which the authors attribute to the size of the patient group.

However, the reduction in the number of days of postoperative drainage required was statistically significant and is directly related to reduced drainage volume. The drainage volume could not be compared with the control group because the drainage data for the control group were not available to us.

The stabilization provided by NPT prevents fluid from draining through the wound, which is demonstrated in the absence of drainage fluid in the mechanism's receptacles. The use of drains is the best method for reducing seroma; however, stabilization and compression produced by NPT help decrease subcutaneous fluid accumulation. This stabilization may be related to the decrease in days of drainage and is also a preventive factor in wound infection, together with the physical barrier of the dressing and the impregnation of the sponge with silver.<sup>12</sup>

The primary limitation of this research is that it is a pilot study conducted with very few patients. However, this is to be the first in a series of publications on this treatment in abdominal incisional hernia surgery. Despite being a small sample, the groups are comparable as there are no statistically significant differences in demographic characteristics and BMI.

Table 3.

## COMPARISON OF THE NUMBER OF DAYS OF POSTOPERATIVE DRAINAGE IN BOTH GROUPS

	Prevena				Control				Mann-Whitney <i>U</i> Test <i>P</i>
	n	Average	P25	P75	n	Average	P25	P75	
No. days	5	4	3	5	37	7	5	10	.010

Despite the limitations, and in accordance with the lack of literature to date, the authors believe that the Prevena mechanism may act to stabilize and protect incisional hernia surgical wounds and prevent postoperative complications. The observed decrease in drainage fluids and the earlier removal of the dressing may lead to shorter hospital stays and even to the treatment of large hernia surgeries without hospital admittance. ●

## REFERENCES

1. Kingsnorth A, Banerjee A, Bhargava A. Incisional hernia repair—laparoscopic or open surgery? *Ann R Coll Surg Engl* 2009;91:631-6.
2. den Hartog D, Dur AH, Tuinebreijer WE, et al. Open surgical procedures for incisional hernias. *Cochrane Database Syst Rev* 2008;16:CD006438.
3. Shell DH 4th, de la Torre J, Andrades P, et al. Open repair of ventral incisional hernias. *Surg Clin North Am* 2008;88:61-83.
4. Leber Ge, Garb JB, Alexander AJ, et al. Long-term complications associated with prosthetic repair of incisional hernias. *Arch Surg* 1998;133:378-82.
5. Cobb WS, Harris JB, Lokey JS, et al. Incisional herniorraphy with intraperitoneal composite mesh: a report of 95 cases. *Am Surg* 2003;69:784-7.
6. Grevious MA, Cohen M, Jean-Pierre F, et al. The use of prosthetics in abdominal wall reconstruction. *Clin Plast Surg* 2006;33:181-97.
7. Bauer JJ, Harris MT, Krael I, et al. Twelve year experience with expanded polytetrafluoroethylene in the repair of abdominal defects. *Mt Sinai Med J* 1999;66:20-5.
8. Jones JW, Jurkovich GJ. Polypropylene mesh closure of infected abdominal wounds. *Am Surg* 1989;55:73-6.
9. Argenta LC, Morykwas MJ. Vacuum-assisted closure: a new method for wound control and treatment: clinical experience. *Ann Plast Surg* 1997;38:563-76.
10. Venturi ML, Attinger CE, Mesbahi AN, et al. Mechanisms and clinical applications of the vacuum-assisted closure (VAC) device: a review. *Am J Clin Dermatol* 2005;6:185-94.
11. Atkins BZ, Wooten MK, Kistler J, et al. Does negative pressure wound therapy have a role in preventing poststernotomy wound complications? *Surg Innov* 2009;16:140-6.
12. Colli A, Camara ML. First Experience with a new negative pressure incision management system on surgical incision after cardiac surgery in high risk patients. *J Cardiothorac Surg* 2011;6:160.
13. Stannard JP, Robinson JT, Anderson ER, et al. Negative pressure wound therapy to treat hematomas and surgical incisions following high-energy trauma. *J Trauma* 2006;60:1301-6.
14. Stannard JP, Atkins BZ, O'Malley D, et al. Use of negative pressure therapy on closed surgical incisions: a case series. *Ostomy Wound Manage* 2009;55:58-66.
15. Chevrel JP. Traitement des grandes éventrations médianes par plastie en paletot et prothèse. *N Presse Med* 1979;9:695-6.
16. Grevious MA, Cohen M, Jean-Pierre F, et al. The use of prosthetics in abdominal wall reconstruction. *Clin Plast Surg* 2006;33:181-97.
17. Klink CD, Binnebösel M, Lucas AH, et al. Do drainage liquid characteristics serve as predictors for seroma formation after incisional hernia repair? *Hernia* 2010;14:175-9.
18. Klink CD, Binnebösel M, Lucas AH, et al. Serum analyses for protein, albumin and IL-1-RA serve as reliable predictors for seroma formation after incisional hernia repair. *Hernia* 2011;15:69-73.
19. Bovill E, Banwell PE, Teot L, et al. Topical negative pressure wound therapy: a review of its role and guidelines for its use in the management of acute wounds. *Int Wound J* 2008;5:511-29.
20. Orgill D, Manders EK, Sumpio BE, et al. The mechanisms of action of vacuum assisted closure: more to learn. *Surgery* 2009;146:40-51.
21. Boele van Hensbroek P, Wind J, Dijkgraaf M, et al. Temporary closure of the open abdomen: a systematic review on delayed primary fascial closure in patients with an open abdomen. *World J Surg* 2009;33:199-207.
22. Caro A, Olona C, Jiménez A, et al. Treatment of the open abdomen with topical negative pressure therapy: a retrospective study of 46 cases. *Int Wound J* 2011;8:274-9.
23. Wackenfors A, Gustafsson R, Sjögren J, et al. Blood flow responses in the peristernal thoracic wall during vacuum-assisted closure therapy. *Ann Thorac Surg* 2005;79:1724-31.
24. López-Cano M, Armengol-Carrasco M. Use of vacuum-assisted closure in open incisional hernia repair: a novel approach to prevent seroma formation [published online ahead of print June 12, 2011]. *Hernia* 2013;17:129-31.

## CALL FOR PAPERS

Advances in

SKIN &  
WOUND CARE®

*Advances in Skin & Wound Care* is soliciting manuscripts on a variety of topics, including original investigations, clinical concepts, and literature reviews.

Consult the journal's Web site, [www.woundcarejournal.com](http://www.woundcarejournal.com), for the Author Guidelines.