

Original Research Article

Negative pressure wound therapy in management of abdominal wound dehiscence: a case-control studyRakesh Kumar¹, Keshav Kumar^{2*}, Manish Mandal³, Sanjay Kumar⁴, Rakesh Kumar Singh⁵¹Senior Resident, Department of General Surgery, Indira Gandhi Institute of Medical Sciences, Patna, Bihar, India.²Senior Resident, Department of General Surgery, Indira Gandhi Institute of Medical Sciences, Patna, Bihar, India.³Professor, Department of G.I Surgery, Indira Gandhi Institute of Medical Sciences, Patna, Bihar, India.⁴Assistant Professor, Department of G.I Surgery, Indira Gandhi Institute of Medical Sciences, Patna, Bihar, India.⁵Assistant Professor, Department of G.I Surgery, Indira Gandhi Institute of Medical Sciences, Patna, Bihar, India.

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Abstract

Background: Since the 1990's, negative pressure wound therapy (NPWT) has been used to treat soft tissue defects, burn wounds, and to achieve skin graft fixation. In the field of abdominal surgery, the application of NPWT is increasing in cases with an open abdominal wound requiring temporary wound closure and a second look operation. In the present study, analyzed negative pressure wound therapy in management of abdominal wound dehiscence. **Materials and Methods:** The study was conducted in the Department of General Surgery Indira Gandhi Institute of Medical Sciences, Patna, Bihar India. This study was done during from Jan 2016 to December 2016. Institutional ethical approval was obtained before conducting this study. A total of n=100 cases were included in this study. Out of n=100, 50 were taken as cases in whom intervention was done by applying VAC Therapy and 50 were taken as control in whom only NS dressing was done. **Results:** In this study major number of patients belonged to the age group between 40-60 years, Abdominal wound dehiscence were more common in males 71 cases (71%) than females 29 cases (29%). Male to female ratio was 2.4:1. The type abdominal wound dehiscence was most commonly partial thickness wound dehiscence 64 case (64%) and full thickness wound dehiscence were 36 (36%). There was mean wound contraction of 0.82 cm in post VAC patients compared to 0.13 cm in post ns dressing, there was significant decrease in wound sepsis of patient by application of negative pressure wound therapy and patients with negative pressure wound therapy dressing has more number of healing by secondary intention and nil mortality rate. **Conclusion:** NPWT significantly reduces the hospital stay of patients, it causes faster and higher degree of wound contraction, reduces wound sepsis thereby reducing morbidity of patient.

Keywords: Abdominal wound dehiscence, Negative pressure wound therapy, Vacuum assisted closure.

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Introduction

Negative pressure wound therapy (NPWT) was introduced as a vacuum-assisted closure (VAC) by Morykwas et al [1,2].

In the late 1990's, and is currently used for wound management in various fields, such as, to manage soft tissue defects, fixate grafted skin, and to treat burn wounds. Whereas the application of NPWT to surgical abdominal wounds was initiated as a form of damage control surgery in trauma patients or for temporary wound closure prior to a second look operation in the 2000s [3,4]. Recently, NPWT has applied in patients who were diagnosed with abdominal compartment

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syndrome as an essential procedure of decompressive laparotomy[5,6]. Wound dehiscence is disruption of any or all of the layers in a wound. It can be partial or complete disruption of abdominal wound closure with or without protrusion of abdominal contents. Post laparotomy wound dehiscence occurs in 0.25% to 3% of patient[7,8]. Most patient will need to return to operation theatre for resuturing. In some patients it may be appropriate to leave the wound open and treat with dressings or vacuum- assisted closure (VAC) pumps. NPWT was also known as a vacuum dressing or VAC dressing (vacuum assisted closure), is a therapeutic technique using a suction dressing to remove excess exudation and promote healing in acute or chronic wounds. The therapy involves the controlled application of sub-atmospheric pressure to the local wound environment, using a sealed wound dressing connected to a vacuum pump[9-12]. The use of this technique in wound management increased dramatically over the 1990s and 2000s[13]. NPWT appear to be useful in management of the open abdomen (laparotomy)[14] General technique for NPWT is as follows: protect the peri wound by applying a skin barrier[15]. A dressing or filler material is fitted to the contours of a wound (which is covered with a non-adherent dressing film) and the overlying foam is then sealed with a transparent film. A drainage tube is connected to the dressing through an opening of the transparent film. A vacuum tube is connected through an opening in the film drape to a canister on the side of a vacuum pump.¹⁰ Vacuum source, turning an open wound into a controlled, closed wound while removing excess fluid from the wound bed to enhance circulation and remove wound fluids. This creates a moist healing environment and reduces edema. There must be an air tight seal in order for this therapy to be successful[15,16]. Abdominal wound dehiscence (AWD) has been a long term dilemma for which no surgical unit has come with a 100% plan (i.e. none of the surgical units worldwide has reported 0% failure rate). However many institutes globally have been trying successfully to achieve and keep failure rates well below 1%. These statistics however do not discourage the continuing research in attempts to eliminate the problem. A wide variety number of publications have been done in the past ten years trying

to explain how this problem can be overcome. In view of increasing incidence of abdominal wound dehiscence, we have chosen to study the cases of abdominal wound dehiscence in our hospital and find the effectiveness of negative pressure wound therapy in management of abdominal wound dehiscence over other conventional methods of wound management.

Material and methods

The study was conducted in the Department of General Surgery Indira Gandhi Institute of Medical Sciences, Patna, Bihar India. This study was done during January 2016 to December 2016. Institutional ethical approval was obtained before conducting this study.

Inclusion criteria

All cases of post laparotomy full thickness/ partial thickness abdominal wound dehiscence including all age groups.

Exclusion criteria

Patients not giving informed consent
Patients having Enterocutaneous fistula

Sample selection

A total of n=100 cases were included in this study. Out of n=100, 50 were taken as cases in whom intervention was done by applying VAC Therapy and 50 were taken as control in whom only NS dressing was done.

Methodology

The primary intervention was by NPWT delivered by any mode (for example vacuum-assisted closure (VAC system) or simple closed-system suction drainage) or AB thera system delivered continuously or intermittently over a specified time period. The comparison was done with simple Normal saline dressing.

Statistical analysis

The recorded data was compiled and entered in a spreadsheet computer program (Microsoft Excel 2010) and then exported to data editor page of SPSS version 19 (SPSS Inc., Chicago, Illinois, USA). Descriptive statistics included computation of percentages and means. Test applied for the analysis was t-test and chi-square test. The confidence interval and level of significance were set at 95% and 0.05.

Results**Table 1: Distribution of subjects according to age, gender and type of wound dehiscence**

Factor	No. of cases=100	%
Age (in years)		
0-20	8	8
20-40	39	39
40-60	43	43
Above 60	10	10
Gender		
Male	71	71
Female	29	29
Type of wound dehiscence		
Full thickness	36	36
Partial thickness	64	64

Table 2: Distribution of patients with abdominal wound dehiscence according to underlying intra- abdominal pathology

Diagnosis	No. of cases
Perforation peritonitis	48
Incisional hernia	17
Malignancy	6
Blunt trauma abdomen with perforation peritonitis	5
SMV/SMA Thrombosis	4
Psoas abscess	2
Post LSCS	4
Intestinal obstruction	12
Other(acute appendicitis,obstructed incisional hernia)	2
Total	100

Table 3: Organism cultured from wound before and after application of vac.

Culture	Frequency	%
Before VAC		
<i>Staphylococcus</i>	17	34
<i>Pseudomonas</i>	13	26
<i>Klebsiella</i>	6	12
<i>Escherichia coli</i>	11	22
No growth	3	6
After VAC		
<i>Staphylococcus</i>	4	8
<i>Pseudomonas</i>	4	8
<i>Klebsiella</i>	2	4
<i>Escherichia coli</i>	3	6
No growth	37	74

Table 4: Post vac and post normal saline wound contraction

Wound Contraction	Group	N	Mean	SD	p-value
	Cases	50	0.82	0.33	0.001
	Control	50	0.13	0.131	

Test applied: student t-test

Table 5: plan at end of treatment

Test applied: chi-square test

Groups	Healing by secondary intension	Secondary resuturing	Tension suturing	Expired	p-value
Cases	16	26	8	0	0.02
Controls	3	40	6	1	

Discussion

This study addresses the superiority between two different ways of managing abdominal wound dehiscence; one is the conventional normal saline dressing and the other newer modality negative pressure wound therapy. Intraoperative and post-operative wound infection is the main cause of abdominal wound dehiscence. When the wound dehiscence occurs mostly saline dressing was done, which has to change multiple times in a day, this increased the chances of further wound infection and also distressing to patient to bear the pain during dressing. On the other hand negative pressure wound therapy increases dermal perfusion and stimulates the formation of granulation tissue, and thus, accelerates wound healing and decreases bacterial colonization because it reduces tissue edema and interstitial tissue fluid, it also promotes wound contraction and causes facial closure. The frequency of dressing is every 2-3 weeks which has psychological benefit for patient and also prevent transmission of environmental infection from entering into wound. In literature many studies have been carried out comparing VAC therapy with Bagota bag, saline dressing, none of them has taken all the four parameter of wound c/s, wound contraction, and mortality which will specifically show the efficacy of VAC therapy over the other conventional forms of dressing. In present study all the parameter were considered[17,18]. In addition, the reverse tissue expansion effect of negative pressure helps to approximate skin and fascia. The efficacy of NPWT has already been proven, and currently, it is used to treat trauma-induced soft tissue defects, necrotizing fasciitis, suppurative and extravasation injuries and burn wounds, and to promote skin graft fixation[19,20]. Recently, NPWT has been applied in the abdominal surgery field for temporary closure in

cases of trauma and bowel strangulation, and to manage abdominal compartment syndrome when the abdomen is open[21,22].

In this study major number of patients belonged to the age group between 40-60 years, youngest age was 6 months and oldest patient was 85 years. The mean age affected is 44.2 yrs. In study of Subramonia et al[23] and Batacchi et al[24] the mean age was 60 year and 68.3 year respectively.

In our study the abdominal wound dehiscence were more common in males 71 cases (71%) than females 29 cases (29%). Male to female ratio was 2.4:1. The type abdominal wound dehiscence was most commonly partial thickness wound dehiscence 64 case (64%) and full thickness wound dehiscence were 36 (36%). Subramonia et al[23] 33 male and 18 female and Batacchi et al[24] 50 male and 16 female were studied.

In present study abdominal wound c/s positive before application of VAC was in 37 patients out of the 50 cases and after application of VAC c/s positive reports came out in 13 patients. The p value is 0.00071 which is highly significant. In study done by Jang et al p value is not significant. In present study 26 out of 50 cases wound closure by VAC which was either healed by secondary intension or was resutured as the wound got contracted so much that simple suturing could be possible, in 8 cases there was no wound contraction so tension suturing had to be done.²⁵ In study of Subramonia et al 31 patients had successful wound closure by VAC and in study of Jang et al out of 50, 39 patients had successful wound closure.^{23,24}

The hospital stay was found to be only 21 days for patients with VAC dressing, when compared to the conventional dressings, who have an average hospital stay of 30 days In study of Batacchi et al the mean hospital stay was 28.5 days with p value of 0.019 which is significant[24]. In study of Jang et al and

Subramonia et al mean hospital stay was 42 and 39 days respectively[23,25]. Patients with VAC dressing have more healing by secondary intension before discharge and nil rate of patient being expired when compared to the control group.

52% of cases were healed by secondary intension when compared to 80 % in control group. The death rates in cases were only 0% when compared to 2% in control group. In study conducted by Subramonia et al out of 51 patients' 27 patients wound was closed by secondary intension[23] in study of Jang et al mostly secondary suturing was done[25].

Conclusion

Negative pressure wound therapy significantly reduces the hospital stay of the patient, it causes faster and higher degree of wound contraction, it reduces the wound sepsis thereby reducing the morbidity of patients and has nil mortality rates. From above study it has been shown that negative pressure wound therapy is far more better way of managing abdominal wound dehiscence and should be used in all possible cases of abdominal wound dehiscence.

References

1. Argenta LC, Morykwas MJ. Vacuum-assisted closure: a new method for wound control and treatment: clinical experience. *Ann Plast Surg* 1997;38:563-76.
2. Morykwas MJ, Argenta LC, Shelton-Brown EI, McGuirt W. Vacuum-assisted closure: a new method for wound control and treatment: animal studies and basic foundation. *Ann Plast Surg* 1997;38:553-62.
3. Caro A, Olona C, Jimenez A, Vadillo J, Feliu F, Vicente V. Treatment of the open abdomen with topical negative pressure therapy: a retrospective study of 46 cases. *Int Wound J* 2011;8:274-9.
4. D'Hondt M, D'Haeninck A, Dedrye L, Penninckx F, Aerts R. Can vacuum-assisted closure and instillation therapy (VACInstill therapy) play a role in the treatment of the infected open abdomen? *Tech Coloproctol* 2011;15:75-7.
5. Plaudis H, Rudzats A, Melberga L, Kazaka I, Suba O, Pupelis G. Abdominal negative-pressure therapy: a new method in countering abdominal compartment and peritonitis - prospective study and critical review of literature. *Ann Intensive Care* 2012;2 Suppl 1:S23.
6. Batacchi S, Matano S, Nella A, Zagli G, Bonizzoli M, Pasquini A, et al. Vacuum-assisted closure device enhances recovery of critically ill patients following emergency surgical procedures. *Crit Care* 2009;13:R194.
7. Gislason H, Gronbech JE, Soreide O. Burst abdomen and incisional hernia after major gastrointestinal operations: comparison of three closure techniques. *Eur J Surg*.1995;161:349-54.
8. Haddad V, Macon WL. Abdominal wound dehiscence and evisceration: contributing factors and improved mortality. *Am Surg*.1980;46:508-13.
9. Lillis, Karin. Effective wound care requires look at total patient picture. *Healthcare Purchasing News*. 2003;27(1):32.
10. Cipolla J, Baillie DR, Steinberg SM, Martin ND, Jaik NP, Lukaszczuk JJ, et al. Negative pressure wound therapy: unusual and innovative application. *OPUS Scientist*.2008;2(3):15-29.
11. Moody, Yasmeeen. Advances in healing chronic wounds. *The Ithaca J*.2001:10.
12. Erich F. Best treatment of non-healing and problematic wounds. *J Am Academy Phys Assist*. 2009;22(8):46-8.
13. Driscoll P. Negative pressure wound therapy. Available at https://en.wikipedia.org/wiki/Negative-pressure_wound_therapy. Accessed on 21 August 2019.
14. James EF. Laparostomy management using the ABThera™ open abdomen negative pressure therapy system in a grade IV open abdomen secondary to acute pancreatitis. *Int Wound J*. 2012;10:138-44.
15. The challenges of negative pressure wound therapy in clinical practice. Available at www.Todayswoundclinic.com. Accessed on 20 April 2017.
16. Baxter H, Ballard K. Vacuum-assisted closure. *Nursing Times*.2001;97(35):51-2.
17. Wittmann DH, Aprahamian C, Bergstein JM, Edmiston CE, Frantzides CT, Quebbeman EJ, et al. A burr-like device to facilitate temporary abdominal closure in planned multiple laparotomies. *Eur J Surg* 1993;159:75-9.
18. Kirshtein B, Roy-Shapira A, Lantsberg L, Mizrahi S. Use of the "Bogota bag" for temporary abdominal closure in patients with secondary peritonitis. *Am Surg* 2007;73:249-52.
19. Armstrong DG, Lavery LA; Diabetic Foot Study Consortium. Negative pressure wound therapy

- after partial diabetic foot amputation: a multicentre, randomised controlled trial. *Lancet* 2005;366:1704-10.
20. Moisisidis E, Heath T, Boorer C, Ho K, Deva AK. A prospective, blinded, randomized, controlled clinical trial of topical negative pressure use in skin grafting. *Plast Reconstr Surg* 2004;114:917-22.
 21. Barker DE, Kaufman HJ, Smith LA, Ciraulo DL, Richart CL, Burns RP. Vacuum pack technique of temporary abdominal closure: a 7-year experience with 112 patients. *J Trauma* 2000;48:201-6.
 22. Brace JA. Negative pressure wound therapy for abdominal wounds. *J Wound Ostomy Continence Nurs* 2007;34:428-30
 23. Subramonia S, Pankhurst S, Rowlands BJ. Vacuum- assisted closure of postoperative abdominal wounds: a prospective study. *World J Surg*.2009;33:931-93.
 24. Batacchi S, Matano S, Nella A, Zagli G, Bonizzoli M, Pasquini A, et al. Vacuum-assisted closure device enhances recovery of critically ill patients following emergency surgical procedures. *Crit Care*. 2009;13:194.
 25. Jang JY, Shim H, Lee YJ, Lee SH. Application of negative pressure wound therapy in patient with wound dehiscence after abdominal open surgery: a single center experience. *J Korean Surg Soc*. 2013; 85 (4): 180-4.

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