Original Research Article

Study of negative pressure wound therapy in management of abdominal wound dehiscence

Bhupesh Tirpude¹, Mrinalini M. Borkar², Nilesh N. Lokhande¹

¹Department of General surgery, Government Medical College Nagpur, Maharashtra, India
²Department of General surgery, Indira Gandhi Government Medical College, Nagpur, Maharashtra, India

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*Correspondence:
Dr. Nilesh N. Lokhande,
E-mail: nilesh lokhande108@gmail.com

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ABSTRACT

Background: Postlaparotomy Abdominal wound dehiscence (AWD) occurs in 0.25% to 3%. Many technique are being used to manage AWD like surgical revision with open dressing/closed irrigation, temporary covering with ‘Bagota bag’, saline soak gauze dressing, absorbable/permanent mesh. Negative-pressure wound therapy (NPWT) is a recent modality of treatment of wound. It involves controlled application of sub atmospheric pressure to local wound environment, using sealed wound dressing connected to vacuum pump. This study aimed at finding the effectiveness of negative pressure wound therapy in management of abdominal wound dehiscence over conventional methods of wound management.

Methods: This was hospital based non randomised comparative prospective interventional study carried between July 2017 to November 2019, includes all patients admitted in GMCH, Nagpur Hospital having post laparotomy AWD, excluding the patients having enter ocutaneous fistula and patient not giving consent for VAC application. Total n=60 cases were included in study. Out of 60, 30 were taken as cases in whom intervention was done by applying vacuum assisted closure (VAC) therapy and 30 were control.

Results: All 60 patients had undergone laparotomy of this patients 30 patients was applied NPWT and efficacy plotted on the parameter of, wound sepsis, wound contraction, length of hospital stay and extension of time therapy. It was found that 90% patients had negative c/s post VAC dressing, compared to 26% in post ns dressing, there was MWC of 0.86 cm in post VAC patients compared to 0.14 cm in post NS dressing, MHS was 18.9 days in cases and was 28 days in controls,13 patients had complete fascial closure in cases whereas none in controls.

Conclusions: NPWT significantly reduces the hospital stay of patients, it causes faster and higher degree of wound contraction, reduces wound sepsis thereby reducing morbidity of patients.

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

INTRODUCTION

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 patients.¹² 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.

The use of negative pressure wound therapy (NPWT) can be dated back to the earliest civilizations. However, in these ancient times, NPWT did not involve electric vacuums because, obviously, these were not invented yet.
Instead of vacuums, ancient men would use their mouths to create the negative pressure by sucking the wound. This sucking action continually drew fluid from the wounds and increased blood flow to the wound, much like the modern day vacuum system, although much less sanitary.

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. The use of this technique in wound management increased dramatically over the 1990s and 2000s. NPWT appear to be useful in management of the open abdomen (laparotomy). 

General technique for NPWT is as follows: "protect the peri wound by applying a skin barrier". A dressing or filler material is fitted to the contours of a wound (which is covered with a non-adhering 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 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.

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.

METHODS

This was hospital based non randomized comparative prospective interventional study carried from July 2017 to November 2019, it includes all the patients admitted in GMCH, Nagpur Hospital having post laparotomy abdominal wound dehiscence. A total of n=60 cases were included in this study. Out of n=60, 30 were taken as cases in whom intervention was done by applying VAC Therapy and 30 were taken as control in whom only NS dressing was done. The statistical analysis was done by open EPI software version 3.01, updated 06 April 2013 where mean and standard deviation was calculated and comparative analysis was done, p value <0.05 was considered statistically significant.

For this study approval was taken from institutional ethics committee Department of Pharmacology GMCH Nagpur and study was started only after approval.

Sample Size

Sample size was calculated according to following formula

S= \( z^2(p1q1+p2q2)/D^2 \)

Where,

S=sample size, P=prevalence, D=allowable error, q = 1-p, z=1.96 for 95% confidence interval

Type of intervention

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 with simple Normal saline dressing.

Inclusion criteria

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

Exclusion criteria

Patients not giving consent for applying vac and patients having Enterocutaneous fistula.

RESULTS

In this study major number of patients belonged to the age group between 51-75 years, youngest age was 2 months and oldest patient was 81 years. The mean age affected is 43.3 yrs. Abdominal wound dehiscence were more common in males 46 cases (77%) than females 14 cases (23%). Male to female ratio was 3.2:1. The type abdominal wound dehiscence was most commonly partial thickness wound dehiscence 36 case (60%) and full thickness wound dehiscence were 24 (40%). Out of 60 cases studied, 24 were of perforation peritonitis, 09 were incisional hernia, 5 were of malignancy, 4 blunt trauma abdomen, 1 psaos abscess and 3 post lower segment cesarian section (LSCS), 7 intestinal obstruction, 3 sma/smv thrombosis and other 4 cases.
The most common organism cultured from the abdominal wound dehiscence before application of VAC therapy was *Staphylococcus* 30%. By the application of VAC therapy mostly no growth of organism seen in 70% of cases.

### Table 1: Distribution of subjects according to age, gender and type of wound dehiscence.

| Factor                     | No. of cases | %    |
|----------------------------|--------------|------|
| Age (in years)             |              |      |
| 0-25                       | 6            | 10   |
| 26-50                      | 25           | 41.66|
| 51-75                      | 28           | 46.66|
| 76-100                     | 1            | 1.66 |
| Gender                     |              |      |
| Male                       | 46           | 76.66|
| Female                     | 14           | 23.33|
| Type of wound dehiscence   |              |      |
| Full thickness             | 24           | 40   |
| Partial thickness          | 36           | 60   |

The most common organism cultured from the abdominal wound dehiscence before normal saline dressing was *Staphylococcus* 25%. By the normal saline dressing, *E. Coli* is present in 30% and no growth of organism in 27% controls.

Thus it showed that there was significant decrease in wound sepsis of patient by application of negative pressure wound therapy. There was mean wound contraction of 0.86 cm in post VAC patients compared to 0.14 cm in post ns dressing.

The chi-square statistic is 11.28 (2-tail). The p value is 0.00078. This result was significant at p<0.05. The chi-square statistic with Yates correction is 9.611. The p value is 0.0019. Significant at p<0.05.

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

| Organisms before        | Frequency | %    |
|-------------------------|-----------|------|
| *Staphylococcus*        | 9         | 30   |
| *Pseudomonas*           | 8         | 26.66|
| *Klebsiella*            | 3         | 10   |
| *Escherichia coli*      | 7         | 23.33|
| No growth               | 3         | 10   |

### Table 4: Post vac and post normal saline c/s cross tabulation and wound contraction.

| Cross tabulation       | C/s positive | C/s negative | Total |
|------------------------|--------------|--------------|-------|
| Vac dressing           | 9            | 21           | 30    |
| Ns dressing            | 22           | 8            | 30    |
| Total                  | 31           | 29           | 60    |

### Table 5: Hospital stay and plan at end of treatment.

| Groups        | N   | Mean | Standard deviation | P value | Independent sample t test |
|---------------|-----|------|--------------------|---------|--------------------------|
| Hospital stay | Cases | 30   | 18.9               | 2.83    | 0.00009                  |
|               | Control | 30   | 28                 | 6.79    |                           |

### End treatment plan

| Groups        | Healing by secondary intensity | Secondary resuturing | Tension suturing | Expired | P value |
|---------------|--------------------------------|----------------------|------------------|---------|---------|
|               | Cases | 11   | 15                 | 4                  | 0       | 0.03    |
|               | Controls | 2   | 23                 | 4                  | 1       |         |
Figure 1: Pre and post negative pressure wound therapy (Pt.1-6).

(*Pt.-Patient)

Table 4 shows that there was significant decrease in wound sepsis of patient by application of negative pressure wound therapy and the above cross table also shows that there was significant wound contraction after application of VAC therapy over abdominal wound dehiscence p value is <0.000001. Table 5 shows that there is significant decrease in hospital stay by application of VAC over abdominal wound dehiscence p value (0.000009). It also showed that patients with negative pressure wound therapy dressing has more number of healing by secondary intention and nil mortality rate.

**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, hospital stay 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.

Table 6: Comparison of age and gender distribution in various studies.

| Study          | Mean age group (in years) | Males | Females |
|----------------|--------------------------|-------|---------|
| Subramonia et al\textsuperscript{11} | 60 |       |         |
| Batacchi et al\textsuperscript{12}  | 68.3 |       |         |
| Jang et al\textsuperscript{13}    | 61.5 |       |         |
| Present study  | 46.6 |       |         |

Table 7: Comparison of organism cultured in various studies.

| Study          | Wound c/s positive pre-VAC | Wound c/s positive post-VAC | P value |
|----------------|----------------------------|-----------------------------|---------|
| Jang et al\textsuperscript{13} | 55 | 36 | 0.705 |
| Present study  | 27 | 9  | 0.00078 |

In present study abdominal wound c/s positive before application of VAC was in 27 patients out of the 30 cases and after application of VAC c/s positive reports came out in 9 patients. The p value is 0.00078 which is highly significant. In study done by Jang et al p value is not significant. In present study 26 out of 30 cases wound closure by VAC which was either healed by secondary intention or was resutured as the wound got contracted so much that simple suturing could be possible, in 4 cases there was no wound contraction so tension suturing had to be done.\textsuperscript{13} 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.\textsuperscript{11,12}

Table 8: Comparison of wound closure and hospital stay in various studies.

| Study          | Successful wound closure by VAC | Unsuccessful wound closure by VAC | Mean hospital stay after application of VAC in days | P value |
|----------------|---------------------------------|-----------------------------------|----------------------------------------------------|---------|
| Subramonia et al\textsuperscript{11} | 31 | 20 | | |
| Jang et al\textsuperscript{13}    | 39 | 11 | | |
| Present study  | 26 | 4  | | |

The hospital stay was found to be only 19 days for patients with VAC dressing, when compared to the conventional dressings, who have an average hospital stay of 28 days. Independent sample t-test showed that the study is significant (p value <0.000009). In study of Batacchi et al the mean hospital stay was 28.5 days with p value of 0.019 which is significant.\textsuperscript{12} In study of Jang et al and Subramonia et al mean hospital stay was 42 and 39 days respectively.\textsuperscript{11,13} Patients with VAC dressing have more healing by secondary intention before discharge and nil rate of patient being expired when compared to the control group. Pearson-chi square test showed the study was significant (p value=0.030).

36.66% of cases were healed by secondary intention when compared to 0% in control group. The death rates in cases were only 0% when compared to 3.33% in control group. In study conducted by Subramonia et al out of 51 patients 27 patients wound was closed by secondary intention.\textsuperscript{11} In study of Jang et al mostly secondary suturing was done.\textsuperscript{13}

Table 9: Comparison of end of the treatment analysis in various studies.

| Study          | Healing by secondary intention | Secondary suturing | Split skin grafting | Tension suturing | VAC therapy stopped | Expired |
|----------------|--------------------------------|--------------------|--------------------|------------------|---------------------|---------|
| Subramonia et al\textsuperscript{11} | 27 | 2 | 2 | - | 16 | 4 |
| Jang et al\textsuperscript{13}    | 9  | 29 | 1 | - | 10 | |
| Present study  | 11 | 15 | - | 4 | - | |
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 rate. 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.

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