(International Print/Online Journal)

SJIF IMPACT FACTOR: 5.565
PUBMED-National Library of Medicine ID-101739732

ISSN (Print): 2209-2870
ISSN (Online): 2209-2862

International Journal of Medical Science and Current Research (IJMSCR)
Available online at: www.ijmscr.com
Volume 5, Issue 3, Page No: 1405-1414
May-June 2022

IJMSCR

A Study On The Role Of Vacuum-Assisted Closure In Complex Wounds

Dr. T. Kannan Kumar
Senior Consultant, Division Of Plastic Surgery, Ramana Surgical Hospital, Salem, Tamil Nadu, India

***Corresponding Author:**
Dr. T. Kannan Kumar
Senior Consultant, Division Of Plastic Surgery, Ramana Surgical Hospital, Salem, Tamil Nadu, India

Type of Publication: Original Research Paper
Conflicts of Interest: Nil

Abstract

Introduction: Vacuum-assisted closure (VAC) is new in the armamentarium of managing wounds acute and chronic. Vacuum-assisted closure also called negative pressure wound therapy is a procedure in which a vacuum is used to enhance wound healing vacuum-assisted wound closure refers to wound dressing that uses pressure below normal continuously or intermittently to the surface of a wound. The negative pressure is maintained by an apparatus, this promotes healing in various kinds of wounds. Negative pressure removes fluid, decreases edema, and increases blood flow. The technique is less expensive than conventional management of complex wounds.

Aim Of The Study: To study the outcome of vacuum-assisted closure of wounds, To evaluate the positive impact of vacuum-assisted closure on wound healing in enhancing granulation tissue formation.

Methods: A total of 50 cases clinically presenting with ulcers to Ramana surgical hospital, hasthampatti, Salem, between January 2019 and July 2020were included in the study. Clinical examination of each case was done systematically as per the proforma drafted for the study. Dressings from the wound are removed. A swab for culture is taken. Wound irrigated with normal saline. Surgical debridement is done and adequate hemostasis is achieved. Negative pressure is applied to the wound using a vacuum pump, which delivers continuous or intermittent pressures, ranging from 50 to 125 mm Hg. The foam dressing squeezes to the negative pressure. The pressure is continuously for the first 48 hours and changes. The outcome was measured using a wound scoring system consisting of an area of wound covered with granulation tissue, and its color and consistency.

Results: Most of the patients presenting with wounds were in the 5th decade of life 18 (36%), followed by the 6th decade 17 (34%). Based on the duration of wounds, cases were grouped into 3 categories: <10 days, 10-30 days, and >30 days. Most cases fall in the group 10-30 days 30(60%), 19 cases(38%) in the group <10 days and 1 case (2%) in the group > 30 days. Wounds were most commonly located in the foot 20(40%) followed by the leg 16(32%), forearm 5(10%), and ankle and sole 4(8%) each. One patient had a wound in the abdomen. A significant difference in wound healing depends on the location of the wound of p-value-0.024. A major portion of 25(50%) cases fell into the traumatic group and 18(36%) into the diabetic and 7 (14%) into the vascular group. Diabetic and non-diabetic wounds constituted 18(36%) and 32(64%) cases respectively. Wounds of area < 20 sq cm constitute a maximum number of cases - 44(88%). The wound area shows an impact on wound healing. Smaller the wound area, wound healing was better compared to the larger wound area. P-value- 0.001. The most common organism cultured from the wounds was Staphylococcus aureus 21 (42%). Following VAC therapy for 3 to 7 days most of the wounds showed progress in wound healing.

Conclusion: VAC therapy is a recent modality of treatment of wounds. Its introduction has changed the course of the management of wounds. Based on the data from the present study and other studies available, VAC results in better wound healing, with very few complications, and promises to be a good modality in the

management of various wounds. The usage of VAC is simple but needs minimal training for competent use. Awareness about VAC and training on the application of VAC dressings will make it more popular.

Keywords: Vacuum-assisted closure (VAC), Negative pressure, Microorganism, Prognosis on wound

Introduction

Vacuum-assisted closure (VAC) is new in the armamentarium of managing wounds acute and chronic. Vacuum-assisted closure also called negative pressure wound therapy is a procedure in which a vacuum is used to enhance wound healing vacuum-assisted wound closure refers to wound dressing that uses pressure below normal continuously or intermittently to the surface of a wound.[1] The negative pressure is maintained by an apparatus, this promotes healing in various kinds of wounds. It also helps in wound debridement.[2]Wounds heal best when the negative pressure is 125 mmHg. Negative pressure removes fluid, decreases edema, and increases blood flow. Thus decreasing bacterial counts. The technique is less expensive than conventional management of complex wounds.[3]The technique is relatively simple. sterile, porous foam dressing is directly placed on the wound. The wound is then closed with a sterile adhesive sheet to create a closed area. A tube is connected to a vacuum pump, fluid is sucked through the foam into a canister which is discarded.[4] The negative pressure of 50-125 mm/Hg, results in the lowering of interstitial pressure, and fluid. and debris from the wound is sucked into a collection chamber. In the beginning, the vacuum is continuous. As the drainage decreases, the vacuum is applied intermittently. [5] The vacuum dressing is usually changed at approximately two-day intervals. Wound progress is recorded using parameters in the wound scoring system. The objectivity of assessments used to mark the wound score makes this scoring system deal for evaluating treatment and outcome of wounds. And the effectiveness of this treatment is established and proven by this objective scoring system.[6]

Methods

A total of 50 cases clinically presenting with ulcers to Ramana surgical hospital, hasthampatti, Salem, between January 2019 and July 2020were included in the study. Clinical examination of each case was done systematically as per the proforma drafted for the study. Dressings from the wound are removed. A swab for culture is taken. Wound irrigated with normal saline. Surgical debridement is done and adequate hemostasis is achieved. Negative pressure is applied to the wound using a vacuum pump, which delivers continuous or intermittent pressures, ranging from 50 to 125 mm Hg. The foam dressing squeezes to the negative pressure. The pressure is continuously for the first 48 hours and changes. The outcome was measured using a wound scoring system consisting of an area of wound covered with granulation tissue, its anditscolorandconsistency. Foam dressing is cut to shape and kept in the wound cavity. The wound is then sealed with an adhesive dressing ensuring that the drapes cover the foam and tubing and at three centimeters of healthy skin. Negative pressure is applied to the wound using a vacuum pump, which delivers continuous or intermittent pressures, ranging from 50 to 125 mm Hg. The foam dressing squeezes to the negative pressure. The pressure is continuously for the first 48 hours and changes. The outcome was measured using a wound scoring system consisting of an area of wound covered with granulation tissue, and its color and consistency. Participation in the study is completely voluntary and confidentiality will be maintained. Data entry analysis will be done using SPSS 22.5 version.

Results

Volume 5, Issue 3; May-June 2022; Page No 1405-1414

Chart 1: Age Distribution Of Wounds

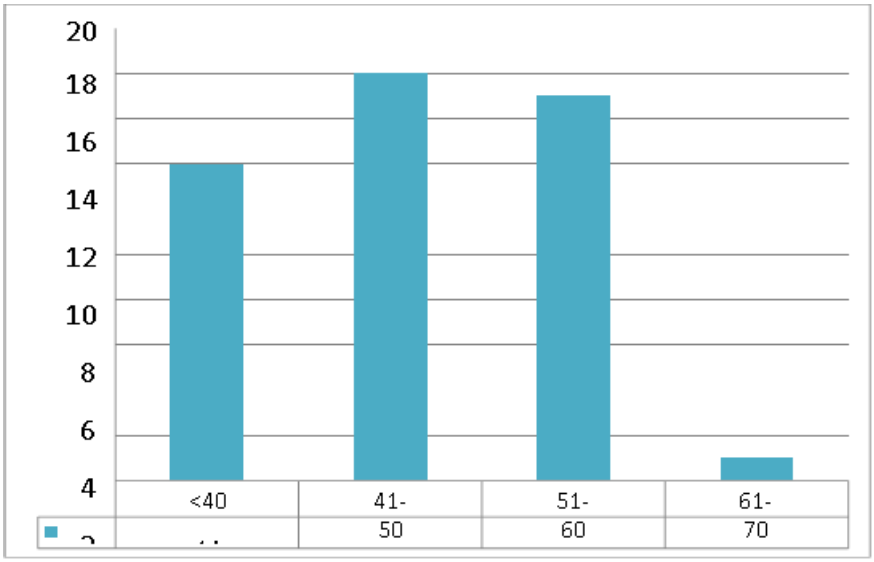

Chart :1 Most of the patients presenting with wounds were in the 5th decade of life 18(36%), followed by the 6th decade 17(34%). Kruskal Wallis test, p=0.8 Wounds were more common in males in 38 cases (76%) than in females in 12 cases(24%) Male to female ratio was 3.167: 1

Chart 2: Duration Of Wounds

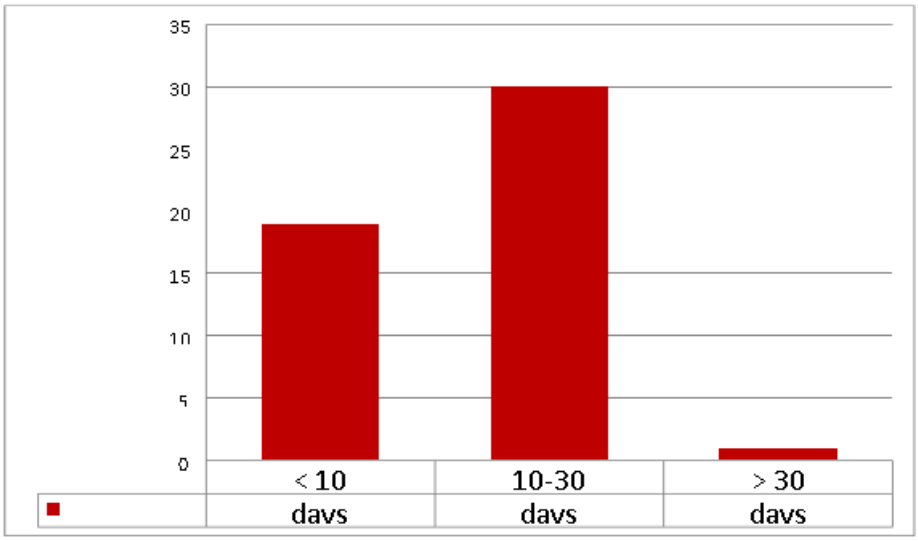

Chart:2 Based on the duration of wounds, cases were grouped into 3 categories: <10 days, 10-30 days, and >30 days. Most cases fall in the group 10-30 days 30(60%), 19 cases(38%) in the group <10 days and 1 case (2%) in the group > 30 days. Mann Whitney test, p=0.7

Volume 5, Issue 3; May-June 2022; Page No 1405-1414

Chart 3: Distribution Of Location Of Wounds

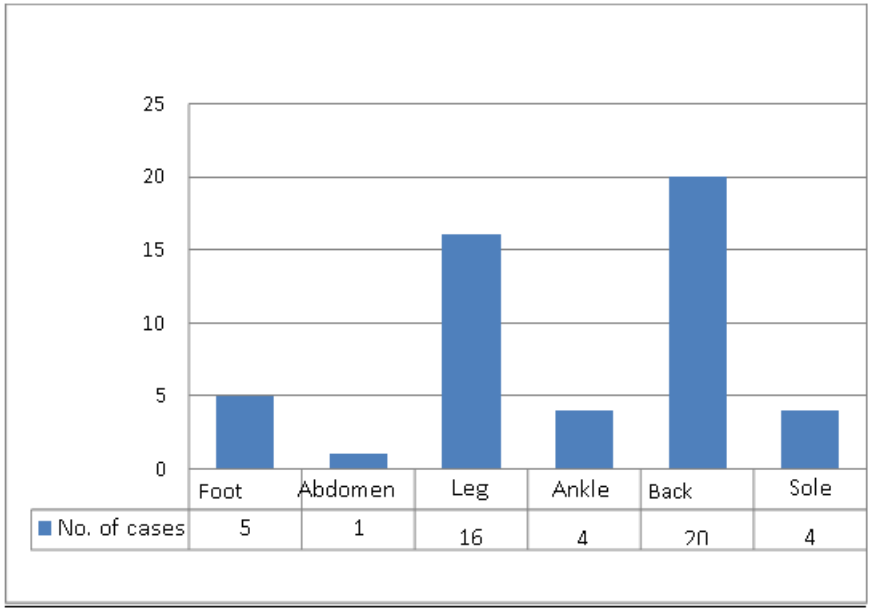

Chart :3 Wounds were commonly located in the back 20(40%) followed by leg 16(32%) foot 5(10%) and ankle and sole 4 (8%) each. One patient had a wound in the abdomen. P-value – 0.024.A significant difference in wound healing depends on the location of the wound. P-value- 0.024

Chart 4: Etiology Of Wounds

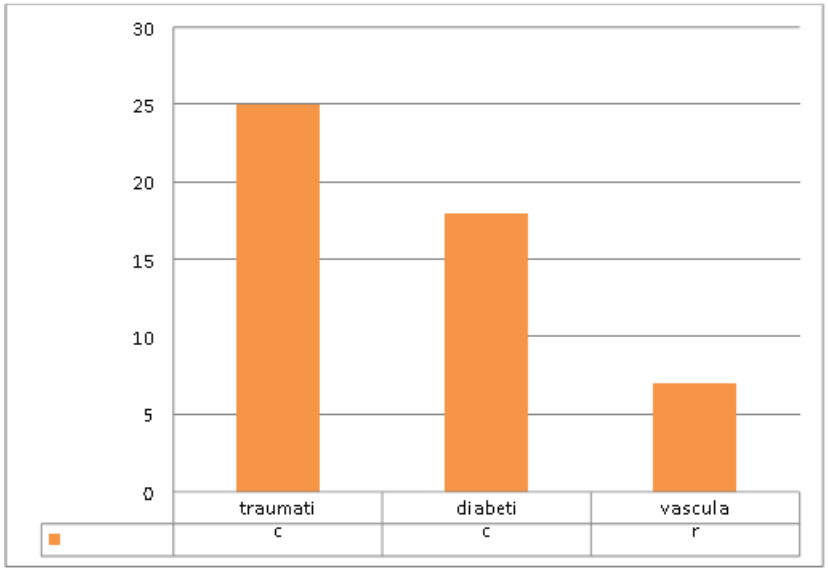

Chart:4 Based on the etiology of wounds, which were determined by history and clinical examination, wounds were divided into Traumatic, Diabetic, and Vascular. A major portion of 25(50%) cases fell into the traumatic group and 18(36%) into the diabetic and 7 (14%) into the vascular group. Diabetic and non-diabetic wounds constituted 18(36%) and 32(64%) cases respectively.

Volume 5, Issue 3; May-June 2022; Page No 1405-1414

Chart 5: Wound Area In Square Cm

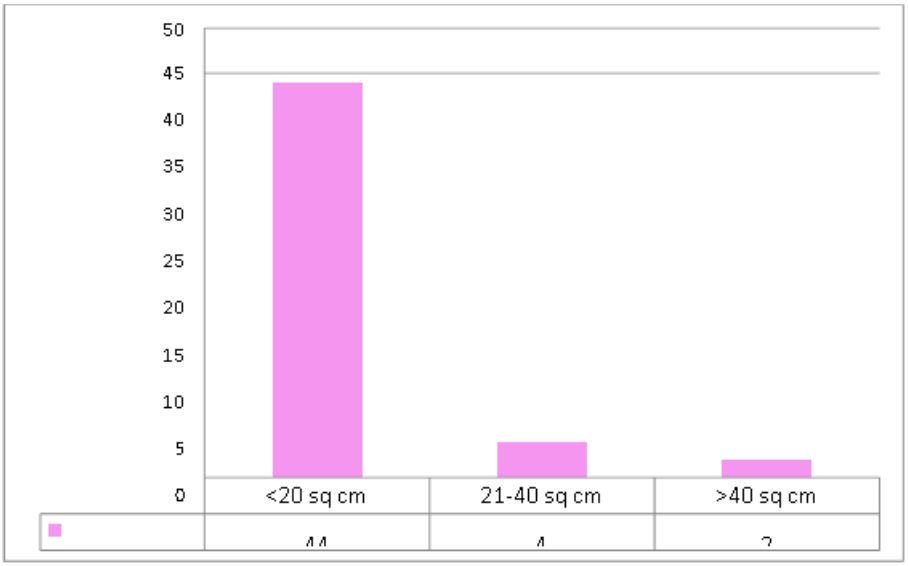

Chart :5 Wounds of area < 20 sq cm constitute maximum number of cases - 44(88%).P-value - 0 .001.The wound area shows an impact on wound healing. Smaller the wound area, wound healing was better compared to the larger wound area. P-value- 0.001

Chart 6: Organisms Cultured From Wound

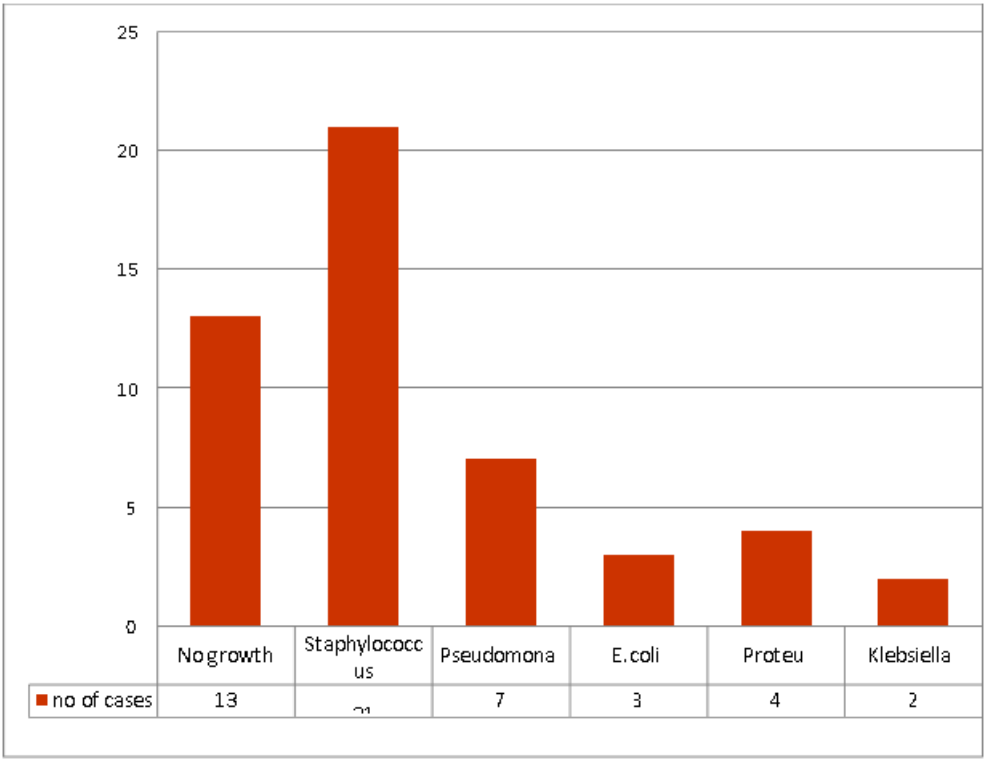

Chart:6 Most common organism cultured from the wounds was Staphylococcus aureus 21(42%). Following VAC therapy for 3 to 7 days most of the wounds showed progress in wound healing.

Volume 5, Issue 3; May-June 2022; Page No 1405-1414

Picture 1: Showing Wound Before Vacuum-Assisted Healing

Picture:2 Operative Procedure & Foam Dressing

Picture :3 Healing Process After Surgery

Discussion

Delay in wound healing contributes significantly to the community health problem, especially in old adults, This requires frequent visits to the hospital.With routine wound management, it takes days to months to heal the wound.Failure of the wound to heal creates a social and financial burden that causes pain and suffering. Vacuum-assisted

Volume 5, Issue 3; May-June 2022; Page No 1405-1414

closure (VAC) therapy is an alternative to routine wound management, This uses negative pressure to optimize conditions and enhances wound healing and therefore few dressing changes. Negative pressure therapy is expensive a recent report says that usage of VAC as first-line therapy is not appropriate. However, we say that VAC can be made less expensive by using homebrew techniques.Although clinical results are promising, there is a gap between scientific evidence which is available and usage in clinical practice that does not give a balanced view.[7] Most studies are too small to detect significant differences between those wounds managed by regular dressings and those by VAC, some studies do show VAC to be better in wound healing than standard methods, and with few complications.VAC is a good alternative for the management of complex wounds. VAC is very effective in treating chronic and complex wounds, with a significant decrease in wound size and increase in granulation tissue and duration of treatment. It reduces health care costs and increases patient satisfaction and also the quality of life.Despite the clinical success of VAC in clinical practice, it is not known exactly how it exerts effects on the wound. Many mechanisms are suggested.[8] VAC increases local blood flow and decreases the edema fluid and colonization rates of microbes. It promotes wound closure by hastening the formation of granulation tissue as also as the mechanical effects on the wound. It provides a clean moist wound and clears excess wound fluid and creates an ‘‘ideal wound healing environment’’. In our study, following VAC therapy, wound scoring was done with scores from 1-to 7 given for the area of granulation tissue, color, and consistency of granulation tissue. The wounds with scores > 5 following VAC therapy can be considered for a skin graft. In the present study, >70% of cases showed wound scores >5 followings a week of VAC therapy.[9] The use of negative pressure dressings is an effective way to accelerate the healing of various types of wounds. The optimal pressure for wound healing appears to be minus 125 mm Hg. VAC is usually well-tolerated and has few contraindications or complications, will become a mainstay of wound care.35.50% of cases among diabetic wounds, and 30% of cases among smokers, showed scores > 5 on day 7 of VAC therapy; thus were showing slower healing in diabetics and smokers despite VAC dressings. [10] Diabetes mellitus compromises wound healing. In a study that examines leukocyte infiltration and the presence of tumor necrosis factor-α (TNF) and IL-6 in wounds in normal and induced diabetic mice, there were fewer inflammatory cells in wound fluid taken from diabetic animals (13.8 × 10 6 /ml) when compared to the fluid taken from normal animals (28.5 × 10 6 /ml) on day 7, but there was more IL-6 in fluid from wounds of normal animals (10,998 U/ml) than in fluid taken from wounds of diabetic animals (2096 U/ml) on Day 7 . there were decreased neo blood vessels and decreased organization of healthy granulation tissue. This tells that delayed healing in diabetes is associated with the change in leukocyte infiltration and IL-6 levels in fluid from wounds during the late inflammatory stage of wound healing. Cigarette smoking and delayed wound healing are well documented and seen in clinical practice.[11] The well-known effects of the toxins of cigarette smoke like nicotine, carbon monoxide, and hydrogen cyanide prove that smoking delays and slow wound repair. Nicotine being a vasoconstrictor reduces nutritional blood flow to the skin and results in tissue ischemia and poor healing of the wound. [12]Nicotine increases the adhesiveness of platelets and raises the risk of thrombotic occlusion of microvasculature and causes tissue ischemia. The proliferation of RBCs, fibroblasts, and macrophages is decreased by nicotine. Carbon monoxide poisons oxygen transport and also metabolism. hydrogen cyanide has an inhibitory action on the enzyme systems oxidation and prevents oxygen transport at the cellular level. The increase in the wound complications of surgical patients with diabetes reflects the increase in the incidence of surgical risks and the metabolic abnormalities with the disease is associated. [13]Microvascular disease in diabetes contributes to wound infection and delayed wound healing. VAC dressings have certainly proven beneficial as a variant method of dressing, mainly by negative pressure therapy which sucks out serous fluid and helps out information of granulation tissue. Used in various wounds, continuous suction for a period of 48 hrs and later intermittent suction depending on wound status have enhanced the wound healing process and faster recovery compared to conventional methods of dressing. [14]Diabetic wounds are always

Volume 5, Issue 3; May-June 2022; Page No 1405-1414

challenging; 18 cases were managed by VAC therapy, 7 cases showed improvement in the first 3 days of VAC therapy and the other wounds later did not show improvement on prolonged therapy. Two cases had to undergo amputation as a result of the failure of VAC therapy and other conventional methods. The main problem cited with diabetic wounds was an infection that flared up in a few cases following closed VAC dressings.[15] Hence diabetic wounds with infections did not benefit from VAC therapy; wound debridement with control of infection, later followed by VAC dressing would be more beneficial.Non-diabetic wounds; traumatic and vascular benefited from VAC therapy with faster healing in terms of granulation tissue formation. Infection was not a problem despite the closed VAC dressing. Traumatic wounds also included cases of iatrogenic wounds. These showed better healing compared to other categories of wounds. There was a case of an abdominal wall wound that showed good healing following VAC therapy.[18] There were 7 cases of vascular wounds which included venous ulcers and ulcers associated with peripheral arterial disease.[19] Venous ulcers showed better outcomes when VAC was combined with other modalities of management like limb elevation. Maintaining negative pressure in VAC dressing and the contact of the foam with the wound surface was difficult. These two issues should be taken care of, for more effective usage of the VAC dressing.[20] Other aspects to be considered are wound debridement and control of infection mainly in diabetic wounds, wherein we can delay VAC therapy until the infection is controlled. Despite the data available, reduction in the bacterial count following VAC therapy practically was more difficult when dealing with diabetic wounds. Finally, even after considering the cost factor for VAC therapy, it is a promising modality of dressing and has proven beneficial in different varieties of wounds and enhances wound healing and faster recovery.[21,22]

Conclusion

VAC therapy is a recent modality of treatment of wounds. Its introduction has changed the course of the management of wounds. Based on the data from the present study and other studies available, VAC results in better wound healing, with very few complications, and promises to be a good modality in the management of various wounds. The usage of VAC is simple but needs minimal training for competent use. Awareness about VAC and training on the application of VAC dressings will make it more popular.

References

1. Argenta LC, Morykwas MJ. Vacuum-assisted closure: A new method for wound control and treatment: Clinical experience. *AnnPlast Surg* 1997; 38(6): 563-76.
2. Armstrong DG, Lavery LA, Frykberg RG, et al. VAC therapy appears to heal complex DFU. Abstract presented at the 2nd World Union of Wound Healing Societies Meeting, July 8-13, 2004; Paris, France
3. Banwell PE, Teotl L. Topical negative pressure (TNP): the evolution of a novel wound therapy. J Wound Care 2003; 12(1):28-30.
4. Barbul A, Efron DT. Wound healing. Brunicardi FC. Schwartz Principles of surgery. 9th ed. New York. McGraw Hill; 2010:209-33.
5. Bowler PG. Wound pathophysiology, infection, and therapeutic options. Annals of Medicine. 2002; 34(6): 419-427.
6. Broussard CL, Mendez-Eastman S, Franz R. Adjuvant wound therapies In Bryant, R.(ed), Acute and Chronic Wounds. St.Louis: Mosby 2000:440.
7. Brunette DM. Mechanical stretching increases the number of epithelial cells synthesizing DNA in culture. J Cell Sci 1984;69: 35-45.
8. Buttenschoen K, Fleischmann W, Haupt U, *et al.* The influence of vacuum-assisted closure noninflammatory tissue reactions in the postoperative course of ankle fractures. Foot and Ankle Surgery2001;7:165-73
9. Curtis AS, Seehar GM. The control of cell division by tension or diffusion. Nature 1978;274:523.
10. Earley J. Wounds, tissue repair, and scars. Williams NS. Bailey and love short textbook of surgery 25th ed. 2010:3:29
11. Eginton MT, Brown KR, Seabrook GR, et al. A prospective randomized evaluation of negative-

Volume 5, Issue 3; May-June 2022; Page No 1405-1414

pressure wound dressings for diabetic foot wounds. Ann Vasc Surg 2003;17(6):645-9.

12. Erba P et al. Angiogenesis in wounds treated by microform National wound therapy. Ann Surg. 2011 February; 253(2): 402-409.
13. Fabian TS, Kaufman HJ, Lett ED, et al. The evaluation of sub-atmospheric pressure and hyperbaric oxygen in ischemic full-thickness wound healing. Am Surg 2000; 66: 1136-43.
14. Fleischmann W, Becker U, Bischoff M, et al. Vacuum sealing indication, technique, and results. Eur J. Orthop & Traumato 1995;5:37-40.
15. Giovanni UM, Demaria RG, Otman S, et al. Treatment of post sternotomy wounds with negative pressure. Plast Reconstr Surg 2002;109:1747.
16. Gustafsson R, Johnsson P, Algotsson L, et al. Vacuum-assisted closure therapy guided by Creative protein level in patients with deep sternal wound infection. J Thorac Cardiovasc Surg 2002;123:895;900.
17. Joseph E, Hamori CA, Bergman S, et al. A prospective randomized trial of vacuum-assisted closure versus standard therapy of chronic nonhealing wounds. Wounds 2000;3:60-7.
18. Joseph E, Hamori CA, Bergman S, Roaf E, Swann NF, Anastasi GW. A prospective randomized trial of vacuum-assisted closure versus standard therapy of chronic non–healing wounds. Wounds.2000;12(3):60-67.
19. Lazarus GS, Cooper DM, Knighton DR, et al. Definition in N Am 2003; 83(3):192-195.
20. Lazarus GS, Cooper DM, Knighton DR, et al. Definitions and guidelines for the assessment of wounds and evaluation of healing. *ArchDermatol* 1994;130(4):489-93
21. Lee HJ et al. Negative pressure wound therapy for soft tissue injuries around the foot and ankle. Journal of Orthopaedic Surgery and Research 2009, 4:14
22. Leong, Phillips LG. wound healing. Townsend CM, Beauchamp RD, Evers BM, Mattox KL. Sabiston Textbook of Surgery.19th ed. Philadelphia; Elsevier; 2012:151-77

Volume 5, Issue 3; May-June 2022; Page No 1405-1414