INTRODUCTION

The modern form of Negative-pressure wound therapy started to appear in the 1990s. However, the principle of using suction to heal wounds goes back to old history, precisely the Roman era [1]. During the Soviet-Afghan war (1979 - 1989), Russians developed the technique of using suction devices and foam to treat infected wounds [2]. Modern NPWT devices were developed by Argenta and Morykwas of Wake Forest University School of Medicine in the nineties [3]. Different theories and mechanisms were suggested to explain the healing potentials of negative pressure wound therapy technique.

Increase local wound blood flow

Morykwas proved that apply a negative pressure that equals -125 mmHg increased blood flow in swine wound models [4]. Lower pressures may increase blood flow in the long run [5]. Very low pressures (<400 mmHg) have been shown to reduce the overall wound blood flow [4].

Mechanical wound contraction (Macrodre formation)

Negative pressure applies contracting forces on the wound when applied in a sealed fashion, leading to mechanical reduction in the wound size [4,6,7].

Microde formation

Mechanical force generated by the negative pressure is transmitted to the cells through the extracellular matrix, leading to microde formation of cytoskeleton that stimulates cell proliferation by a process called mechano transduction [8]. These cellular changes lead to undulant wound surface due to negative suction at the foam-tissue interface [9].

Angiogenesis stimulation

Surface hypoxia induced by negative pressure and vascular endothelial growth factor (VEGF) expression along with mechanical forces were linked with formation of more physiological and straight blood vessels at the wound site [10].

Edema reduction

Infected wounds produce higher levels of exudate leading to edema. Negative pressure application removes excess wound fluid and reduces edema [11]. The same mechanism can explain low levels of anti-inflammatory mediators e.g. metalloproteinase, which breaks down adhesion proteins responsible for wound healing [12,13].

Decrease discharge and bacterial load of the wound

Wounds treated with NPWT showed a faster reduction in bacterial colonization [4], which can be explained by either decreasing wound discharge that discourages bacterial colonization or isolating the wound against outer environmental contamination [14,15].

Variables in applications

Pressure

Morykwas proved that -125 mmHg increased blood flow in swine wound models [4]. Lower pressures may increase blood flow in the long run [5]. Very low pressures (<400 mmHg) have been shown to reduce the overall wound blood flow [4] (Figures 1-9).

Mode (continuous vs. intermittent)

Continuous mode was found to cause less pain [16,17]. However, intermittent mode was found to induce granulation faster [4] but cause more pain and can lead to exudate spillage into the wound during off period [16,17].

Filler material

Polyurethane foam can fit into deeper wounds [18], but antibacterial gauze caused less pain and fits into more superficial irregular surfaced wounds [19].

Frequency of dressing change

Varies from two to four days as time gaps between dressings [20].

Indications and contraindications

NPWT is indicated for temporary wound closure, wound preparation for final surgical closure, as an aid for successful graft take and adjunct therapy in wound reconstruction using dermal substitute [21]. On the other hand, it is contraindicated in wounds with very poor vascularity [14], deeper tissues infections e.g. osteomyelitis, malignancy, fistulas and unbedridered wounds with necrotic tissues and eschars [22] (Figures 1-9).
Three patients were chosen to apply the technique of management.

CASE REPORTS

NPWT was applied on three patients using the assembled device considering the following conditions:

Pressure: -125 mmHg, according to Morykwas recommendations [4].

Mode: Intermittent (5 minutes: ON and 3 minutes: OFF)

Frequency of dressing: Once every 48 hours sterile petrolatum gauze, sterile cotton roll, sterile nasogastric tube and sterile transparent waterproof film were used for dressing. The three cases can be briefly presented as following:

Case 1
A 52-year-old male, post road traffic accident, presented to our hospital around two weeks after the incident with nearly complete avulsion of the skin and subcutaneous tissues all around the left thigh. Wound was severely septic with heavy suppurative discharge. Patient was in a general septicemic bad condition with fever, high ESR and CRP, malaise and disturbed appetite. Wound swab for culture and sensitivity on admission showed heavy growth of Klebsiella pneumoniae, Acinetobacter baumannii and Proteus mirabilis.

Management: Patient was taken directly to OR. Generous irrigation was done. Proximal and distal flaps were approximated using tension Ethibond sutures 5 to decrease the defect and eliminate any spaces. NPWT was applied in our method. Dressing was changed every two days. Healthy and clean granulation tissue was ready for split thickness skin grafting after 39 days.
Case 2

A 55-year-old female patient, post road traffic accident, presented to our hospital 12 days after the incident with right leg both bone open fracture (Gustilo IIIB) with a bony segmental loss from the right tibia, and skin and soft tissue loss at the same spot. Wound swab for culture and sensitivity on admission showed heavy growth of Klebsiella pneumoniae, Acinetobacter baumannii.

**Management:** Patient was shifted to OR, where she underwent wound debridement and fibular bone segment grafting. NPWT was applied in our technique. Wound was irrigated. NPWT was applied in our technique. Wound was clean and granulated after 58 days. Exposed bone was covered by adipofascial turnover flap then a split thickness skin graft.

Case 3

A 59-year-old male patient, underwent bariatric surgery four months ago. The surgery was complicated by DVT and deep, infected and highly discharging ulcer on the dorsum of the right foot. Patient presented to our hospital 12 days after the incident with right leg both bone open fracture. Wound swab for culture and sensitivity on admission showed heavy growth of Klebsiella pneumonia.

**Management:** Patient was shifted to OR, where she underwent wound debridement and fibular bone segment grafting. NPWT was applied in our technique. Wound was clean and granulated after 58 days. Exposed bone was covered by adipofascial turnover flap then a split thickness skin graft.

**DISCUSSION AND CONCLUSION**

Application of the NPWT principle of treatment using an economic modified suction unit and cheaper affordable consumables gives significantly positive results of improvement in different kinds of wounds as shown in the case report.

**REFERENCES**