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Role of hydrosurgery in the management of diabetic foot disease- new application of an age-old technique

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ABSTRACT

Background: The lifetime risk of diabetic foot ulcer (DFU) may be as high as 25%. The primary aim in a case of DFU is to obtain wound closure as expeditiously as possible. Hydrosurgery debridement is a recent and new novel approach for debridement.
Methods: The study was an observational prospective comparative study between hydrosurgery system and surgical debridement for assessment of hydrosurgery as a tool for debridement of DFUs carried out at tertiary care centre on patients presenting to or referred to the hospital. Study was being conducted on 60 patients of diabetic foot disease. They were divided into two groups of 30 each. Randomization was done by computer generated numbers.
Results: Mean diabetes duration was lower in hydrosurgery group as compared to surgical debridement group (11.53 and 14.63 years respectively). Deformity was present in 43.3% and 33.3% of patients in hydrosurgery and surgical debridement groups respectively. On culture sensitivity of tissue/pus, *Klebsiella* (23.3%) was dominantly found in hydrosurgery group whereas *Klebsiella* and *Pseudomonas* were found equally in Surgical debridement group (20% each). Mean operative time was less in hydrosurgery group as compared to Surgical debridement (15.30 and 23.67 minutes respectively).
Conclusions: Hydrosurgery system showed significant advantages over standard surgical scalpel debridement with lesser debridements required, reduced operative time and in hospital stay. It permitted adequate debridement of the diabetic foot wounds without much collateral damage which usually happens with standard scalpel debridement, preserving more viable tissues to promote rapid healing.

Keywords: Diabetic foot ulcer, Hydrodissection

INTRODUCTION

Diabetes mellitus (DM) is characterized by hyperglycemia resulting from defects in insulin secretion, insulin action or both. Individuals with diabetes are at risk for micro-vascular complications like retinopathy, neuropathy and nephropathy as well as macro-vascular complications like coronary heart disease and peripheral vascular disease.[1,2]

India is gradually becoming the diabetes capital of the world with a prevalence of 7.8% with as many as 69.2 million people with DM and are expected to cross 123.5 million by 2040.[3] Considering the high prevalence of the disease and increasingly younger population that is affected by this issue, the economic costs of the problem are much larger than the outright treatment costs. Especially in a country like India where healthcare cost is a major concern, effective economical means of assisting healing and limiting disability will be greatly affected.

The prevalence of diabetic foot ulcer (DFU) is 4% to 10% with lifetime incidence being as high as 25%. The lifetime risk of DFU for patients with DM may reach up to 68 per 1,000 persons as reported by some studies.[4]

Most patients can be cured if properly managed and treated on time with correct diagnostic and therapeutic approaches, reducing the need for amputations. Therefore, the primary aim in a case of DFU is to obtain wound closure as expeditiously as possible. The present gold-standard of DFU care is debridement of the wound, management of infection, revascularization procedure when indicated, off-loading of the ulcer and timely reconstructive surgery.[5]

Debridement which consist of medical removal of devitalised, bacterially contaminated or senescent cells improving the healing potential of remaining healthy tissue is very crucial. Schultz et al identified four components that should be tackled in order to maximise wound healing: T (tissue); I (Infection); M (moisture) and E (edge) - the TIME principle of wound healing. Debridement is considered to play a role in three of these components through the removal of necrotic tissue (T), removal of infection or contamination (I), and treatment of nonadvancing or undermined wound edges (E).[6] Appropriate debridement causes activation of platelets to control hemorrhagic responses and releases growth factors that initiate the cascade of wound healing process.[5]

Debridement should be aimed at decreasing the bacterial load by removal of all necrotic, callus and fibrous tissue as removal of these are pivotal for DFU healing and wound closure. Debridement can be performed by various methods such as surgical, autolytic, mechanical, chemical ultrasonic, hydrosurgical and larval.[7] The type of debridement to be used depends on the available expertise, patient preferences, clinical context and cost.[8,9]

Various other methods have also been suggested for assisting in diabetic foot ulcer healing like hyperbaric oxygen therapy (HOT), negative wound pressure therapy (NPWT), growth factors, acellular matrix tissues and use of advanced wound care products. Till now no conclusive evidence has been found to support the use of these modalities, moreover the economical costs involved are often prohibitive.

The role of surgery is important as it has been shown to be effective in DFU healing. Surgical debridement involves cutting away dead and infected tissues followed by daily application of saline-moistened cotton gauze. The main purpose of this type of debridement is to turn a chronic ulcer into an acute one. Surgical debridement should be repeated as often as needed if new necrotic tissue continues to form.[10] Surgical debridement should cause only minimal damage to surrounding tissues. Surgical debridement procedures have conventionally been performed with scalpels and other sharp instruments; however alternative techniques are now available. The preservation of viable tissue while removing necrotic tissue and slough allows wound healing to occur rapidly.

Surgical debridement creates a very clean wound but is not selective since healthy collateral tissue is also removed. There are other physical methods which use whirlpool therapy to slough off the necrotic tissues. However, during debridement if the saline coming out of the hand piece vaporises over the wound it causes dissemination of contaminated droplets. Hydrosurgery combines physical and surgical debridement sans these drawbacks.[11]

Hydrosurgery debridement is a recent and new novel approach for debridement. It is a different modality, an alternative to the conventional surgical technique described in many wound care literatures. It is used for wound bed preparation precisely conserving viable structures for eventual repair. It enables the surgeon to simultaneously hold, cut and remove nonviable tissue without collateral damage to healthy surrounding tissue, allowing the healing process to progress quickly.

A commercial hydrosurgery system has been developed by hydrocision of Andover (USA) and brought into clinical practice by Smith and Nephew Medical Limited (Hull, UK).[12] It works on the principle of Venturi effect. Sterile saline flows to the console where it is pressurised, and forced through a tiny jet nozzle at the end of a hand piece to produce a high-velocity stream, which passes back into an evacuation collector. This creates a localised vacuum, which simultaneously grasps, cuts and removes the debris from the wound. Different power levels are available that can be changed depending on the tissue being debrided.

In addition, the cutting effects can also be manipulated by adjusting hand piece orientation and pressure. The powered console and the hoses supplying high pressure fluid and removing fluid and waste are not visible. When a nozzle is placed perpendicularly to the surface of debrided wound, the tissues can be cut and sucked. When it is placed diagonally, it allows to rinse the surface, smooth wound bottom and edges. This highly effective cutting tool leaves a clean, dry surgical field while removing minimum tissue volumes. Cutting efficiency is controlled through downward hand pressure, angle of orientation and saline velocity.

The suggested advantages are that hydrosurgery debridement is rapid and is focussed to precisely debride necrotic tissue whilst sparing the viable tissue, supports epidermisation, removes biofilm, reduces a risk of infection and prevents infection. This technique prevents evaporation and splash, allows good visibility, reduces risk the users from inhaling contaminated particles and minimises contamination of the operating suite or site of the procedure. A guideline from the National Institute for Health and Care Excellence (NICE) reported that hydrosurgery is an efficient and safe wound debridement tool in both adults and children with acute and chronic wounds.[13]

There are many studies that have utilised hydrosurgery in their wound debridement and wound bed preparation, but majority of these studies have been reported on burn wounds, traumatic wounds like open fractures and degloving wounds, plastic surgery reconstructive wounds and chronic vascular leg ulcers.[14] There are very few studies that report the usage of hydrosurgery debridement in diabetic foot wounds.

This study aimed to compare the time taken for the wound to be covered with healthy granulation tissue in each of the study group.

Both the groups are also compared with respect to operative time required for debridement (in minutes), blood loss (quantity in ml), post-operative pain (to be measured by visual analog scale) and hospitalisation in days.[15]

METHODS

The study is an observational prospective comparative study between hydrosurgery system and surgical debridement for assessment of hydrosurgery as a tool for debridement of DFUs carried out at tertiary care centre on patients presenting to or referred to the hospital. Study has been conducted on 60 patients of diabetic foot disease. They were divided into two groups of 30 each. Randomization was done by computer generated numbers. A thorough history was taken from each participant and all the patients underwent detailed clinical and biochemical examinations. Prior ethical clearance was obtained from the ethics committee.

Inclusion criteria

Inclusion criteria were known cases of DM; patients with non-healing lower limb ulcers (non-healing for more than 2 weeks); DFUs more than 25 cm^2 in size (measured using graph paper); HbA1c less than 9 mmol/mol, ankle brachial pressure (ABPI) index more than 0.5 as measured by handheld Doppler were included.

Exclusion criteria

Exclusion criteria were DFUs more than 100 cm^2 in size (measured using graph paper); positive probe to bone test; Wagner's grade III, IV or V of diabetic lower limb ulcers (Wagner's grading); evidence suggestive of sepsis (quick SOFA score of 2 or more); patients who did not give consent to be a part of the study.

Classification of diabetic foot ulcers/wounds - Wagner's/Meggitt-Wagner system

Grade

Grade 0 was preulcerative/high-risk foot, 1 was superficial ulcer, 2 was deep ulcer extending through dermis, tendon, ligament, joint capsule or bone, 3 was deep ulcer with abscess/osteomyelitis or joint sepsis, 4 was forefoot gangrene and 5 was whole foot gangrene.

Quick SOFA (qSOFA) criteria points are respiratory rate $\geq$ 22/min, altered mentation, and systolic blood pressure $\leq$ 100 mmHg.

Procedure

Patients who were known cases of DM with non healing ulcers on the lower limbs, who meet the inclusion criterion were included in the study.

After enrolling the patient from Department of Surgery, Command hospital, Chandimandir and taking pre informed consent from these patients, a thorough examination and required investigations were conducted amongst the patient between April 2022 and September 2023. Examination included a history of the clinical course of the disease, making a note of the present status of the patient and previous treatment received if any. The patient underwent swab culture and sensitivity, HbA_{1c}, and doppler for ABPI. Other parameters included inflammatory markers such as leukocyte count and C-reactive protein (CRP). Ulcer were measured using graph paper and were photographed. The ulcers were randomly placed in one of the two treatment groups by computer generated numbers.

Surgical debridement group: The wound was managed by conventional surgical debridement.

Hydrosurgery system debridement group: The hydrosurgery system was used in 30 patients. It consists of a disposable handpiece, power console with foot pedal activation and a waste bin. It projects a high velocity stream of sterile saline across the operating window and into the evacuation collector. This created a localised vacuum to hold and cut targeted tissue while aspirating debris from the operation site. The handpiece has to be held such that the waterjet is parallel to the wound so that tangential excision can be achieved. This allows rapid removal of damaged devitalised tissues while preserving the surrounding viable tissues. There are 2 types of handpieces available for the operator to use depending on wound type and treatment strategy. The operator can regulate the waterjet velocity using the 10 power settings that are available and visualised on the power console.

After debridement, for both the groups, acticoat antimicrobial silver dressings was be applied as per dressing protocol of the institute. Subsequently, wound inspections were performed on postoperative day 2 and if slough was present, second session of respective debridement were carried out and wound dressings were done using acticoat antimicrobial silver. Patients were subjected to a maximum of 3 sessions of respective debridement (more than 3 sessions was taken as failure of treatment). Regular wound dressings were performed for those wounds left for secondary granulation until healing occurs.

All the wounds were observed at 48 hrs post any debridement session, thereafter bi-weekly for the first 2 weeks and then after 1 month. The patients were thereafter reviewed at three months after the treatment to assess the quality of scar/wound healing.

During the course of study the following cases were considered as a failure of treatment: 1) Increase in the size of ulcer on follow-up/ failure to completely heal at the end of three months, 2) Evidence of frank infection such as cellulites or pus at the ulcer base after 3 hydrosurgery debridement/surgical debridement, and 3) Evidence of sepsis, quick SOFA score >2 during the course of study.

Statistical analysis

The data were observed over two procedures. All the measurable data were checked for their normality using Kolmogorov–Smirnov test within each procedure and also for the overall data. For normally distributed measurable data over the two procedures, their means were compared using Student's t-test (unpaired); whereas for skewed (non-normally distributed) or ordinal data, their distributions over the two procedures were compared using Mann Whitney test. The data is presented with descriptive statistics with Mean±SD or Median and inter-quartile range as also their minimum and maximum values were depicted.

For categorical/classified data, their association with the two procedures is analyzed using Chi-Square test. The data is presented as frequencies, percentage, rates etc. The descriptive statistics like Mean±SD, Median and Inter-quartile range for the overall data is presented with their minimum and maximum values. All tests are two sided and $p < 0.05$ is taken as the level of significance.

RESULTS

Table 1 shows the distribution of age categories in both treatment groups. Age group of 61-70 years had the maximum patients with 46.7% patients in hydrosurgery group and 36.7% in surgical debridement group followed by 50-60 years age group which had 30% and 16.7% patients respectively. Age group more than 70 years had 16.7% and 23.3% patients in hydrosurgery and surgical debridement group respectively whereas there were 6.7% and 23.3% patients below the age of 50 years in both treatment groups respectively. The distribution of age categories was similar in both groups. The mean age was similar in both groups.

Table 1: Age distribution of participants under the study.

Age (in years)	Hydrosurgery (%)	Surgical debridement (%)	Total N (%)
<50	2 (6.7)	7 (23.3)	9 (15)
50-60	9 (30)	5 (16.7)	14 (23.3)
61-70	14 (46.7)	11 (36.7)	25 (41.7)
>70	5 (16.7)	7 (23.3)	12 (20)
Mean age	63.50±8.85	61.00±11.48	

Table 2: Clinical parameters of study participants related to diabetes control.

Variable	Hydrosurgery	Surgical debridement	Total
Diabetes duration (in years)	11.53±5.16	14.63±6.96	13.08±6.27
Mean haemoglobin levels	9.74±2.32	11.02±2.89	10.38±2.69
Mean HbA1C	7.04±1.03	6.85±0.69	6.95±0.87
Mean SBP	135.80±14.81	131.33±16.15	133.56±15.53
Mean DBP	79.53±10.44	78.93±9.60	79.23±9.95

Males were 70% and females were 30% in hydrosurgery group whereas in surgical debridement group males and females were 56.7% and 43.3% respectively. This distribution of gender was similar in both treatment groups and was not statistically significant (p=0.284).

Table 2 shows the clinical parameters in both the treatment groups. Mean diabetes duration was lower in hydrosurgery group as compared to surgical debridement group (11.53 and 14.63 years respectively). Mean haemoglobin levels was also less in hydrosurgery group when compared to the other group (9.74 and 11.02 gm/dl respectively). Mean HbA1c, mean systolic and diastolic blood pressure were comparatively higher in Hydrosurgery group as compared to surgical debridement group.

Table 3 shows clinical parameters related to ulcer's presence. The mean duration of ulcer's presence was high in hydrosurgery group. In hydrosurgery group left foot was predominant site whereas in Surgical debridement group, right foot predominant site. Regarding the margins, induration was present in majority of patients in both groups (66.7% and 73.3% respectively). The edges of the ulcer were sloping in majority of the patients in both treatment groups (86.7% and 80% respectively). The size of ulcer was smaller in hydrosurgery group as compared to surgical debridement group. However, it was non-significant. Wagner's grade 2 (deep ulcer extending through dermis) was the predominant type in both study groups. Peripheral pulses were present in 66.7% and 56.7% in hydrosurgery and surgical debridement group respectively.

Table 3: Clinical parameters related to ulcer's presence.

Variable	Status	Hydrosurgery (%)	Surgical debridement (%)	P value
Ulcer duration	Duration (in days)	79.67±68.13	72.83±36.89	0.631
Site	Right foot	14 (53.3)	16 (53.3)	0.606
	Left foot	16 (46.7)	14 (46.7)	
Margin	Erythema	2 (6.7)	2 (6.7)	0.364
	Induration	20 (66.7)	22 (73.3)	
	Induration and erythema	3 (10)	0	
	Normal	5 (16.7)	6 (20)	
Edge	Sloping	26 (86.7)	24 (80)	0.488
	Undermined	4 (13.3)	6 (20)	
Slough and granulation	Present	30 (100)	30 (100)	1.00
Size (cm^2)	Area	57.77±22.98	59.12±17.98	0.802
Wagner's grade	1	8 (26.7)	5 (16.7)	0.283
	2	22 (73.3)	25 (83.3)	
Peripheral pulses present	Yes	20 (66.7)	17 (56.7)	0.426
	No	10 (33.3)	13 (43.3)	

Less than 7 HbA1c was present in 46.7% and 50% of patients in hydrosurgery and surgical debridement group whereas 7-8% HbA1c was present in 30% and 43.3% patients respectively. 23.3% and 6.7% patients fell in HbA1c category more than 8% in hydrosurgery and surgical debridement groups respectively.

Deformity was present in 43.3% and 33.3% of patients in hydrosurgery and surgical debridement groups respectively. There was no abnormality detected in foot x-ray in both treatment groups. On culture sensitivity of tissue/pus, *Klebsiella* (23.3%) was dominantly found in hydrosurgery group whereas *Klebsiella* and *Pseudomonas* were found equally in Surgical debridement group (20% each).

Table 4 shows the distribution of patients in both treatment groups who had undergone for diabetic foot. One, two and three debridement were done in 56.7%, 36.7% and 6.7% of patients respectively in hydrosurgery group whereas 23.3%, 70% and 6.7% patients underwent one, two and three debridement in surgical debridement group. The distribution of patients in both treatment groups was statistically significantly different with hydrosurgery group requiring only one debridement in majority of patients as compared to surgical debridement (p=0.026).

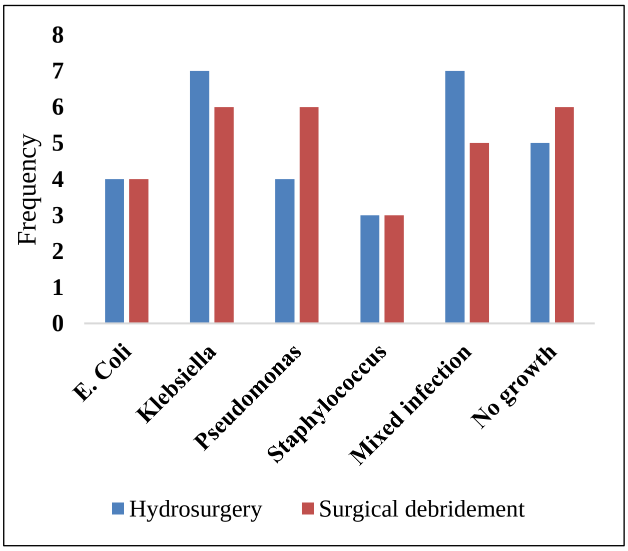

Figure 1: Culture sensitivity results from tissue/pus among study groups.

Mean operative time was less in hydrosurgery group as compared to surgical debridement (15.30 and 23.67 minutes respectively). The median operative time was less in hydrosurgery group as compared to surgical debridement group. On statistical analysis, there was significant difference in the mean operative time among the two study groups (p<0.001).

Table 4: Distribution of number of debridement procedures done in two group of patients.

No of debridement done	Hydrosurgery (%)	Surgical debridement (%)	Total (%)
One	17 (56.7)	7 (23.3)	24 (40)
Two	11 (36.7)	21 (70)	32 (53.3)
Three	2 (6.7)	2 (6.7)	4 (6.7)
Total	30	30	60

Chi-square test, p-value=0.026

Table 5: Proportion of patients observed to be achieving healthy status of granulation tissue.

Granulation health status	Hydrosurgery (%)	Surgical debridement (%)	Total N (%)
Healthy	24 (80)	24 (80)	48 (80)
Not healthy	6 (20)	6 (20)	12 (20)
Total	30 (100)	30 (100)	60

Mean blood loss (in ml) was less in hydrosurgery group as compared to surgical debridement (15.00 and 23.20 ml respectively). The median blood loss (in ml) was less in hydrosurgery group as compared to surgical debridement group. On statistical analysis, there was significant difference in the mean blood loss (in ml) among the two study groups.

Mean pain score (VAS) was less in hydrosurgery group as compared to surgical debridement (2.90 and 3.00 respectively). The median pain score (VAS) was same in both the treatment groups. On statistical analysis, there was no difference in the mean pain score (VAS) among the two study groups.

Mean duration of hospital stay was less in hydrosurgery group as compared to surgical debridement (6.27 and 7.50 days respectively). The median duration of hospital stay was almost similar in both the treatment groups. On statistical analysis, there was statistically significant difference in the mean duration of hospital stay among the two study groups (p=0.040).

Figure 2: Diabetic foot ulcer over left foot and lower leg with exposed tendons with grossly necrotic tissue.

Table 5 shows the status of granulation tissue among the study groups. In both the study groups, there was formation of healthy granulation tissue in equal proportions (80%). Since there was no difference in occurrence of healthy granulation tissue in both groups, it was not statistically significant.

Figure 3: Wound condition after 1 hydrosurgery debridement followed by regular dressings. Wound is around 90% covered with granulation tissue, which bleeds on dressing change.

Figure 4: Diabetic foot ulcer over plantar aspect of left foot of 2 months duration.

In diabetic patients who maintained adequate control over their glycemic status, in hydrosurgery group comparatively less time for healthy granulation tissue was taken as compared to surgical debridement group (12.38 and 13.11 days respectively). On the other hand, among diabetic patients not having adequate control over their glycemic status, hydrosurgery group had less mean duration of developing healthy granulation tissue as compared to surgical debridement group (14.19 and 14.40 days respectively). However, the difference in both the comparisons was not statistically significant (p>0.05).

Figure 5: Wound condition after 1 hydrosurgery debridement followed by regular dressings. Healthy granulation tissue along with minimal slough is present.

Figure 6: Wound condition after 2nd hydrosurgery debridement followed by regular dressings. Wound is around 100% covered with granulation tissue.

DISCUSSION

Diabetic foot is one of the most devastating complications of diabetes. The prevalence of diabetic foot ulcer (DFU) is 4% to 10% with lifetime incidence being as high as 25%.[3] Studies have reported that a round 14%-24% of these individuals are at a risk of amputation during the same or subsequent ulceration.

Multiple factors affect the wound healing process in diabetic patients. Debridement of devitalised tissue is an essential component of the effective treatment of chronic wounds. It is of great significance in the rapid wound healing to minimise risk of secondary infection and prevent amputation. It is an essential part of the treatment of wounds which are slow to heal.[1] Debridement is an expected and inseparable component of wound management and underpins the concept of wound bed preparation. Debridement also forms a part of bacterial load management within a wound. Surgical debridement is one of the aspects in the management of DFUs. The method of choice for debridement should be the one deemed most effective for the patient, particularly considering patient tolerance and the wound depending upon its anatomical location and the extent of debridement required. Debridement is aimed at decreasing the bacterial load by removal of all necrotic, callus, and fibrous tissues. In our study, hydrosurgical debridement for the management of diabetic foot disease was compared with surgical debridement. Hydrosurgery is based on Fluidjet technology, which simultaneously garps, excises and aspirates the unwanted tissue by using the venturi effect.[2]

A study has reported that 46 out of 68 (67.6%) patients who underwent the hydrosurgical debridement in the wards at the patient's bedside required only 1 operative procedure to achieve an adequately debrided wound bed for split-skin grafting and two and three operative procedures were required in 17 and 5 patients, respectively.[16] Another study conducted by Granick et al depicted that the hydrosurgery aided to reduce the number of debridements for the closure of the wound bed.[17] In the context of non-healing wounds that require a rapid and effective debridement to promote wound healing, hydrosurgery can be a better debridement methodology since most of the wounds required only one hydrosurgical debridement procedure.[18]

In our current study it was observed that mean duration of achieving healthy granulation tissue was comparatively less in hydrosurgery group as compared to surgical debridement (13.58 and 13.92 days respectively). We observed that a high percentage of granulation tissue was achieved only one week after the debridement procedure, in agreement with other previous published studies.[18] Our study also showed that for patients who maintained adequate control over their glycemic status, comparatively less time for healthy granulation tissue was taken as compared to surgical debridement group. One, two and three debridement were done in 56.7%, 36.7% and 6.7% of patients respectively in hydrosurgery group whereas 23.3%, 70% and 6.7% patients underwent one, two and three debridement in surgical debridement group. The majority of studied patients required only one debridement in hydrosurgey group to adequately prepare wound bed for eventual healing.

Caputo et al reported in a prospective randomised trial that hydrosurgery resulted in shorter debridement time without compromising wound healing.[19] In our study, the average time per procedure performed was also significantly short (p<0.001) in hydrosurgery group as compared to surgical debridement (15.30 and 23.67 minutes respectively). In our study, it was observed that hydrosurgery had the advantage with reduced debridement time. This might lower the risk of complications due to infection as it reduced the time of contact with devitalised tissue.

In the current study it was observed that hydrosurgical debridement better for wound bed preparation in complex contoured wounds without further alteration of its contour. Pain is also an important parameter in wound assessment as suggested in a review. Our study showed that mean pain score was less in hydrosurgery group as compared to surgical debridement (2.90 and 3.00 respectively).

We did not observe bleeding complications after hydrosurgery debridement, in agreement with other studies and in comparison with conventional sharp debridement.[6] Our results showed that mean blood loss (in ml) was significantly less in hydrosurgery group as compared to surgical debridement (p value <0.001).

Hydrosurgical debridement can be a good alternate to the conventional surgical debridement as most of the wounds requires only one hydrosurgical debridement procedure. There was significant reduction in total hospital stay with hydrosurgery debridement group (Mean duration of stay 6.27 days as compared to surgical debridement group of 7.50 days, p value = 0.040), which has favourable financial outcome with hydrosurgery debridement.

We also found that wound debridement using hydrosurgery was well tolerated by the patients. In our study it was observed that hydrosurgery allowed to precisely select, excise, and evacuate non-viable tissues, bacterial load, necrotic debris, and contaminants from wounds, while preserving the bone and viable tissue. Hence it can be concluded that hydrosurgery is a fast, effective, less painful and selective debridement method for chronic wounds like DFUs, which can also be effectively used as a bed side debridement procedure.

The above study if done with a larger sample size with a larger follow up period can conclusively prove that hydrosurgery is a more efficient alternative making it a routine in a surgeon's armamentarium.

CONCLUSION

Hydrosurgery system showed significant advantages over standard surgical scalpel debridement with lesser debridements required, reduced operative time and in hospital stay. It permitted adequate debridement of the diabetic foot wounds without much collateral damage which usually happens with standard scalpel debridement, preserving more viable tissues to promote rapid healing. However, further studies that use a larger cohort and a randomised controlled trial are required to further evaluate the effectiveness of hydrosurgery for debridement of diabetic foot wounds.

Recommendations

Further studies are required with larger cohort and a randomised controlled trial to fully evaluate the effectiveness, of the hydrosurgery system for the debridement of diabetic foot wounds.

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