

Pressurised irrigation versus swabbing for wound cleansing: a multicentre, prospective, randomised controlled trial

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KEY MESSAGES

1. Pressurised irrigation is more cost-effective than swabbing for wound cleansing by shortening the wound healing time.
2. Patients experience less pain during wound cleansing by pressurised irrigation than swabbing.
3. Patients have more satisfaction on the comfort after wound cleansing with pressurised irrigation than swabbing.
4. The total direct medical cost of pressurised irrigation is lower than that of swabbing.

Hong Kong Med J 2014;20(Suppl 7):S42-6

HHSRF project number: 05060011

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Introduction

Pressurised irrigation for wound cleansing is advocated, as it can loosen debris, remove excess exudates, and reduce bacterial colonisation without traumatising the wound bed and hence impeding the healing process.¹ The use of the DeVilbiss Syringe (DeVilbiss Healthcare LLC, Somerset [PA], USA) connected to the Gomco Vacuum/Pressure Pump Model 309 (Allied Healthcare products, Inc., St Louis [MO], USA) can generate a steady stream at 4 to 15 psi, which is safe and effective pressure for wound cleansing.²

Methods

A multicentre, prospective, randomised controlled trial was conducted in four out-patient clinics in the New Territories East Cluster of the Hospital Authority from April 2008 to August 2010. A total of 256 patients were randomised to receive pressurised irrigation (n=122) or swabbing (n=134) for wound cleansing. Patients were excluded if they had unbroken skin, full-thickness skin loss, damage to muscle, bone, and/or any supporting structures, wounds with a sinus, wounds to be healed by primary intention, wounds that were prescribed to be cleansed by pressurised irrigation, more than one wound, a very poor life expectancy, or a clinical condition that might interfere with wound healing.

Wounds were assessed at enrolment and upon healing (or after 6 weeks if the wounds had not healed). Primary outcome measures included time to wound-healing, change of wound size, and

proportion of wounds healed completely within 6 weeks. Secondary outcome measures included infection rate during follow-up, patient perceived wound symptoms, patient satisfaction with the cleansing method, health-related quality of life (HRQOL), and cost. The intention-to-treat principle was used. The two groups were compared using the log rank test, Pearson Chi-square test, Fisher's exact test, Mann-Whitney *U* test, or independent *t*-test as appropriate.

Cost-effectiveness analysis of wound healing was performed for those who completed the treatment. The total direct medical cost of wound dressing per patient was estimated by arithmetic mean. Mean time to complete wound healing estimated by the approach of Efron was used as the effectiveness measure. Biased-corrected and accelerated bootstrapping with 5000 replications was used to estimate the 95% confidence intervals (CIs) of the mean difference in the medical cost and time to complete wound healing between the pressurised irrigation and swabbing.

Results

Of the 256 patients, 39 (15.2%) were withdrawn: 15 in each group were lost to follow-up, and one in the pressurised irrigation group and eight in the swabbing group were due to adverse events. The two groups were similar in terms of baseline characteristics (Table 1).

Respectively in the pressurised irrigation and swabbing groups, 82.0% and 78.4% of wounds healed

within 6 weeks (Table 2), and the median times to complete wound healing were 9.0 (95% CI, 7.4-10.6) days and 12.0 (95% CI, 10.2-13.8) days (P=0.007, log rank test), whereas the mean times to complete wound healing were 11.4 and 14.5 days, with a saving of 3.1 (95% CI, 0.3-5.9) days.

The two groups did not differ significantly in terms of five wound symptoms (wound pain, fluid leaking from wound cleansing, bleeding, smell, and itchiness), except for pain during wound cleansing (P=0.020). The two groups also did not differ significantly in terms of the level the patient's life being interfered with by the six wound symptoms (Table 3).

Patients in the pressurised irrigation group had higher satisfaction scores after wound cleansing in terms of cleanliness (P=0.161), comfort (P=0.002), and overall satisfaction (P<0.001) [Table 4].

The two groups did not differ significantly in terms of HRQOL according to the Short Form-12 subscale scores of physical functioning, role physical, bodily pain, general health, vitality, social functioning, role emotional, and mental health (Table 5).

Respectively in the pressurised irrigation and swabbing groups, the mean total direct medical costs per patient were HK\$244±283 and HK\$354±882, with a saving of HK\$110 (95% CI, HK\$ -33 to 308) [Table 6].

In the cost-effectiveness plane displaying the distribution of incremental costs and effects of the bootstrapped results of 5000 replications, 90% of the bootstrapped cost-effectiveness pairs were located in the south-east quadrant, indicating that pressurised irrigation was dominantly more effective and less expensive than swabbing for wound cleansing (Fig).

Discussion

Pressurised irrigation for wound cleansing enabled shorter wound healing time, less pain during wound cleansing, and more patient satisfaction. Benefits of pressurised irrigation have been reported to be promoting wound healing and patient comfort,³ and shortcomings of swabbing involve the deleterious effects on tissue owing to the extra pressure applied on to the wound affecting the healing of wounds.^{3,4}

Although the nurses performing the dressing change were aware of the cleansing method used, the bias in outcome assessment was minimised by having a second assessor. When wounds showed signs of infection as determined by Cutting's criteria,⁵ patients were referred to a physician blinded to the method of wound cleansing and study purpose.

The glass bottle and stainless steel nozzle of the pressurised irrigation device were reusable. Although samples of saline were not tested to determine whether there was contamination, the

TABLE 1. Demographics of patients

Variable	No. (%) of patients	
	Pressurised irrigation (n=122)	Swabbing (n=134)
Sex		
Male	76 (62.3)	99 (73.9)
Female	46 (37.7)	35 (26.1)
Mean±SD age (years)	47.9±18.2	47.1±17.1
Education level		
Primary school or below	48 (39.3)	50 (37.3)
Secondary school	64 (52.5)	70 (52.2)
Tertiary school or above	10 (8.2)	14 (10.4)
Employment		
Employed full-time	58 (47.5)	58 (43.3)
Retired	26 (21.3)	36 (26.9)
Other	38 (31.1)	40 (29.9)
Mean±SD body mass index (kg/m ²)	23.7±3.7	23.8±4.2
Known chronic disease	32 (26.2)	43 (32.1)
Smoking		
Current smoker	24 (19.7)	19 (14.2)
Ex-smoker	18 (14.8)	21 (15.7)
Median (interquartile range) initial wound size (cm ²)	1.7 (0.6-6.6)	2.0 (0.8-9.5)
Median (interquartile range) time from wound onset to treatment (days)	5 (3-9)	6 (3-14)
Mean±SD overall wound status score	27.4±3.6	28.1±3.8
Wound type		
Trauma	41 (33.6)	36 (26.9)
Burn/scald	20 (16.4)	25 (18.7)
Surgical	23 (18.9)	21 (15.7)
Leg ulcer	2 (1.6)	10 (7.5)
Dog bite	4 (3.3)	6 (4.5)
Other	32 (26.2)	36 (26.9)
Wound site		
Upper extremity	54 (44.3)	52 (38.8)
Lower extremity	57 (46.7)	61 (45.5)
Trunk	8 (6.6)	16 (11.9)
Head/neck	3 (2.5)	5 (3.7)
Wound characteristics		
Delayed healing due to bacteria	0 (0)	1 (0.7)
Wound with risk of infection	2 (1.6)	2 (1.5)
Discolouration of granulation tissue	0 (0)	1 (0.7)
Foul odour	0 (0)	0 (0)
Infection in wound and antimicrobial treatment		
Yes	24 (19.7)	37 (27.6)
No	98 (80.3)	97 (72.4)

TABLE 2. Wound healing outcomes on an intention-to-treat basis

Variable	Pressurised irrigation (n=122)	Swabbing (n=134)	P value
% of wounds healed completely	82.0	78.4	0.470 (Chi-square test)
Median (interquartile range) time to complete wound healing (days)*	9.0 (7.4-10.6)	12.0 (10.2-13.8)	0.007 (log rank test)
Median (interquartile range) reduction of wound area (cm ²)	1.3 (0.3-6.3)	1.4 (0.3-6.9)	0.701 (Mann-Whitney U test)
Median (interquartile range) % of wound area reduction	100 (100-100)	100 (100-100)	0.225
Infection rate during follow-up (%)	3.3	5.2	0.443 (Chi-square test)

* Estimated median (95% CI) time to complete wound healing by the Kaplan-Meier method

TABLE 3. Patient perceived wound symptoms and levels of life interference by wound symptoms

Variable	% of patients		P value
	Pressurised irrigation (n=122)	Swabbing (n=134)	
Wound symptom			
Pain over wound			
No/mild	81.1	80.6	0.911 (Chi-square test)
Moderate/severe/very severe	18.9	19.4	
Pain during wound cleansing			
No/mild	93.4	84.2	0.020 (Chi-square test)
Moderate/severe/very severe	6.6	15.8	
Fluid leaking from wound cleansing			
No/mild	86.1	85.1	0.822 (Chi-square test)
Moderate/severe/very severe	13.9	14.9	
Wound bleeding			
No/mild	97.5	96.3	0.725 (Fisher's exact test)
Moderate/severe/very severe	2.5	3.7	
Wound smell			
No/mild	99.2	99.3	0.999 (Fisher's exact test)
Moderate/severe/very severe	0.8	0.7	
Itchiness over wound or surrounding skin			
No/mild	73.8	79.9	0.249 (Chi-square test)
Moderate/severe/very severe	26.2	20.1	
Life interfered by wound symptom			
Pain over wound			
Not at all/a little bit	78.7	82.8	0.400 (Chi-square test)
Somewhat/quite a lot/very much	21.3	17.2	
Pain during wound cleansing			
Not at all/a little bit	95.1	91.0	0.201 (Chi-square test)
Somewhat/quite a lot/very much	4.9	9.0	
Fluid leaking from wound cleansing			
Not at all/a little bit	95.1	95.5	0.868 (Chi-square test)
Somewhat/quite a lot/very much	4.9	4.5	
Wound bleeding			
Not at all/a little bit	97.5	98.5	0.671 (Fisher's exact test)
Somewhat/quite a lot/very much	2.5	1.5	
Wound smell			
Not at all/a little bit	99.2	100.0	0.477 (Fisher's exact test)
Somewhat/quite a lot/very much	0.8	0.0	
Itchiness over wound or surrounding skin			
Not at all/a little bit	91.8	93.3	0.652 (Chi-square test)
Somewhat/quite a lot/very much	8.2	6.7	

TABLE 4. Patient satisfaction

Patient satisfaction*	Median (interquartile range)		P value (Mann-Whitney U test)
	Pressurised irrigation (n=106)	Swabbing (n=111)	
Cleanliness after wound cleansing	6 (5-6)	5 (5-6)	0.161
Comfort after wound cleansing	6 (5-6)	5 (5-6)	0.002
Overall wound cleansing method	6 (5-6)	5 (5-5)	<0.001

* Rated by 6-point Likert scale from 1 (very unsatisfactory) to 6 (very satisfactory)

TABLE 5. Patient health-related quality of life

Short Form-12 subscale scores	Mean±SD		P value (independent samples t-test)
	Pressurised irrigation (n=106)	Swabbing (n=111)	
Physical functioning	65.1±28.6	67.3±25.2	0.539
Role physical	23.6±42.1	22.1±40.8	0.788
Bodily pain	59.2±28.3	57.2±30.4	0.619
General health	47.8±26.9	50.0±28.0	0.553
Vitality	69.4±28.6	70.3±28.0	0.828
Social functioning	71.9±36.3	74.5±34.0	0.584
Role emotional	62.7±42.6	64.9±40.8	0.707
Mental health	71.9±23.7	72.8±25.1	0.785

TABLE 6. Comparison of costs between pressurised irrigation and swabbing*

Cost (HK\$)	Pressurised irrigation group (n=106)	Swabbing group (n=111)	Mean difference (95% CI)
Cost for sterile dressing set (with forceps) [1]	21.8±24.7	27.2±28.9	
Cost for sterile gauze (2)	0.53±0.94	0.30±1.17	
Cost for sterile cotton wool ball (3)	0.00±0.04	0.22±1.00	
Cost for normal saline (4)	1.10±1.09	0.99±1.16	
Basic cost for wound cleansing materials (1+2+3+4)	23.4±25.6	28.7±30.6	
Cost for dressing fixation materials (5)	37.4±150.8	126.2±716.8	
Cost for supplementary dressing materials (6)	53.5±158.1	153.0±764.7	
Nursing time spent in dressing (minutes)	57.5±60.1	59.4±73.7	
Cost for nurse labour* (7)	166.7±174.4	172.1±213.7	
Total cost: materials + labour (1+2+3+4+5+6+7)	243.7±283.2	353.8±882.0	110.1 (-32.8-308.3)†
Mean (SE) time to complete wound healing‡ (days)	11.4 (1.0)	14.5 (1.1)	3.1 (0.3-5.9)†

* Nursing time spent in dressing times HK\$2.9 (HK\$2.9=nurse cost in 1 minute for an average salary of HK\$30 604 per month)

† 95% CI were estimated using bootstrap method

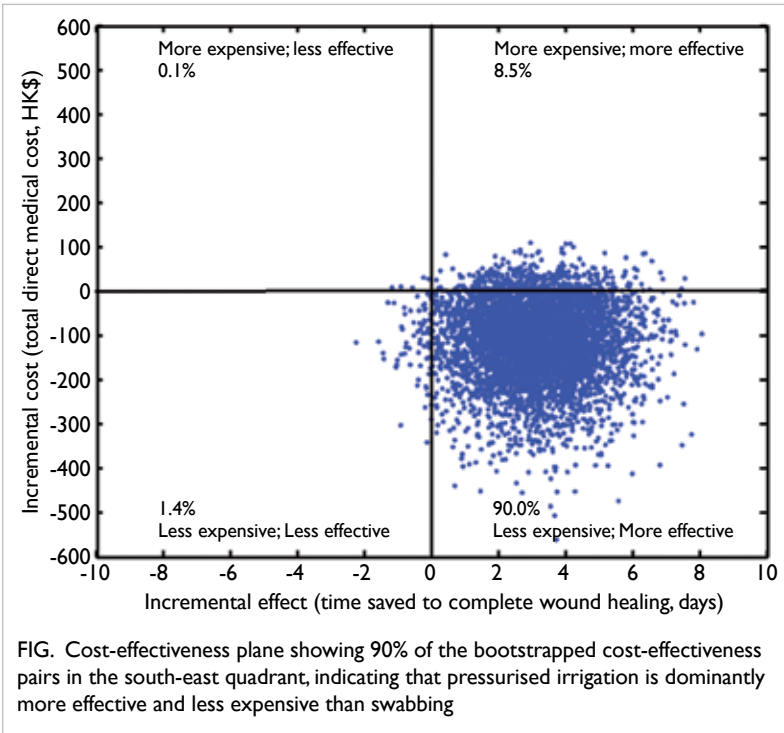
‡ Estimated by the approach of Efron

infection rates for the two cleansing methods did not differ significantly.

Of the nine adverse events, eight were from the swabbing group and its infection rate may have been underestimated. Most wounds were trauma wounds, burns/scalds, and surgical wounds; this may have been due to the demographics of the population.

Costs for chronic wounds are considerably

higher than those for all acute wounds. This may create variability of central tendency in the cost analysis. The dressing packs used for swabbing generate unnecessary waste from the disposal of unused items such as swabs, gauze, and wrappings. The waste disposal landfill is expensive. These financial and environmental liabilities of waste disposal make reducing non-hazardous waste



imperative. Dressing changes can be performed with clean, reusable instruments such as the self-modified pressurised irrigation device.

Conclusions

Compared with swabbing, pressurised irrigation is more cost-effective for wound cleansing in terms of shorter time of wound healing, less pain during wound cleansing, higher patient satisfaction, and lower total direct medical cost.

Acknowledgements

This study was supported by the Health and Health Services Research Fund, Food and Health Bureau, Hong Kong SAR Government (#05060011). We thank staff in the four general out-patient clinics of the New Territories East Cluster Nursing Research Workgroup for support and assistance.

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