The Efficacy of Silver Mesh Dressing Compared with Silver Sulfadiazine Cream for the Treatment of Pressure Ulcers

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Background: *Controlling infection and promoting healing should be aims of pressure ulcer treatment along with improving a patient's general condition and relieving pressure. Many pressure ulcers present with cavities, tracks or a combination of these. A new silver mesh dressing (Tegaderm™ Ag Mesh dressing) has the ability to contour around and conform to irregular surfaces of a wound bed.*
Objective: *To evaluate the efficacy of a silver mesh dressing compared with silver sulfadiazine cream for pressure ulcer treatment.*
Material and Method: *A prospective, randomized, clinical trial was conducted in patients with pressure ulcers grade III or IV. The patients were divided randomly by computer into two 20 patient-groups. The study period was eight weeks for each patient. Demographic data, wound size, wound photography, and bacterial wound culture were recorded at the beginning of the study and every two weeks thereafter. Wound beds were covered with silver sulfadiazine cream in the control group and silver mesh dressing in the experimental group. Dressings were changed twice a day in the control group and every three days in the experimental group.*
Results: *Forty-five patients enrolled in the present study but only 40 patients finished the study. Twenty patients in each group finished the eight-week study. The mean healing rates and the percentage of reduction in PUSH score at eight-week were better in the study group than in the control group but they were not statistically significant. Better changing in bacteriological study after the treatment was shown in both groups. The estimated average cost of the treatment in the mesh group was 263 USD per patient while it was 1812 USD in the cream one ($p = 0.0001$). Silver mesh dressing can be adapted very well on the bed, can control infection, and promote wound healing. Wound reduction was greater in the experimental group than the control group. The cost of treatment, using silver mesh was cheaper than using silver sulfadiazine cream significantly.*
Conclusion: *Silver mesh dressings is one of the choices for pressure ulcer treatment with good healing rate, minimal care and lower overall cost.*

Keywords: *Silver dressing, Pressure ulcer, Wound*

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Pressure ulcer is still a common problem found in either developing or under-developed countries[1,2]. Control of infection and promotion of healing along with improving the patient's general condition and relief of pressure are the aims of pressure ulcer treatment. Silver has been used for medicinal purposes for several thousand years[3]. It is widely recognized as an effective broad-spectrum antimicrobial agent[4]. Silver is an inert metal and does not react with human tissues in its non-ionized form. Clinical literature shows silver ions reduce microbial load through multiple mechanisms of action. The literature suggests that the risk of micro-organisms becoming resistant to ionic silver is minimized because of silver's ability to destroy microbes in three different ways[5]. First, the silver ions react with the cell's DNA, prohibiting reproduction[6]. Second, the silver ions enter the cytoplasm and bind with enzymes that control respiration. The enzymes

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shut down, suffocating the cell[6-10]. The last, the silver ions bind to the cell wall, causing lysis[11,12]. Silver has been proven to be an antimicrobial agent against most bacteria and fungus, including antibiotic-resistant strains, such as methicillin-resistant Staphylococcus aureus (MRSA) and vancomycin-resistant enterococci (VRE). No resistant strains have been encountered[13,14]. As well as having broad antimicrobial activity, silver also appears to have anti-inflammatory properties[15]. Many pressure ulcers are present with cavities, tracks, or a combination of these. It is important to ensure that the dressing is in contact with the majority of the cavity and that dead space is reduced[16]. In Siriraj Hospital, silver sulfadiazine cream has been used for topical dressing more than 20 years as a standard dressing for pressure ulcer with good results. It has some disadvantages such as dressing change twice a day and too much exudates. A new silver mesh dressing (Tegaderm™ Ag Mesh dressing) that contains silver sulfate has the ability to contour around and conform to the irregular surface of a wound bed. When wound exudates, sterile saline or sterile water comes into contact with the dressing, the silver sulfate dissolves, releasing silver ions rapidly and over time. It can release silver to the wound, up to seven days. This product may have a role in pressure ulcer treatment because it has a broad spectrum of antimicrobial activity and enhances wound healing. It might add the benefits to both the family and the medical personnel also.

Objective

To evaluate the efficacy of a silver mesh dressing compared with silver sulfadiazine cream for pressure ulcer treatment.

Material and Method

A prospective, randomized clinical trial was conducted in Siriraj Hospital on out- and in-patients with pressure ulcers graded according to National Pressure Ulcer Advisory Panel[17]. The present study was approved and monitored by the ethical committee of Siriraj Hospital. The ulcers graded III-IV were divided randomly by computer into two 20 patient-groups. The study period was eight weeks for each patient. Demographic data, wound size determined by using VISITRAK^R Wound measurement system, wound photography, and bacterial wound culture were recorded at the beginning of the present study and every two weeks thereafter. The ulcer healing was assessed by using the Pressure Ulcer Scale for Healing (PUSH 3.0)[18] every two weeks also. PUSH tool was used for evaluation of the condition of the wounds. Wounds were debrided as necessary. After wound bed cleansing was done, wound beds were covered with silver sulfadiazine cream in the control group and silver mesh dressing in the experimental group. Cotton gauze was used as the outer dressing in both groups. Dressings were changed twice a day in the control group and every three days in the experimental one.

Statistical analysis

All data analysis was performed using SPSS 13.0. Data were expressed as mean $\pm$ standard deviation (SD). Comparison of the mean between two groups of all parameters was evaluated for the significance by non-parametric Mann-Whitney U-test before treatment and at eight week of treatment. A p-value of less than 0.05 was considered significant.

Results

Forty patients enrolled to the present study. Twenty patients in each group finished the eight-week study. Mean ages were 62.6 years and 69.1 years in mesh and cream groups, respectively. The patients in each group were not different in the underlying disease, general condition, size, and duration of the ulcer when these parameters were compared by Mann-Whitney test (Table 1). The mean ulcer areas at the start of treatment were 12.17 and 22.82 cm^2 in the mesh and cream groups, respectively ($p = 0.016$), and were 7.96 and 18.22 cm^2, respectively at the eighth week ($p = 0.093$) (Fig. 1). The mean healing rates (area@0-area@N/area@0x 100) at the eighth week were 36.95% in the mesh group and 25.06% in the cream group ($p = 0.507$) (Fig. 2). The means of push score were 11.4 and 13.4 in mesh and cream groups, respectively at the initial. PUSH scores were 7.55 and 9.6 in respective groups at the eighth week ($p = 0.071$) (Fig. 3). The percentage of reduction in PUSH score was calculated by score@0-score@n/score@0x100. In the mesh group, the mean of this percentage was 28.15% and in the cream group 34.51% ($p = 0.473$) (Fig. 4). The bacterial studies in the mesh group and the cream group are shown in Table 2 and Table 3.

There was no complication from the treatment in both groups. The estimated average cost of the treatment in the mesh group was 263 USD per patient while it was 1812 USD in the cream one ($p = 0.00$). The average cost of treatment was calculated by drug cost+ outer dressing cost x time of dressing change/20 (Fig. 5).

Table 1. Baseline characteristics of patients and wounds in the silver mesh and the silver sulfadiazine cream groups*

Characteristics	Silver mesh group (n = 20)		Silver sulfadiazine cream group (n = 20)	
Age (year)	62.60 ± 20.59		69.10 ± 16.02	
Sex (male:female)	8:12		9:11	
Hct (%)+	34.21 ± 4.91		30.66 ± 4.02	
Blood sugar	104.55 ± 28.74		99.15 ± 23.93	
Total protein	6.80 ± 1.35		6.96 ± 1.09	
Albumin	3.31 ± 0.47		3.06 ± 0.65	
BUN	15.14 ± 6.28		15.68 ± 10.89	
Creatinine	0.74 ± 0.43		0.77 ± 0.33	
Onset (days)	232.00 ± 180.52		197.40 ± 131.65	
Location	Sacrum	16	Sacrum	14
	Rt. Greater Trochanteric	1	Rt. Greater Trochanteric	3
	Rt. ischium	2	Lt. Greater Trochanteric	2
	Lt. ischium	1	Rt. ischium	1

* Values expressed with a plus/minus sign are means ± SD, p > 0 .05 for all comparisons
+ p < 0.05

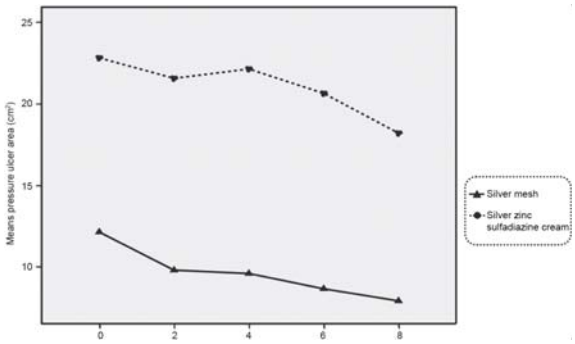

Fig. 1 Cumulative Improvement in mean ulcer area (cm^2) by subject over time (weeks)

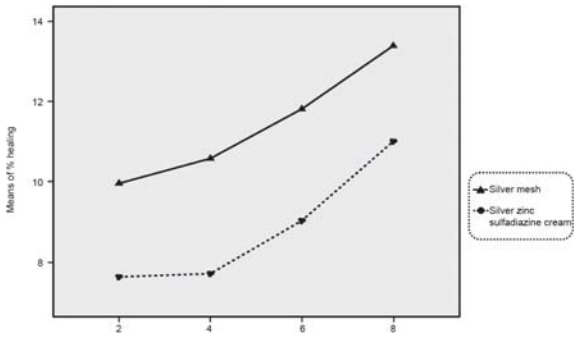

Fig. 2 Wound healing over time as measured by percentage improvement of healing

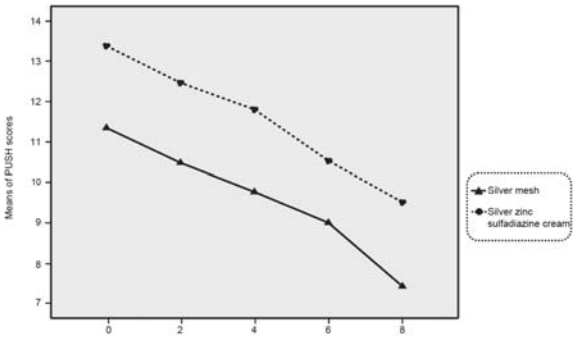

Fig. 3 Cumulative improvement in PUSH tool scores by subject over time (weeks)

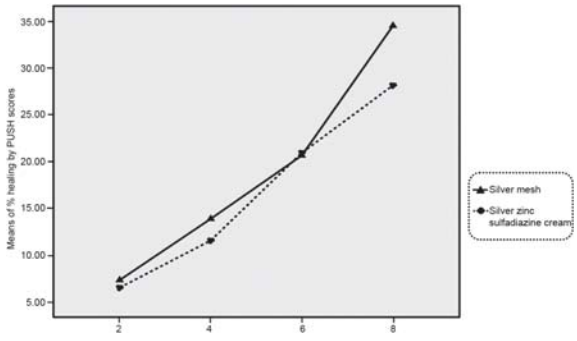

Fig. 4 Wound healing over time as measured by percentage improvement of PUSH tool scores

Discussion

Pressure ulcer still is a common problem occurring all over the world especially in seriously ill or immobile patients. In Siriraj Hospital, one of the biggest modern hospitals in Thailand, the prevalence was 4.76% in one day cross sectional study of the in-patients on

Table 2. Microbiologic study of pressure ulcer in the silver mesh group

Group	Patient	Week 0	Week 8
Silver mesh	A	Proteus mirabilis - Few	No growth
	B	Enterococcus Faecalis - Few Escherichia Coli - Rare	Staphylococcus aureus (MSSA) - Moderate Proteus mirabilis - Moderate
	C	Escherichia coli - Moderate Pseudomonas aeruginosa - Moderate Gram negative rods, non-fermentative (NF) - Moderate Enterococcus faecalis - Moderate	No growth
	D	Morganella morganii - Moderate Escherichia coli, ESBL negative - Moderate Commensal flora - Moderate	Streptococcus, beta - hemolytic, group G - Moderate Mixed bacteria - Moderate
	E	Staphylococcus aureus (MRSA) - Few	No growth
	F	Staphylococcus aureus (MSSA) - Few Pseudomonas aeruginosa - Few	Staphylococcus aureus (MSSA) - Moderate Mixed bacteria - Moderate
	G	Escherichia coli - Moderate Proteus mirabilis - Moderate Klebsiella pneumoniae - Moderate	Staphylococcus aureus (MSSA) - Moderate Mixed bacteria - Moderate
	H	Staphylococcus aureus (MSSA) - Numerous Mixed bacteria - Numerous	Mixed bacteria - Few
	I	Pseudomonas aeruginosa - Few Commensal flora - Few	Escherichia coli - Numerous Mixed bacteria - Moderate
	J	Streptococci, beta-hemolytic, group C - Moderate	Streptococci, beta-hemolytic, group C - Few
	K	Morgannella morganii - Few Streptococcus agalactiae - Few Commensal flora - Moderate	Streptococcus agalactiae - Moderate Commensal flora - Moderate
	L	-	-
	M	Staphylococcus aureus (MRSA) - Numerous	Staphylococcus aureus (MSSA) - Numerous
	N	Escherichia coli, ESBL negative - Moderate Morganella morganii - Moderate	Streptococcus agalactiae - Few Commensal flora - Few
	O	Acinetobacter baumannii - Numerous Klebsiella pneumoniae, ESBL positive - Moderate Enterococcus faecalis - Moderate	Acinetobacter baumannii - Few Staphylococcus aureus (MRSA) - Few
	P	No growth	Proteus mirabilis - Few Staphylococcus aureus (MSSA) - Rare
	Q	Streptococcus agalactiae - Moderate Commensal flora - Moderate	Mixed bacteria - Moderate Staphylococcus aureus (MSSA) - Moderate
	R	Staphylococcus aureus (MSSA) - Few Mixed faecal flora - Few	Staphylococcus aureus (MSSA) - Moderate Streptococci, beta-hemolytic, group A - Moderate Mixed bacteria - Moderate
	S	Morganella morganii - Few Staphylococcus aureus (MSSA) - Few	Mixed bacteria - Moderate
	T	-	Staphylococcus aureus (MSSA) - Numerous Mixed bacteria - Few

May 16, 2007 despite the existence of standard protocol for prevention. Silver has a long history in wound care. The conventional dressing method for stage III or IV pressure ulcer in Siriraj Hospital is cleansing the wound with normal saline and putting silver sulfadiazine cream over the wound surface twice daily. This takes a lot of time for the care team or the relatives. Many new silver dressing containing products have come out in the market. Silver mesh dressing is a new ionic silver dressing. It is composed of non-woven cotton fibers that are coated with silver sulfate. *In vitro* testing has demonstrated rapid and sustained effectiveness against a wide range of microbes. It is soft and has the ability to contour around and conform to irregular surface of a wound bed. This suits the pressure ulcer with cavities, tracks, or a combination of these. From the result of the present study, silver mesh dressing can enhance wound healing of the ulcer more than silver sulfadiazine (mean ulcer area at the eighth week = 3.65 and 5.28 cm^2 in the mesh and the cream groups ($p = 0.423$) and mean healing rate = 77.18% and 63.25% in the mesh group and the cream group

Table 3. Microbiologic study of pressure ulcer in the silver zinc sulfadiazine cream group

Group	Patient	Week 0	Week 8
Silver zinc sulfadiazine cream	AA	Staphylococcus aureus (MRSA) - Numerous Pseudomonas aeruginosa - Few	Staphylococcus aureus (MSSA) - Numerous Proteus mirabilis - Few
	BB	Enterococcus faecalis - Numerous	Enterococcus faecalis - Moderate
	CC	Proteus mirabilis - Numerous Pseudomonas aeruginosa - Numerous Enterococcus faecalis - Few	No growth
	DD	Proteus mirabilis - Rare	No growth
	EE	-	-
	FF	Staphylococcus aureus (MRSA) - Moderate Mixed bacteria - Numerous	Acinetobacter baumanii - Few
	GG	-	-
	HH	Enterobacter cloacae - Numerous Proteus mirabilis - Numerous Enterococcus faecalis - Moderate	Staphylococcus aureus (MRSA) - Moderate Mixed bacteria - Moderate
	II	Commensal flora - Moderate	Staphylococcus aureus (MRSA) - Moderate
	JJ	Providencia stuartii - Few Enterococcus faecalis - Few	Commensal flora - Few
	KK	Mixed bacteria - Numerous	Proteus mirabilis - Few Klebsiella pneumoniae - Few Enterococcus faecalis - Few
	LL	Acinetobacter baumannii - Few Enterococcus faecalis - Few	Staphylococcus aureus (MSSA) - Moderate
	MM	Staphylococcus aureus (MRSA) - Moderate Acinetobacter baumannii - Few	Mixed bacteria - Numerous
	NN	No growth	Enterococcus faecalis - Few
	OO	Staphylococcus aureus (MSSA) - Numerous Mixed bacteria - Numerous	No growth
	PP	Mixed bacteria - Numerous	Escherichia coli - Numerous Acinetobacter baumannii - Numerous Staphylococcus aureus (MRSA) - Moderate Stenotrophomonas maltophilia - Moderate
	QQ	Enterococcus faecalis - Moderate Escherichia coli - Moderate Acinetobacter baumannii - Moderate	Pseudomonas aeruginosa - Numerous Providencia rettgeri - Numerous Staphylococcus aureus (MSSA) - Numerous
	RR	Mixed bacteria - Numerous	Escherichia coli, ESBL positive - Numerous Morganella morganii - Numerous Enterococcus faecalis - Numerous
	SS	Staphylococcus aureus (MRSA) - Moderate Pseudomonas aeruginosa - Few Acinetobacter baumannii - Few	Staphylococcus aureus (MRSA) - Few
	TT	Pseudomonas aeruginosa - Rare	Commensal faecal flora - Moderate

(p = 0.470), respectively. PUSH score turned to be better in the silver mesh group than in the cream group but it was not statistically different. The presented silver mesh dressing did not stain the wound with black color as some of other silver containing dressings. Regarding the cost of treatment, using silver mesh was significantly cheaper than using silver sulfadiazine cream.

It means that using silver mesh dressing for treatment of pressure ulcer will reduce the work load of medical personnel or caregivers and the discomfort to patients.

Conclusion

Silver mesh dressings is one of the choices for pressure ulcer treatment with good healing rate, minimal care, and cost saving.

Potential conflicts of interest

None.

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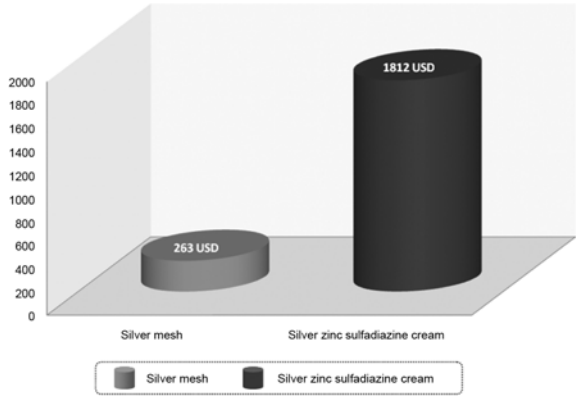
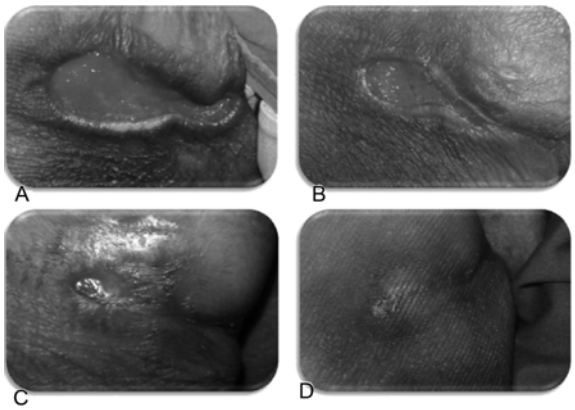
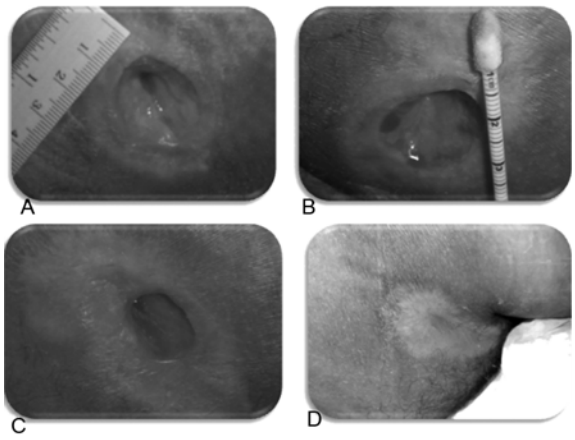


Fig. 5 Comparing cost of treatment between silver mesh and silver zinc sulfadiazine cream



A 75-year-old female with a 35-day history of sacral pressure ulcer stage III, treated with Silver mesh. (A = week 0, B = week 2, C = week 6, D = week 8)

Case 1. A 75-year-old female with a 35-day history of sacral pressure ulcer stage III, treated with silver mesh. Medical history was OA knee S/P total knee arthroplasty



A 35-year-old male presented with a 5-month history of Rt. ischial pressure ulcer stage III treated with Silver mesh. (A = week 0, B = week 2, C = week 6, D = week 8)

Case 2. A 35-year-old male presented with a 5-month history of Rt. ischial pressure ulcer stage III treated with silver mesh. Medical history was T-spine injury and paraplegia

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การศึกษาประสิทธิภาพของแผ่นปิดแผลตาข่ายเงินเทียบกับซิลเวอร์ซัลฟาไดอะซีนครีมสำหรับการรักษาแผลกดทับ

อภิรักษ์ ช่วงสุวนิช, อรวรรณ ชาญสันติ, วิษณุ โล่ห์สิริวัฒน์, จุฬาพร กังวางพุ่ม, นฤมล ทองอิน

บาดแผลกดทับเป็นปัญหาที่พบบ่อย การรักษานอกจากจะต้องทำให้ผู้ป่วยมีร่างกายสมบูรณ์ขึ้นแล้ว การรักษาการติดเชื้อ และกระตุ้นให้มีการหายของแผลเป็นส่วนสำคัญที่จะทำให้แผลหาย บาดแผลกดทับอาจจะมีลักษณะเป็นหลุมหรือช่องทางแคบ ๆ วัสดุปิดแผลตาข่ายเงินสามารถจะวางในพื้นที่แคบ ๆ นี้ได้ดี การวิจัยนี้มีวัตถุประสงค์เพื่อศึกษาประสิทธิภาพของตาข่ายเงินเทียบกับซิลเวอร์ซัลฟาไดอะซีนครีมในการรักษาบาดแผลกดทับ ทำการทดลองในผู้ป่วยมีบาดแผลกดทับระดับ 3-4 จำนวน 40 คน โดยแบ่งเป็น 2 กลุ่ม กลุ่มที่ทำแผลโดยตาข่ายจะเปลี่ยนแผล 3 วันครั้ง กลุ่มที่ควบคุมทำแผลวันละ 2 ครั้ง ติดตามผลการรักษาทุก 2 สัปดาห์ เป็นเวลาทั้งหมด 8 สัปดาห์ พบว่าบาดแผลในกลุ่มทดลองมีอัตราลดขนาดของแผลดีกว่ากลุ่มควบคุม และการเปลี่ยนแปลงของแผลดีขึ้นโดยวัดจาก PUSH SCORE แต่การเปลี่ยนแปลงทั้งสองอย่างนี้ไม่มีความแตกต่างทางสถิติที่สำคัญ พบว่าในกลุ่มทดลองมีค่าใช้จ่ายน้อยกว่ากลุ่มควบคุมอย่างมีนัยสำคัญ โดยสรุปตาข่ายเงินเป็นวัสดุทำแผลชนิดหนึ่งที่สามารถจะใช้รักษาบาดแผลกดทับได้ดี