COMPARISON OF CURING COSTS BETWEEN MAGGOT AND CONVENTIONAL THERAPIES FOR CHRONIC WOUND CARE

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ABSTRACT: The aims of this retrospective descriptive study were to evaluate effectiveness of maggot therapy in wound curing, to analyze the cost of therapy in a Thai district hospital setting and to compare the cost of maggot therapy to that of conventional ones. Study populations included all OPD and IPD patients with chronic wounds who underwent either maggot or conventional therapies in January to October 2009 (Total 150 cases, 80 cases with maggot therapy and 70 cases with conventional therapy) at Bangyai Hospital, Nonthaburi Province, Thailand. Data on patients' general characteristics and costs of therapies were collected from patients' medical records. Data were analyzed using descriptive statistics. It was revealed that maggot therapy resulted in a shorter wound healing period (6.5 days) when compared to that of conventional therapy (14 days). The majority of patients receiving maggot therapy did not have limb amputated (98.75%) while most of those receiving conventional therapy contrastively had limb amputated (7.14%). The median cost of maggot therapy was lower (6,700 Baht per case) when compared to that of conventional ones (16,800 Baht per case). Thus, it is well illustrated that maggot therapy could potentially reduce wound curing cost in a district hospital setting and effectively resulted in shorter curing period and less likely to have limb amputated. Ultimately, maggot therapy should be considered as a rational alternative for chronic wound curing in terms of the economical cost and wound curing effectiveness.

Keywords: curing cost, maggot therapy, chronic wound

INTRODUCTION: Maggot therapy or larval therapy, using live fly larvae to eliminate necrotic tissue in chronic wound, has been recognized for several hundred years as a simple but safe and effective method of wound debridement[1]. Therapeutic principle is that maggots secrete digestive enzymes which specifically dissolve necrotic tissue and this results in wound disinfection and wounds healing promotion[2].

Extensive use of maggot therapy during the World War II was abridged by the discovery and arising use of penicillin. Nevertheless, an emerging problem of antibiotic resistant bacteria has initiated concern to reuse maggot therapy in modern chronic wound care[2]. *Lucillia sericata*, a strain of green bottle fly, is currently utilized as therapeutic maggots. According to Food and Drug Administration (FDA) of the United States, maggots can be used in human with indication to debride non-healing necrotic skin and soft tissue wounds; including venous stasis ulcers, pressure ulcers, neuropathic foot ulcers, and traumatic or post surgical wounds[2].

Since maggot therapy has been reported to potentially reduce total expenditure which could be attributed to reduction in debridement times, number of hospital visits, and bed days[3]; it is interesting to determine whether maggot therapy would result in significant saving of wound care expenditure in Thai public hospital setting, especially in comparison with currently-use conventional therapy. Thus, the aims of this study were to evaluate effectiveness of maggot therapy in wound curing, to analyze the cost of therapy in a Thai district hospital setting and to

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compare the cost of maggot therapy to that of conventional ones.

RESEARCH METHODS: This retrospective quantitative study included all OPD and IPD patients with chronic wounds who underwent either maggot or conventional therapies in January to October 2009 (Total 150 cases, 80 cases with maggot therapy and 70 cases with conventional therapy) at Bangyai Hospital, Nonthaburi Province, Thailand. Data on patients' general characteristics and costs of therapies were collected from patients' medical records. Data collected for each patient included age, gender, wounds position, size of wound and wound classification; such as pressure sore wound, diabetic wound, burn wound and infected wound. Data was analyzed using SPSS software, version 17. Descriptive statistics was used to describe what was observed in the study populations.

RESULTS: Since distribution of patients' ages was not normally distributed, median of age was reported instead of mean. The median age of patients receiving maggot therapy was 56 years old, which is slightly greater than that of patients receiving conventional therapy (51 years old). The maximum age of the whole group of patients was 86 years old while the lowest age was 3 years old. The 3-year-old patient was the only case of burn wound in this study. The result revealed comparable percentages of male patients receiving maggot therapy (48.75%) and conservative therapy (51.25%). Nevertheless, there was a greater difference in percentages of female patients receiving maggot therapy (58.57%) and conservative therapy (41.43%). The majority of outpatients received maggot therapy (96.78%). However, conservative therapy dominated in the group of inpatients (58.12%).

The three common types of chronic wounds found in the whole group of patients were diabetic ulcer (112 cases, 74.67%), pressure sore ulcer (19 cases, 12.67%), and infected ulcer (16 cases, 10.66%). In each type of chronic wound, there were comparable percentages of cases receiving maggot therapy and conventional therapy. In case of patients with diabetic ulcers, 53.57% of them received maggot therapy while 46.43% received conservative therapy. For those with pressure sore ulcer, 52.63% received maggot therapy and 47.37% received conventional ones. In the group of patients with infected ulcers, 43.75% received maggot therapy while 56.25% received conventional ones. In addition, there were three cases with other types of wound, two cases had calluses and a three-year-old boy had burn wound, and they received maggot therapy.

Wound locations in the whole group of patients were as followed: foot ulcers (109 cases, 72.67%), leg ulcers (21 cases, 14%), back (19 cases, 12.67%), and hand and arm (1 case, 0.66%). More number of patients with foot and back ulcers received maggot therapy. In contrast, the number of patients with leg ulcer who received conventional therapy was doubled the number of patients receiving maggot therapy. There was only a case of hand and arm ulcer found in this study.

Table 1: Characteristics of study population and chronic wounds classified by received wound therapies

Features	Maggot therapy (n = 80)	Conventional therapy (n = 70)
Age		
- Median age	56	51
- Range (Min. – Max.)	82 (3-85)	67 (19-86)
Gender		
- Male	39 (48.75%)	41 (51.25%)
- Female	41 (58.57%)	29 (41.43%)
Cases by department		
- OPD cases	31 (96.78%)	2 (3.21%)
- IPD cases	49 (41.88%)	68 (58.12%)

Table 1: (Cont.) Characteristics of study population and chronic wounds classified by received wound therapies

Features	Maggot therapy (n = 80)	Conventional therapy (n = 70)
Types of wound		
- Diabetic ulcer 112 (74.67%)	60 (53.57%)	52 (46.43%)
- Pressure sore ulcer 19 (12.67%)	10 (52.63%)	9 (47.37%)
- Infected ulcer 16 (10.66%)	7 (43.75%)	9 (56.25%)
- Others 3 (2%)	3 (100%)	0
Wound locations		
- Foot	62 (56.88%)	47 (43.12%)
- Leg	7 (33.33%)	14 (66.7%)
- Back	10 (52.63%)	9 (47.37%)
- Hand and Arm	1 (100%)	0
Necrotic tissue size before therapy		
- Median size	12 cm^2	25.5 cm^2
- Range (Min. – Max.)	67 (3-70) cm^2	44 (6-50) cm^2
- Interquartile range	8.25-22.25 cm^2	15-35 cm^2
Necrotic tissue size after use		
- Median size	0 cm^2	3 cm^2
- Range (Min. – Max.)	18(0-18) cm^2	37(0-37) cm^2
- Interquartile range	0-0 cm^2	2-5 cm^2
Limb amputation		
- Having limb amputated after therapy	1 (1.25%)	5 (7.14%)
- No limb amputated after therapy	79 (98.75%)	65 (92.85%)

Median size of necrotic tissue found before treatment was larger in the group of patients receiving conventional therapy (25.5 cm^2). The largest size of necrotic tissue was 70 cm^2 while the smallest size was 3 cm^2. As revealed from interquartile ranges of necrotic tissue size, 50 percent of the cases receiving conventional therapy had necrotic tissue sizes between 15 to 35 cm^2, while 50 percent of patients receiving maggot therapy had necrotic tissue sizes in the range of smaller sizes (8.25 – 22.25 cm^2).

After maggot therapy has been provided, median size of necrotic tissue was decreased to 0 cm^2. As revealed from the interquartile range, up to 75 percent of the patients receiving maggot therapy had complete wound healing. In contrast, in the group of those receiving conventional therapy, median size of the necrotic tissue after treatment was 3 cm^2 and 50 percent of them had remaining chronic wound sized 2 to 5 cm^2.

After completed treatment, only 1.25% of patients receiving maggot therapy had limb amputation while 7.14% of patients receiving conventional therapy had the amputation. The results also showed that more than 90 percent of patients receiving either maggot or conventional therapies did not have limb amputation after the therapies.

For cost comparison between maggot and conventional therapies, three cost categories have been compared. These categories included main therapeutic cost, related cost, and total cost.

In maggot therapy, cost calculation was as followed.

- Main therapeutic cost (maggot therapy) = 3,000 Baht per one tube of maggot for the use of 3 days duration (It should be noted that there was a sale promotion that for 2 tubes of maggot purchased, one tube would be obtained for free.)

- Related cost (maggot therapy) = related cost for OPD cases (wound dressing set costing 70 Baht per visit) plus related cost for IPD cases (room service + food + nursing care cost + dressing set = 740 Baht per day)

- Total cost (maggot therapy) = main therapeutic cost plus related cost

In conventional therapy, cost calculation was as followed.

- Main therapeutic cost (conventional therapy) = cost of sterile set for wound debridement (300 Baht per set)

- Related cost = related cost for IPD cases (room service + food + nursing care cost = 600 Baht per day) (It should be noted that there was no related cost for OPD cases as they spent only on main therapeutic expenditure.)

- Total cost (maggot therapy) = main therapeutic cost plus related cost

When the main therapeutic costs of both therapies were compared, it was evident that the median cost of maggot therapy (3,000 Baht) was significantly cheaper than that of conventional therapy (8,400 Baht). Range of 3,000 to 6,000 Baht spent by 50 percent of the cases receiving maggot therapy was cheaper than the range of 4,200 to 12,000 Baht paid by 50 percent of those receiving conventional therapy. Maggot therapy also had a cheaper median related cost (2,960 Baht) when compared to that of conventional ones (8,400 Baht). All in all, median total cost of maggot therapy was only 6,700 Baht which was apparently cheaper than that of conventional therapy (16,800 Baht). It was well illustrated that the costs of maggot therapy was lower than the costs of conventional therapy in all cost categories.

Table 2: Cost comparison between maggot therapy and conventional therapy

Costs	Maggot therapy cost (Thai Baht), (n = 80)	Conventional therapy cost (Thai Baht), (n = 70)
Main therapeutic cost		
- Median cost	3,000	8,400
- Range	6,750	14,400
(Min. – Max.)	(2,250 – 9,000)	(3,000 – 17,400)
- Interquartile range	3,000 – 6,000	4,200 – 12,000
Related cost		
- Median cost	2,960	8,400
- Range	15,330	17,400
(Min. – Max.)	(210 – 15,540)	(0 – 17,400)
- Interquartile range	210 – 8,140	4,100 – 11,100
Total cost		
- Median cost	6,700	16,800
- Range	16,080	30,300
(Min. – Max.)	(2,460 – 18,540)	(4,500 – 34,800)
- Interquartile range	3,210– 14,140	8,400 – 22,200

Median curing duration of wounds treated by maggot therapy was 6.5 days which was shorter than that of conventional therapy (14 days). Curing durations in 50 percent of patients receiving maggot therapy were in smaller range (3 – 11 days) when compared to that of conventional ones (7 – 20 days).

Table 3: Comparison of curing duration in maggot therapy and conventional therapy

Curing duration	Maggot therapy (Days), (n = 80)	Conventional therapy (Days), (n = 70)
- Median curing duration	6.5	14
- Range (Min. – Max.)	18(3-21)	40(5-45)
- Interquatile range	3-11	7-20

RESEARCH LIMITATION: This study is retrospective and the sample populations have chronic wounds that was visit at Bangyai hospital for treatment chronic wounds, researcher collected data during January – October 2009.The sample population of receiving conventional therapy, in some cases can not search data of necrotic tissue size on wounds because the doctor did not record wounds size thus some sample populations may not have representative. This study can not control sample populations between receiving maggot therapy and conservative therapy because there was a limitation of time for the research.

DISCUSSIONS: This study simply evaluated healing of wound by assessing the size of necrotic tissue after receiving maggot and conventional therapies. The result demonstrated that maggot therapy was more effective in decreasing the necrotic tissue than the conventional ones. Furthermore, when the curing duration was considered, maggot therapy also resulted in shorter median curing duration. These findings were consistent with the findings

reported by Sherman that up to 80 percent of pressure ulcers treated by maggot therapy were completely debrided while less than half of pressure ulcers (48%) treated by conventional therapy alone were completed debrided[4]. He also concluded that maggot therapy was more efficient and effective in debridement of chronic pressure ulcers than were the prescribed conventional treatment[4].

In addition, when the percentages of case having limb amputated in this study was considered, just one case or 1.25% of those receiving maggot therapy had limb amputation. In this case, maggot therapy was prescribed late as the last alternative to amputation and that did not improve the prognosis. In contrast, up to 5 cases or 7.14% of those receiving conventional therapy had limb amputated. These evidences also indicated that maggot therapy could potentially reduce the number of case to have limb amputated. Collectively, these findings suggest that maggot debridement therapy should not be considered as the last alternative to limb amputation, instead, it should be earlier prescribed to aid further surgical wound closure or even complete healing without surgical intervention. Nevertheless, it should not be misinterpreted that conventional therapy was not effective since the efficacy of conventional therapy was assessed to be effective in treatment most of the wounds.

Although the result was not a full economic evaluation, it was well illustrated that the cost of maggot therapy was more economical than that of conventional therapy in all of the cost categories. The median cost of maggot therapy (6,700 Baht) was even less than half of the expenditure for conventional therapy (16,800 Baht). The cost saving by the use of maggot therapy was due to its shorter curing duration, about half of the curing duration for conventional therapy. The economical feature of maggot therapy would be useful in the health care setting where health resources are limited for chronic wound care, especially in the district hospitals and in developing country, such as Thailand.

As this study was an anecdotal study, the wound healing was still subjective, therefore, the prospective study with a large number of study subjects and controlled group for comparison with those receiving maggot therapy would be strongly recommended to further be undertaken to apparently demonstrate the effectiveness of maggot therapy in chronic wound healing. Full cost-benefit and cost-effectiveness should also be undertaken for further decision making in clinical practice and policy planning at the national level.

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