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Chronic Wounds Healing by Innovative Herbal Medicine and Buddhist Ways to Prevent Disability in Diabetic Patients

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Abstract--The objectives of this research were 1) to study the properties of both scientific and traditional medicinal herbs to produce innovative herbal medicine for chronic wounds healing in diabetic patients, and 2) to analyze chronic wounds healing by innovative herbal medicine and Buddhist ways to prevent disability in 30 diabetic patients in Mahasarakham, Thailand. The results revealed that 19 medicinal herbs have properties in managing the blood, vascular, lymphatic system, the main cause of chronic wounds, reducing blood viscosity, purifying blood vessels, flushing out waste water, and healing wounds. 5 medicinal herbs were used to produce innovative herbal medicine, and Buddhist principles were used in research and for informants. Chronic wounds in diabetic patients have three characteristics: peripheral neuropathy, ischemic wounds, and infectious wounds. Herbal Oil Formula 1 and Herbal Infusion Formula 2 were used as basic medicines for healing, Herbal Capsule Formula 3 for inflamed wounds, Herbal Infusion for wounds with dark secretions and rotten blood. Wounds with a lot of secretions, foul odors, and full

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wounds were healed by Mangosteen Peel Powder Formula 5. Accordingly, 100% of all 3 types of chronic wounds were healed. This saved all patients from disability.

Keywords---chronic wounds, diabetic patients, innovation, herbal medicine, Buddhist way.

Introduction

Diabetes is one of the most common chronic non-communicable diseases in the world [1-5], with increasing numbers every year due to lifestyle changes and inappropriate eating habits [6-8]. According to the International Diabetes Federation (IDF) report on the global diabetic patient situation, there were 366 million diabetic patients in 2012 and this number is expected to exceed 552 million in 2030. In 2019, about 463 million adults (20-79 years) were living with diabetes, by 2045, this will increase to 700 million. 79% of adults with diabetes were living in low-and middle -income countries and this disease caused 4.2 million deaths [9]. For Thailand in 2019, the number of people with diabetes continues to rise to 4.8 million and is expected to increase to 5.3 million by 2040 [10].

The pathology of diabetes is caused by abnormalities, insufficient insulin production, resulting in high blood sugar levels and slow circulating viscous blood. When there is more sugar than necessary, the body converts that sugar into fat that blocks the arteries and causes the arteries to narrow. There are few gaps in blood flow within the blood vessels, causing many complications [11-14]. The most common blood and vascular problems are nerve endings, numbness of the soles of the feet, followed by chronic wounds on the feet, and there is the need for hospitalization and many patients require amputation [15]. Diabetic patients are 15-40 times more likely to have their feet and legs amputated than the average person [16]. Foot ulcers are a common cause of amputation of 85% [17]. In Thailand, diabetic patients have chronic wounds which are increasing year by year, leading to continued disability [10]. In the Northeast, a large number of diabetic patients are found to be complication of chronic wounds that are difficult to heal and long to heal. Especially in Mahasarakham Province, diabetic patients have many chronic wounds and have been treated with amputation in more than a thousand cases, which is increasing every year [10].

Despite the variety of innovations in the past, it has not been able to truly meet the needs of chronic wounds healing in diabetic patients. In addition, eating behavior is one of the main causes of diabetes. In addition to drug healing, it is important to take care of the mind, the controller of behaviors simultaneously. Therefore, the researchers not only had studied medicinal herbs to produce innovative chronic wounds healing in diabetic patients, but also applied Buddhist principles to manage and control patient behavior to prevent disability from chronic wounds.

Research objectives

- To study the properties of both scientific and traditional medicinal herbs that can be used to produce innovative herbal medicine for chronic wounds healing to prevent disability in diabetic patients.
- To analyze chronic wounds healing by innovative herbal medicine and Buddhist ways to prevent disability in diabetic patients.

Methodology

Research model

This study was carried out by means of the model of 'Research and Development or R&D'. There were 3 phases of research methodology. The first phase was to study the situation of chronic wounds healing in diabetic patients in Mahasarakham Province from health care facilities. The second phase was the study of medicinal herbs, both scientific and traditional, that have properties in managing the blood, vascular, and lymphatic system to produce innovative herbal medicine and study Buddhist principles for use in research. The third phase was to study the effects of chronic wounds healing by innovative herbal medicine and Buddhist ways to prevent disability in diabetic patients.

Population and key informants

The samples included diabetic patients in Mahasarakham Province. In this research, 77 informants were selected by Purposive Sampling. Selection criteria were as follows. 1) 30 diabetic patients in Mahasarakham Province with diabetes for more than 3 years and chronic wounds (do not heal for more than 3 months); 2) 30 family members or primary caregivers of diabetic patients with chronic wounds; 3) 2 professional nurses; 4) 6 village health volunteers (VHV); 5) 2 monks; 6) 1 traditional herbal medicine healer; 7) 6 general public.

Research area

The researchers chose the area by Purposive Sampling that was Mahasarakham Province. The area selection criteria were: 1) it was an area in the northeastern region; 2) there were many diabetic patients with chronic wounds; 3) it was an area of diabetic patients with chronic wounds that did not heal for more than 3 months and were at risk for disability; 4) it was an area where people well cooperated in research study.

Research instruments

The researcher created the instruments to collect data with four parts: a questionnaire, an in-depth interview, a soles sensation assessment in diabetic patients using monofilament, and a chronic wounds healing by innovative herbal medicine to prevent disability. The instruments have been verified by 3 relevant experts.

Data analysis

Was divided into 2 parts: 1) qualitative analysis by examining credibility through participatory observations, inquiries, and in-depth interviews; 2) numerical analysis by analyzing the results of chronic wounds and then analyzing the content by Descriptive Analysis Method.

Results

Scientific and traditional medicinal herb properties to produce innovative herbal medicine for chronic wounds healing to prevent disability in diabetic patients

The researchers found 19 medicinal herbs, effective in managing the blood, vascular, and lymphatic systems, the main causes of chronic wounds: peripheral neuropathy, ischemic wounds and infectious wounds in diabetic patients. Therefore, the researchers used them to produce innovative herbal medicine for chronic wounds healing by applying wounds or eating.

Medicinal herbs with wound healing properties by applying wounds

The researchers found that five medicinal herbs: coconut oil, sesame oil, turmeric, halibut, and mangosteen peel have properties to reduce inflammation and wound healing. Therefore, the researchers brought them to produce 2 herbal medicines: Herbal Oil Formula 1 and Mangosteen Peel Powder Formula 5, with the following properties.

Coconut oil has antibacterial and antifungal properties. Traditional medicine can be applied to burns, scalds, chronic wounds, and gangrene to reduce inflammation and heal wounds.

Sesame oil contains linoleic acid that can dilate blood vessels, prevent platelet clotting in traditional blood vessels, reduce inflammation of wounds, treat scalds and burns.

Turmeric contains a mixture of turmeric extract and curcuminoids that help heal skin inflammation. Traditional medicine helps reduce bruises, swelling, wound healing, and blisters.

Acanthus ebracteatus, the fruit has a spicy flavor used to pound and mask to cover the abscess and heal wounds.

Mangosteen rind contains Mangostin that has a bactericidal action that causes pus, has anti-inflammatory xanthenes that destroy staphylococcus aureus, and contains tannins that helps to heal wounds. The traditional one has an astringent taste and helps heal wounds.

Medicinal herbs with wound healing properties by eating

The researchers found 14 medicinal herbs with properties, such as managing the blood, vascular, and lymphatic systems, thought to be the main causes of chronic wounds. The researchers then used them to produce herbal medicines for oral use as 3 drugs: Herbal Tea Formula 2, Herbal Capsule Formula 3, and Herbal Tea Formula 4.

Herbal Tea Formula 2 that helps manage the blood system consists of 3 main types of medicinal herbs: (1) '*Melientha suavis Pierre*' contains high vitamin C, help elastic blood vessels, reduce stenosis, bring blood to various organs, restore the peripheral nervous system, reduce foot numbness, and with vitamin B1 that helps reduce beriberi. Traditional medicine helps quench heat, neutralize fever, and balance body; (2) '*Rattan*' has a cold bitter taste, which helps to quench hot poison, and neutralize blood poisoning. Stem, leaves, flowers, rhizomes, and the whole plant help diuretic and dissolve swelling; (3) '*Cinnamomum porrectum Kosterm*', essential oil contains saffron, which is antibacterial. Traditional medicine can cure the breath problems, helps to open the air veins inside the body, neutralizes the hot-blooded, hot air, and drains the lymph.

Herbal Capsule Formula 3 helps manage the lymphatic system to reduce infection, flushing of lymphatic waste secretions, and reducing inflammation. Herbal Capsule Formula 3 consists of 6 types of medicinal herbs: '*Litosanthes biflora Blume*' against Gram-positive bacteria. Traditional *Staphylococcus epidermidis* stem nourishes blood, detoxifies blood, and nourishes lymph. '*Thongpanchang or Rhinacanthus nasutus Kurz*' root contains 'Rhinacanthin' that inhibits bacteria and viruses. In traditional medicine, the root and the whole plant are used to drain lymph and pus. '*Maclura cochinchinensis Corner*' is an extract that inhibits the growth of Gram-positive bacteria well. In traditional medicine, the flowers were used as an antiseptic and to nourish the lymph. '*Cleome viscosa Linn*' helps to heal wounds, increases epithelial cells, contains coumarin lignoid compounds that inhibit inflammation-initiating substances. In traditional medicine, the whole plant can cure the lymph and drive the pus. '*Rhubarb Emod*' has an astringent taste and contains tannins that help heal wounds. In traditional medicine, rhizomes have a bitter taste, help quench the heat, and increase blood circulation. '*Turmeric*' contains turmeric extract and curcuminoids that help reduce skin inflammation. In traditional medicine, rhizomes help heal wounds.

Herbal Tea Formula 4 is used for chronic wounds that are very inflamed, have dark secretions, and have started to spoil. This formula contains 6 types of herbs: '*Curcuma comosa Roxb*' contains anti-inflammatory 'diarylheptanoids' that are beneficial to the nervous system. In traditional medicine, it helps to drive waste blood out of the deep organs. In traditional medicine, '*Eurycoma longifolia Jack root*' is bitter, transfuses blood, and drives lymph. '*Plumbago*' inhibits the bacteria '*S. aureus*' well, and contains plumbagin that inhibits inflammation. In traditional medicine, its root has a hot taste, nourishes blood, and dispels blood. '*Smilax cerbularia subsp, Corbularia*', traditional, cures lymphatic drainage, disinfect pus, rotting wounds, reduces inflammation. '*Smilax glabra*' helps to inhibit fungi and bacteria that cause pus, such as *Staphylococcus aureus*, *Bacillus subtilis*, and anti-inflammatory. In traditional medicine, it helps cure lymphatic, pus, and rotting wounds.

Innovative Buddhist ways to prevent disability in diabetic patients

In addition to chronic wounds healing by herbal medicine in diabetic patients, the researchers performed a concurrent Buddhist way. In this study, Buddhist principles: Four Brahmavihāra Dhammas (Sublime States of Mind), Four

Saṅgahavatthu Dhammas (Bases of Social Solidarity), Four Iddhipāda Dhammas (Paths of Accomplishment) were used to conduct research in terms of having mercy, wishing the patient to be happy, desiring to see the patients free from suffering, and be happy when the patient's symptoms are relieved. Four Saṅgahavatthu Dhammas is used to educate people about diabetes with chronic wounds and correct practices in visiting patients at home, speaking politely, being compassionate and helping patients physically and mentally, being consistent, friendly, sharing awareness, and sharing problems. Four Iddhipāda Dhammas was used as the principle of research conduct, including the desire to be satisfied with what they are conducting research with, perseverance, continually monitoring patients, planning their work, monitoring, and evaluating patients' symptoms. Moreover, Buddhist principles were taught to the patients to practice while conducting research by organizing meetings to exchange knowledge of diabetes with chronic wounds once a month. Patients became more tolerant of provocations, self-control and knew to suppress their appetite, limit starchy foods, sugars, and fats, and must practice strict foot care and daily wound care, 2 times a day. Patients need to keep their minds calm, conscious and meditative by chanting each night before bedtime, and participating in monthly Buddhist activities organized by the researchers.

Effects of innovative herbal medicine and Buddhist ways to prevent disability in diabetic patients

Data were collected through participatory observations, in-depth interviews, monofilament foot sensation assessments, and weekly evaluations of chronic wounds. The research results can be summarized as follows. Patients were 17 males or 56.66%, 13 females or 43.33%, and aged 32–82 years, average 56 years. Patients with diabetes were 8–27 years old, average 19.25 years. The number of chronic wounds is 2–8 times, average 4.9 times. The duration of these chronic wounds is 3–30 months, average 13.33 months. Most of the lesions were degenerative nerve endings of 16 cases or 53.33%, followed by infected wounds in 9 or 30%, and ischemic wounds in 5 cases or 16.66%, respectively.

Group 1: Diabetic patients with chronic wounds (degenerative nerve endings)

Degenerative nerve lesions are characterized by numbness of the feet. Most of the wounds were characterized by thick, pale edges, rough cracked skin, no pain in the wound, unsteady gait, and poor balance. To heal the chronic wounds healing, the researchers used innovative herbal medicines as follows: Herbal oil medicine for wound Formula 1; Herbal Tea Formula 2, the basic medicine. However, if the wound was inflamed, we used Herbal Capsule Formula 3 together. The results showed that 100% of the nerve endings were healed. Wounds were healed in 6–11 weeks, including numb feet in 6–9 weeks.



Figure 1. Chronic wounds, degenerative nerve endings, pale wound texture, thick pale yellow wound edges treated with innovative herbal medicine

Group 2 Diabetic patients with chronic wounds (infected wounds)

Infected lesions were pronounced as swollen, red, hot, milky-white secretions, purulent or brown mucus-like discharge. In some cases, the infection spread until there was a dark black blood secretion inside. The researcher used 3–5 chronic wounds healing by innovative herbal medicine: Herbal oil medicine for wound Formula 1; Herbal Infusion Formula 2; Herbal Capsule Formula 3 to reduce inflammation, wounds and wash away lymphatic secretions. If the wound was very inflamed, had dark, putrefactive secretions, and smelled, two other innovative herbal medicines were used: Herbal Infusion Formula 4 and Mangosteen Peel Powder Formula 5. The study has shown that chronic wounds can heal 100% of infected wounds in 5-8 weeks, including foot numbness in 5-8 weeks.



Figure 2. Chronic wounds of an infectious nature in diabetic patients with inflamed excretory secretions / ulcer, swollen feet treated with innovative herbal medicine

Group 3 Diabetic patients with ischemic chronic wounds

Ischemic ulcers are characterized by numbness of the soles of the feet. The wounds are usually dry, dark in color, and some may even have a hard, black charred wound. The researcher used 3–5 innovative herbal medicines, namely: Herbal Oil Formula 1; Herbal Infusion Formula 2; Herbal Infusion Formula 4. The study has shown that chronic wounds healed 100% in 8-12 weeks, which took longer than other types of wounds, and feet heal in 6-8 weeks.



Figure 3. Chronic wounds, ischemic wounds, dark scars caused by angina, chronic wounds treated with innovative herbal medicine

Discussion

- Scientific and traditional medicinal properties of innovative herbal medicine for chronic wounds healing to prevent disability in diabetic patients:

The study has shown that chronic wounds in diabetic patients are caused by problems with the blood, vessels, and lymph. This is consistent with Att Nitipon [18], who described chronic wounds in diabetic patients that are difficult to heal. Problems from high blood sugar levels and constricted arteries cause poor blood supply of oxygen and nutrients to the peripheral organs. The wound is lacking in blood supply, impairing the defense mechanisms against pathogens, susceptible to infection [18], and resulting in congestion of lymphatic fluid. The study has shown that there are three types of chronic wounds in diabetic patients: peripheral neuropathy, ischemic ulcers, and infectious wounds. This is in line with the study of Siamhealth [19] on the diabetic foot ulcers healing.

The researcher investigated 19 medicinal herbs that showed properties that can heal the main cause of chronic wounds and used them to produce innovative herbal medicine for chronic wounds healing. Production started from extracting coconut and sesame seeds to extract the oil. Other medicinal herbs were made smaller, finely milled with an electric grinder, baked with an electric dryer, and packaged into infusions and capsules. This method was consistent with Pichet Lerthammasak [20] who has described that there are 28 methods for concocting medicines according to the principles of traditional medicine. Methods of chopping pills, crushing pills, baking pills, producing powdered pills for brewing, capsule pills, and oil-mixed pills are all part of the process of concocting traditional medicine [20].

- Analysis of the effect of chronic wounds healing by innovative herbal medicine and Buddhist ways to prevent disability in diabetic patients.

According to the research, there are 3 types of chronic wounds: degenerative nerve endings, ischemic wounds, and infected wounds. Most of them are lesions under the anterior foot that tend to have numbness in the 3rd toe area and are the slowest healing location. These are in line with Thiti Prab Na Sak [21], who explained that the position of the bone head at the base of the 3rd toe is where the average person puts the most weight on this point. Wounds in this area are therefore often found and have the longest symptoms [21].

Chronic wounds healing by innovative herbal medicine can treat chronic wounds of all types of wounds because each herbal medicine has different properties to deal with the causes of chronic wounds in the blood, vessels, and lymph, including 2 herbal infusions containing *Melientha suavis*, rattan, and *Cinnamomum porrectum* Kosterm that help manage the blood system. This is also in line with Institute of Science and Technology of Thailand [22] that 100 grams of *Melientha suavis* tea contains 37.49 milligrams of vitamin C which helps build collagen, and 10.64 milligrams of vitamin B3 which helps the blood vessels to be flexible, preventing atherosclerosis, solve atherosclerosis, and bring more blood to the various parts [22]. Rattan reduces blood viscosity, as Somporn Na Nakorn et al [23] described rattan as having a bitter-cold taste, detoxifying properties of hot, and neutralizing fever, thus neutralizing hot-blood poisoning and reducing blood viscosity in diabetic patients. With such properties, Herbal Infusion Formula 2 is used as a basic medicine in combination with Herbal Oil Formula 1 to treat chronic wounds of all characteristics. This Herbal Oil Formula 1 has properties to reduce inflammation caused by coconut oil and mangosteen peel powder. This is in line with what Sungthong Wicharuang [24] explained that using coconut oil mixed with astringent medicine is good for wound healing. In addition, coconut oil has antiseptic properties and in line with what Kanda Saenmanee [25] explained that coconut oil inhibits bacteria and fungi.

The lymphatic system uses Herbal Capsules Formula 3 that consists of *Litosanthes biflora* Blume, which the Faculty of Pharmaceutical Sciences, Ubon Ratchathani University has studied for its antibacterial and antifungal activity (Faculty of Pharmacy, Ubon Ratchathani University, 2010), including the root of *Thongpanchang* or *Rhinacanthus nasutus* Kurz, which Wut Wutthithamwet [26] said that the root and the whole plant have antibacterial, fungal, and antiviral properties. If the wound is infected, spreads, has pus, has dark, black secretions, we will use Herbal Infusion Formula 4. Indian leadwort root helps to inhibit *S. Aureus* bacteria, purulent wound infection, and anti-inflammatory [27], consistent with Pichet Lertthammasak [20] explained that the Indian leadwort has the effect of dispersing the blood and dispelling the blood.

For the Buddhist way of researching innovative chronic wounds healing, the researcher has done by adopting Buddhist principles as a guideline in the research study. For example, Four Saṅgahavatthu Dhammas is used to educate people about diabetes with chronic wounds and correct practices in visiting patients at home, speaking politely, being compassionate and helping patients physically and mentally, being consistent, friendly, sharing awareness, and sharing problems. Four Iddhipāda Dhammas was used as the principle of research conduct, including the desire to be satisfied with what they are conducting research with, perseverance, continually monitoring patients, planning their work, monitoring, and evaluating patients' symptoms. Moreover, Buddhist principles were taught to the patients to be more tolerant of provocations, have self-control and knew to suppress their appetite, limit starchy foods, sugars, and fats.

New knowledge

The researcher discovered five innovative herbal medicines for chronic wounds healing to prevent disability in diabetic patients and discovered the integration of Buddhist principles, namely Four Brahmavihāra Dhammas, Four Saṅgahavattū Dhammas, Four Iddhipāda Dhammas, including mindfulness, meditation, patience, and self-control that are able to treat three types of chronic wounds in diabetic patients: peripheral neuropathy, ischemic wound, and infectious wound. The methods of using herbal medicine can be summarized in the following table.

Table 1
Method of using herbal medicine to treat chronic wounds in diabetic patients 3 characteristics

Chronic wounds	Type of herbal medicine used to treat chronic wounds
Degenerative nerve endings	Herbal Oil Formula 1, Herbal Infusion Formula 2
Ischemic wounds	Herbal Oil Formula 1, Herbal Infusion Formula 2, and Herbal Infusion Formula 4
Infected wounds	1 Herbal Oil Formula 1, Herbal Infusion Formula 2, Herbal Capsules Formula 3, Herbal Infusion Formula 4, and Mangosteen Peel Powder Formula 5

Conclusion/Recommendation

Innovative herbal medicine for chronic wounds healing 5 medicinal herbs can treat all 3 types of chronic wounds in diabetic patients because each herbal medicine has the following properties: Herbal Oil Formula 1 reduces inflammation of wounds and increases wound tissue cells; Herbal Infusion Formula 2 reduces blood viscosity, flushes blood vessels, and brings more blood to wounds; Herbal Capsule Formula 3 reduces wound inflammation, and lymphatic drainage, waste products, and secretions; Herbal Infusion Formula 4 washes away the blackened fermented waste secretions, reduces inflammation of the wound that is severely spreading, and penetrates well into the tissues that are lacking in blood; Mangosteen Peel Powder Formula 5 deodorizes wounds, flushes secretions, drives pus, and heals wounds. In the Buddhist way, the researchers applied the Buddhist principles in research and applied them to diabetic patients with chronic wounds, enabling them to concentrate, behave properly, stay sane, and be healthy. Suggestions for utilizing the research results are as follows: various Buddhist principles should be applied to various activities in research studies. The results of this research should be registered and commercialized as innovative herbal medicine for chronic wounds healing in diabetic patients.

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