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Systematic Review

The effect of chit powder technology in the treatment of burn hazards victims: A systematic review

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Abstract

Objective: In order to heal burn wounds, many researches have been done, including the use of biological scaffolds due to their ability to achieve the desired properties. Owing to the appropriate biological properties of chitosan such as biocompatibility and antimicrobial properties as well as the promotion of wound healing in biomedical applications, we aimed to perform a systematic review to investigate the effect of this technology on the treatment of burn hazards victims.

Methods: The present research was conducted in 2020 as a systematic review of studies related to the effect of chitosan on burns. In this study, Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) and Critical Appraisal Skills Programme (CASP) guidelines were used to assess the articles. The key words "Chitosan," "Chitin," "victim," "Injury," "Burn," "Heal," "wound" "treat," "hazard," and "care" were used in combination with the Boolean operators OR and AND. The ISI web of science, PubMed, Scopus, Science Direct, Ovid, Pro Quest, Wiley and Google Scholar were searched.

Results: Recently, chitosan and its derivatives have been proposed as suitable candidates for scaffolding and can be used as temporary scaffolds to modify and stimulate the growth of new tissues. Studies to demonstrate the use of chitosan in the treatment of burns have been limited to research on animal models and have been superior to conventional therapies in terms of time, pain, and efficacy.

Conclusion: The effect of chitosan on burns has been positive in animal models and has accelerated wound healing. Since the main ingredient of chit powder is chitosan and due to the limited studies done on humans, it cannot be said with certainty that the use of chitosan and its derivatives to treat burns is better than other ways to treat burns.

Keywords: Chitosan, Chitin, Chit powder, Burns, Hazard, Victims

Introduction

Burns are one of the most common problems in developing countries. Globally, 95% of burn deaths occur in low- and middle-income countries. Studies show that half of these deaths occur in South and Southeast Asia (1-3). Burn injuries have a unique age and sex distribution (4). The largest group of burn patients is children under 6 years of age. At these ages, the most severe injuries occur to children under 2 years of age (5,6). The prevalence of burns decreases during adolescence, however, burns are the fourth maximum usual reason of dying from accidents per this age group (7,8). Many burns in the first two decades of life are due to accidents and can be prevented. However, severe burns are important causes of morbidity and mortality in children and adolescents and burns are the third maximum usual reason of dying due to injury per this age group (9).

Burn injuries are often accompanied by psychological damage. Burn stress, like other psychological disorders, has short-term and long-term effects on health, function, and quality of life, and is caused by depression, sleep disorders, and dissatisfaction with the appearance of the body (10). Pain is also one of the serious problems after burns, especially in the early stages (11). Psychological problems are one of the most common symptoms of patients after burns (12). In Japan and United States this complication has been observed in patients three to six months after burns (13,14).

It can be very important to find dressings that do not have any side effects and are of natural origin. In

addition, their preparation processing must be cheap and affordable, and also accelerate wound healing by creating a suitable situation (14,15). In order to repair wounds caused by burns, many researches have been done, including the use of biological scaffolds due to their ability to achieve the desired properties (16,17) Due to the suitable biological properties of chitosan, such as biocompatibility, antimicrobial properties and promoting wound healing in biomedical applications, we decided to conduct a systematic review on the effect of chit powder (the active ingredient of chitosan) on the burns treatment. The findings of the present study can be used in the health sector of the country.

Methods

The present research was conducted in 2020 as a systematic review of studies related to the effect of chitosan on the treatment of burns.

Data Sources

To achieve this goal, databases including ISI Web of Science, PubMed, Scopus, Science Direct, Ovid, Pro Quest, Wiley and Google Scholar were searched from 2000/11/30 to 2020/10/30.

Search Strategy

In searching databases, keywords used included "Chitosan," "Chitin," "victim," "Injury," "Burn," "Heal," "wound" "treat," "hazard," and "care". All keywords were combined using "AND" and "OR" in the database search section. Mesh strategy was used in English language databases to find all synonyms. The search strategies are shown in Table 1.

Data Selection, Extraction, and Analysis

Independent reviewers (MH and HSH) screened abstracts and titles for eligibility. When the reviewers felt that the abstract or title was potentially useful, full copies of the articles were retrieved and considered for eligibility by both reviewers. If discrepancies occurred between reviewers, the reasons were identified and a final decision was made based on third reviewer (AJ) agreement in a blinded way. The Critical Appraisal Skills Programme (CASP) tool uses a systematic approach to appraise different study designs from the following domains: study validity, the quality of methodology, presentation of results, and the external validity. Each item from the checklist was judged with yes (low risk of bias, score 1), no (high risk of bias), or cannot tell (unclear or unknown risk of bias, score 0). Total scores were used to grade the methodologic quality of each study (17).

Inclusion and Exclusion Criteria

We included articles that investigated Chitosan and Chitin in the treatment of burns and researches on the effect of chitosan on human. Our exclusion criteria encompassed studies that examined other dressings and investigated animal populations. We also excluded studies that examined chitosan in other therapeutic applications.

Results

Database Search

The initial electronic database search of the literature resulted in a total of 4075 documents. In the next stage, repetitive documents including duplicate articles, books, dissertations, and presentations were excluded and the number of documents decreased to 1054 articles. Based on systematic screening, the titles and abstracts were surveyed to find those relevant to the effect of chitosan in the treatment of burn, and we extracted 63 eligible articles. In the next step, all 63 selected full text papers were considered and finally 6 papers which reported the effect of this technology on the treatment of burn hazards victims were selected. Figure 1 shows a diagram for the selection of papers assessed based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (18) guidelines.

Results

Demographic Characteristics of Studies

The number of participants of these six studies was 33 in total. Details of each study and other information

Table 1. The Search Strategy

Database: ISI web of science, PubMed, Scopus, Science Direct, Ovid, Pro Quest, Wiley and Google Scholar.	
Keywords: "Chitosan," "Chitin," "victim," "Injury," "Burn," "Heal," "wound" "treat," "hazard," "care".	
Limit: Language (English), Text (Full), Subject (Effect of Chitopowder Technology in the Treatment of Burn).	
Data: 2000/11/30 to 2020/10/30.	
Strategy: #1 And#2 And #3 And #4 And #5	
#1	Chitosan Or Chitin
#2	Burn OR Heal OR Wound
#3	Treat OR Care
#4	Hazard
#5	Victim Or injury

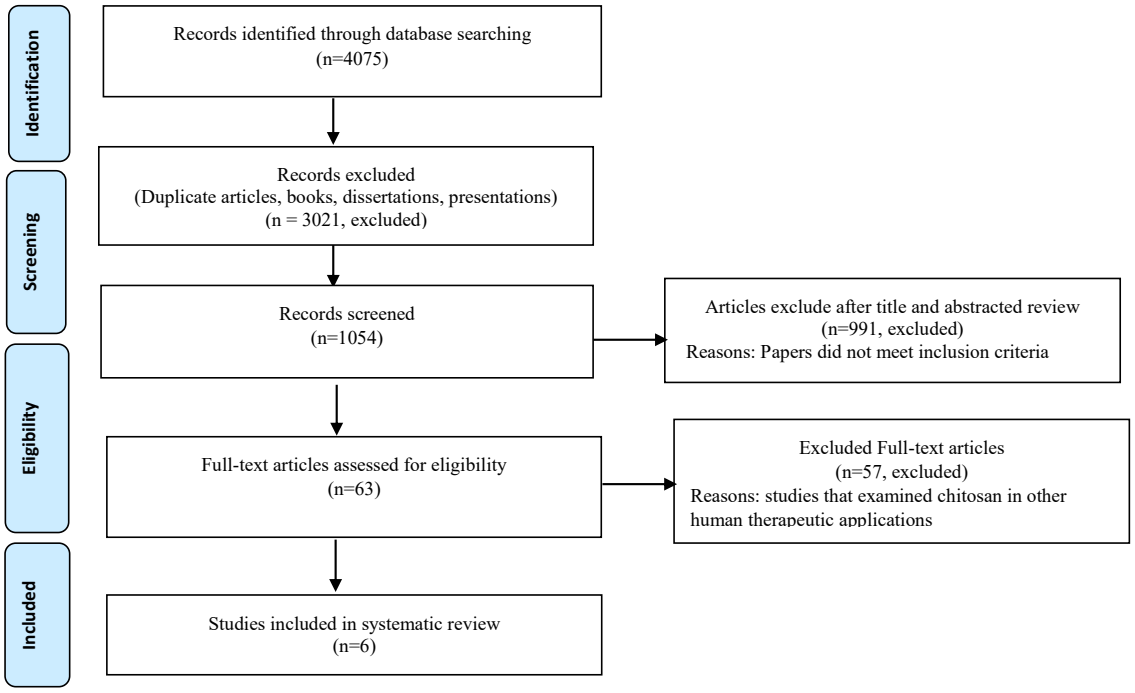

Figure 1. Flow diagram showing the selection of articles reviewed, in accordance with the PRISMA guidelines.

regarding the name of authors, year, study type, place, sample size, setting, data collection and main concepts were evaluated. The studies were mainly conducted in Asian countries including Chania (17), Japan (16,19,20), Korea (15) and Iran (21). Moreover, the summaries of each paper related to the effect of chitosan on the treatment of burns are shown in Table 2.

Discussion

It is very important to find dressings that do not have any side effects, are of natural origin, their processing is cheap and affordable, and accelerate wound healing by creating a suitable substrate. In order to repair the wound caused by burns, many researches have been done, including the use of biological scaffolds due to their ability to achieve the desired properties. Owing to the suitable biological properties of chitosan such as biocompatibility and antimicrobial properties and promotion of wound healing in biomedical applications, its evaluation is not without merit.

Kang et al showed that burn wound treated with CHI-AgCl NPs ointment was completely healed within 14 days of treatment. In particular, the density of regenerated collagen was the highest in the CHP-AgCl NPs ointment group (CHI-AgCl NPs ointment is a suitable therapeutic agent for burn wounds due to its chitosan activity) (15).

Also, in a study entitled "The effect of chitosan and heparin in the early treatment of burns", the findings showed that chitosan is widely used in wound healing, including burns. Heparin is also the most widely used glycosaminoglycan in burns. To evaluate the effects of chitosan and heparin alone and a mixture of chitosan and heparin on the early treatment of burn wounds, an experiment was performed on three groups of mice. In this study, chitosan and heparin powder and a mixture of chitosan and heparin were applied to burn wounds, respectively. After 72 hours, histological examination of burn wounds was performed. The results showed that the effect of chitosan in the treatment of burns was more severe than the control group and chitosan largely prevents the increase of burns in the initial stage. However, heparin had no protective effect on the early increase of burns. Co-administration of chitosan and heparin weakens the protective effect of chitosan (16).

In another study entitled "Chitin, chitosan and its derivatives to heal wounds", many animal experiments were reported and the beneficial effects of chitin for wound healing were examined. In a study entitled "Chitin, Chitosan, and Its Derivatives for Wound Healing: Old and New Materials" histologists, used the effects of chitin on 147 clinical cases, including 72 dogs, 38 cows, 33 cats, 2 rabbits, a monkey, and a horse, for a variety of traumas, abscesses, and surgical tissue defects. The results showed that in 77 out of 86 cases (89.5%), chitin recovery was effective and the recovery needed less time .

A histologist studied the effectiveness and safety of chitosan wound dressings for second-degree deep burns in a randomized, controlled, single-blind clinical trial. In this study, 60 patients with second degree deep burns were randomly divided into two groups, and one group was treated with chitosan wound dressing (experimental group) and the other group was treated with chitosan

Table 2. Summary of articles related to the effect of chit powder on the treatment of burn hazards victims

Authors	Type of Study	Year of Publication	Place	Setting	Design (Data Collection)	Number of Participants	Main Concept
Liu et al (17)	Interventional	2017	Chania	Hospital	Experimental	6	Burns are much more common than other injuries that involve body contact with flames, hot appliances and liquids, or chemicals or electricity. -Scaffolding should have several important features, including: A) It has many pores with suitable sizes so that the cells can anchor in it B) It has a wide external surface C) The rate of degradation of the scaffold should be proportional to the growth rate of the resulting tissue D) It has good mechanical properties so that the structure does not disintegrate during tissue growth time E) It is non-toxic and has high biocompatibility
Jin et al (16)	Interventional	2007	Japan	Hospital	Experimental	4	Evaluation of the effects of heparin and chitosan alone and a mixture of the two on burn wounds showed that in comparison with chitosan and heparin in burns, chitosan reduces the severity of burns. Heparin, on the other hand, has no protective effect on the early spread of burns. The use of heparin and chitosan together also weakens the effect of chitosan.
Murakami et al (19)	Interventional	2010	Japan	Laboratory	Experimental	12	ACFHS has many advantages as a wound dressing for repairing healing wounds. The application of ACFHS significantly stimulated the repair of wounds in rats treated with mitomycin C. Therefore, ACFHS is a promising dressing for healing deteriorating wounds.
Aoyagi et al (20)	Interventional	2007	Japan	Laboratory	Experimental	3	Different formulas were applied in the early stages for severe burn wounds in mice, and the wound state was investigated at the wound level. The use of 10 mg of sealing of water and full materials with Tegaderm had a negative effect. MH Ointment was not effective, but Geben cream was relatively effective. However, the arousal CH83-MH-A containing 2 mg of MH (CH83 - MH2 - A) and CH83 film also showed an excellent effect. Due to the removal of dirt, CH83 - MH2 - A tends to be better than CH83. CH83 - MH2 - A is suggested as a useful formula for treating severe burns.
Kang et al (15)	Interventional	2016	Korea	Laboratory	Experimental	6	Comparison of patients treated with CHI-AgCl NPs burn ointment, compared with treatment with Vaseline and Chitosan ointment, shows that the burn wound treated with CHI-AgCl NPs burns completely in 14 days and looks like normal skin. Due to its antibacterial activity, this ointment is a good healing agent for burn wounds.
Oryan and Sahvieh (21)	Cross-sectional	2017	Iran	Hospital	Reviewed various forms of CS including hydrogels, sponges, films, and nanofiber membranes	2	The role of CS alone or in combined form with other materials has also been reviewed in healing and regeneration of the cutaneous, cartilage and bone wounds. In addition, findings clarify the controversies and conflicts regarding the effectiveness of CS in the healing process.

biomedical dressing (control group). Then, the efficacy, recovery rate, pain intensity and safety were evaluated through adverse reactions and laboratory indicators before and after the treatment. The results showed that there was no significant difference between the two groups in terms of recovery time (21 and 23 days), recovery rate and pain intensity on the 14th, 21st and 28th days of treatment ($P > 0.05$). Also, there was no significant difference between the two groups in terms of normal blood parameters, liver and kidney functions before and after the treatment. In addition, side effects occurred in both groups. The overall results showed that the effectiveness and safety of chitosan wound dressing in the treatment of secondary deep burns is the same as conventional dressings in humans (17). Again, since the mechanism of wound healing in humans is different in comparison to animals and no clinical studies have been performed in this regard, it cannot be stated with certainty that chitosan is superior to conventional treatments regarding burns and requires more clinical research in humans.

Conclusion

In this systematic review we evaluated the effect of chitosan in the treatment of burns. Our research shed light on the

fact that the effect of chitosan on burns is positive in animal models and facilitates the healing of burn wounds. In our investigation only one clinical study was undertaken on humans, which has not yielded significant results. Since the main ingredient of chit powder is chitosan and due to the limited studies done on humans, it cannot be said with certainty that the use of chitosan and its derivatives to treat burns is better than other methods and more research is needed to be done.

Authors' contributions

MH conceived the concept and design of the study, AJ and HS contributed in searching, reviewing the literature, and summarizing the results, HS was involved in data analysis and manuscript writing and AJ supervised the study and critically reviewed the manuscript. All the authors read and approved the final manuscript.

Ethics issues

This study was approved by the ethics committee of the National Institute for Health System Research with the ethics code number 241/M/69118.

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