

# Effective management of cardiothoracic surgical wounds: a scoping review

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**Abstract.** Cardiac surgery is included among the seven surgical procedures with the highest surgical site infection rate. Surgical wounds have been a major topic worldwide, having the healthcare team to face a big challenge on their management, giving a multidisciplinary approach to the patient. The following scoping review aims to capture the most effective management of the cardiothoracic surgical wound, comparing conventional and more advanced techniques.

**Methods.** A scoping review completed of seven full text free of charge publications corresponding to the research topic. Selection criteria for publications were determined by researchers. A scoping review and analysis of the scientific literature was performed.

**Results.** There is no consensus between which of the two therapies is the best for cardiac wound management. While some of the authors consider negative pressure wound therapy a better choice due to healing time, cost-effectivity and the number of complications, yet others claim that there are no differences. Despite of whether this therapy is considered a superior or equal method to wound dressings, each particular case must be individually evaluated and all methods are taken for consideration.

**Conclusions.** Two principal methods were found for wound management - conventional wound dressings and negative pressure wound therapy. By reviewing the publications hardly any differences were found in the use of one or the other therapy.

**Keywords:** cardiothoracic wound, care resources, dressings, negative pressure, therapy, nursing.

## Efektyvi kardiotorakalinių žaizdų priežiūra: literatūros apžvalga

**Santrauka.** Širdies chirurgija patenka tarp septynių chirurginių operacijų, kurioms būdingos operacinių žaizdų infekcijos. Su operacinėmis žaizdomis susiduriama visame pasaulyje, todėl sveikatos priežiūros komandai tenka susidurti su dideliais iššūkiais jas prižiūrint ir taikant daugiadiscipliną požiūrį į pacientą. Apžvalgos tikslas – nustatyti, kokiais būdais veiksmingiausiai atliekami kardiotorakalinės chirurginės žaizdos priežiūros veiksmai, lyginant įprastus ir pažangius metodus.

**Metodai.** Pagal atrankos ir atmetimo kriterijus atrinktos septynios pilno teksto mokslinės publikacijos, atitinkančios tyrimo temą. Atlikta mokslinės literatūros apžvalga ir analizė.

**Rezultatai.** Vienos nuomonės, kuris iš pateiktų gydymo būdų yra geriausias kardiochirurginių žaizdų priežiūrai, nėra. Vieni autoriai teigia, kad neigiamo slėgio žaizdų priežiūra yra geresnis pasirinkimas pagal gijimo trukmę, ekonomiškumą ir komplikacijų skaičių, kiti teigia, kad skirtumų nėra. Nepriklausomai nuo to, ar ši terapija laikoma geresniu, ar lygiaverčiu metodu žaizdų priežiūrai, reikia atsižvelgti į kiekvieną individualų atvejį.

**Išvados.** Nustatyti du pagrindiniai žaizdų priežiūros metodai: įprastiniai žaizdų tvarsčiai ir neigiamo slėgio žaizdų terapija. Skirtumų taikant vieną ar kitą terapiją nebuvo nustatyta.

**Reikšminiai žodžiai:** kardiotorakalinė žaizda, žaizdų priežiūros priemonės, tvarsčiai, neigiamas slėgis, terapija, slauga.

## Introduction

A wound is defined as the loss of skin or mucous continuity produced by a physical or chemical agent. Wounds can be classified according to different criteria, such as: the appearance of the wounds, the mechanism of action, according to loss of substance, among others [1]. The care of these wounds will vary depending on different factor: the type of wound, available resources, personal aspects, and the mastery and ability of the nurse providing this care [2, 3]. This last aspect is essential for the prevention of infections of the surgical wound, as despite the fact that the nursing staff has integrated the necessary knowledge for the management of surgical wounds, they are not equally carried out [3].

According to The National Center for Health Technology Excellence and the United States Centers for Disease Control and Prevention, surgical wound infection is related to surgical procedure that occurs within 30 days of the surgery, or up to 90 days later when an implant is involved, being the cause of common infection associated with health care [1]. The International Nosocomial Infection Control Consortium (INICC) Report, Data Summary of 30 Countries, Lithuania is included in one of the eight European analyzed countries and rated 2,715 number of surgical site infections (SSI), out of 62,753 surgical procedures. Out of 31 surgical procedures, cardiac surgery has seventh higher SSI rate of 5.6% [4].

The management of the surgical wound has been a major topic worldwide due to added budget costs of approximately £5 billion per year, or around 3% of the total cost of health care system [5]. To date, there have been an extensive number of wound dressings developed to treat different kinds of wounds [6, 7]. Regarding wounds, there are acute wounds, where external corruption of intact skin is present, these being surgical wounds, bites or burns, among others. On the other hand, there are chronic wounds, caused by endogenous mechanisms, in this type of wounds the ulcers would be collected [7]. The choice of dressing should be based on several criteria, such as the characteristics of the wound, its advantages and disadvantages, as it can have an easy usage but not present the necessary absorption, needed for example in the case of a suppurating wound, and its cost-effectiveness, among others [6, 9]. For this reason, nurses and doctors have to face a big challenge on the decision-making for managing wounds, as they are the main suppliers of wound care following cardiac surgery, to carry out a great teamwork giving a multidisciplinary approach to the patient [5, 10, 11].

Therefore, the aim of the following scoping review is to capture the most effective management of the cardiac surgical wound, comparing conventional and more advanced techniques.

**The aim** – to analyze conventional and advanced cardiothoracic wound management techniques.

**Methods.** The selected type of study is a scoping review. Publication search was done using PubMed database and the academic searchers EBSCO and Google Scholar.

For scientific publication search keywords in different combinations were used for the databases: wound, surgical, management, nurs, dressings, conventional methods, negative pressure, with combined prefixes “AND” and “OR”. The search has the following selection criteria: 1) inclusion: articles no older than 10 years published in English or Spanish, full text, available free of charge; 2) rejection: articles that do not have free full text access, publications older than 10 years, articles written in other languages.

Search method is reflected in a flowchart which includes the identification and selection process of the articles that were used for a scoping review (Figure 1).

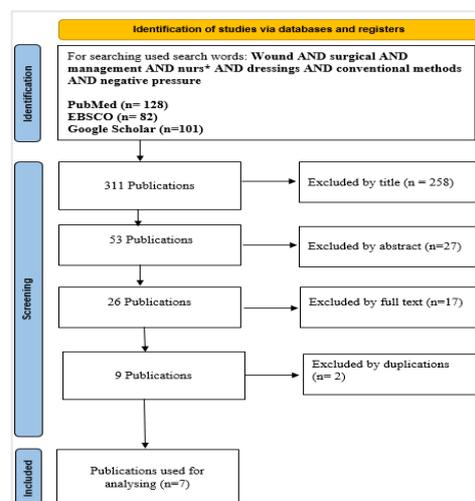


Figure 1. Extracted publications during the search process

Applying the selection criteria according to the research aim, 311 records were found. 53 publications were selected by title of which 27 were rejected as abstracts did not correspond to the topic. After removing 2 duplicates 7 full text articles were analyzed. 17 articles were rejected due to not corresponding to the topic under consideration. Rejected articles were not included in the bibliography.

**Study results and discussion.** The correct management of wounds is essential to reduce the pain of patients as well as the healing time or the probability of the surgical wound infection. It is necessary for the healthcare team to have required evidence-based competence to provide quality care [12-14].

In the field of surgical wound healing, two principal types of techniques or methods are used [6, 7, 12, 14-16].

The comparison and summarization of data is described in the Table 1.

Table 1. Summaries of analyzed publications

Authors, year	Aim of research	Wound management	Results
Maitret-Velázquez et al, 2018	To present the results obtained in a service of a Mexican hospital in patients treated with negative pressure wound therapy.	Conventional methods remove necrotic material from the tissue and prevents bacterial proliferation. The occlusive dressings can be passives or actives, these last are based on a wet healing which creates an optimized temperature and humidity conditions. Negative pressure wound therapy, it is a mechanical and adjuvant treatment for wound healing, which creates an occlusive and sterile environment that promotes the granulation of the affected tissue.	Negative pressure therapy showed that the bleeding complication occurred only with continuous therapy. The use of drugs for pain control presented the highest proportions with continuous negative pressure therapy.
Domínguez-Saavedra et al, 2021,	To identify materials for wound healing and know when to use them, from organic products to the highest technology.	The conventional healing is the one that uses passive materials. Advanced healing methods are based on the humid environment principle, which uses high-tech dressings being cost-effective. The negative pressure therapy, hyperbaric oxygen therapy and hydro scalpel system, among others, in which there is still more need for investigation.	Usage of the negative pressure wound therapy, hyperbaric oxygen therapy, hydro scalpel system is supported by serious evidence. This type of healing has proved to be more comfortable for the patient and the caregiver. Additionally, multiple studies have evidenced higher cost-effectiveness for these therapies.
Hawthorne et al, 2021,	To explore the different types of biomaterials and wound dressings applied to treat wounds. To illustrate the benefit of direct collaboration between physicians and scientists on wound management.	Semipermeable films, hydrocolloids wound dressings, foam, hydrogel wound dressings, negative pressure, hyperbaric oxygen and shock wave therapy are other wound management techniques, consisting of more complex methods, more developed technology and a greater need for resources.	Recommendations for wound dressing is to provide a damp environment, antimicrobial properties and prevent contamination, remove excess exudate and minimize pain, facilitate autolytic debridement and has an easy usage, be non-allergenic, isolate the wound from environmental conditions, and be cost effective. Wet-to-dry wound dressings include: foam dressings, contact layer dressings, film dressings, hydrogels, hydrocolloids, alginates, and antimicrobial dressings.

Costa et al, 2020,	To assess outcomes in patients who have incisions resulting from surgery and who were treated with negative pressure wound therapy or standard wound dressing.	Use of specialized dressings after the surgery in purpose to create negative pressure on the wound. Using a standard sterile dressing for wounds that does not involve negative pressure and may vary depending on healthcare team or facility routine.	No relevant differences were observed between the treated with negative pressure therapy or standard dressings groups of patients in the presence of deep surgical site infection. The most common complication in both groups was the presence of pain in the surgical wound.
Andersson Mattox et al, 2017	To review and organize published consensus, research, manufacturer guidelines and expert opinion about the security of the patients, relevant to nurse practice, during negative pressure wound therapy.	Negative pressure wound therapy systems can be used for the wound healing promotion. These systems are used with generic or specific wound dressings supplies, which are fixed with an occlusive dressing, creating that negative pressure. Infection, bleeding and retained dressing material have been described as the most common complications.	There were identified complications related to negative pressure wound therapy: bleeding, retained dressing materials and infection. There was not enough evidence to ensure a direct causal nexus between the use of negative pressure therapy and the appearance of these complications. Negative pressure wound therapy could be beneficial in certain types of patients and wounds, being more cost-effective than conventional wound therapy.
Hunt, 2016	To reflect the efficacy and clinical use of negative pressure wound therapy, as well as the management of wounds and tissue viability nurses.	Negative pressure wound therapy is an essential resource when treating wounds. There must be a good interaction among the healthcare team, establishing steps to follow and common objectives for this method to be successful. Conventional dressing methods must also be implemented from the beginning of the treatment and throughout the entire process.	Negative pressure wound therapy had a successful result, providing a first-line clinically effective method for the management of wounds. It was related to reduced dressing changes and less time of hospital stay.
Roa Devia, 2017	To present the theoretical and scientific foundations of the application of negative pressure to treat wounds in hospitals.	Negative pressure therapy is non-invasive. There are different ways of using negative pressure therapy depending on the pressure exerted on the wound or whether this pressure is continuous or intermittent. This therapy presents a series of complications, among which is mainly pain and destruction of the perilesional skin or bleeding of the wound.	Negative pressure therapy reduces hospital stays and health care costs. This therapy has shown a greater reduction in the surface area of the wound compared to the use of conventional methods in terms of wound healing. Negative pressure wound therapy produces an increase in blood flow, improving perfusion and thus the environment of the injured area, reducing bacterial levels in the wound area and edema.

### Methods used for cardiothoracic wound care

To achieve proper maintenance of the cardiac surgical wound, it is essential to carry out adequate healing methods, optimizing the healing process and achieving granulation and epithelialization of the wounds in the shortest possible time. These methods can be carried out by both the nursing staff and the rest of the healthcare staff, all working as a team to achieve the same goal: the patient's well-being [14].

For wound healing, conventional and technological healing methods have been included to close wounds. Due to the use of different techniques, the materials will also be different, using dressings, gauze or negative pressure devices, among others [14]. The role of a nurse in monitoring the patient's condition during the initiation of therapy is important, since its effects can generate complications such as pain or bleeding [12-14, 17] (Table 2).

Table 2. Wound management methods used for cardiothoracic wound care

	Maitret-Velázquez et al, 2018	Domínguez-Saavedra et al, 2021	Hawthorne et al, 2021	Costa et al, 2020	Andersson Mattox, 2017	Hunt, 2016	Roa Devia, 2017
<b>Conventional wound therapies</b>	+	+		+	+	+	+
<b>High Tech dressing</b>		+	+				
<b>Negative Pressure Therapy or Vacuum Assisted Closure (VAC)</b>	+	+	+	+	+	+	+
<b>Negative Pressure Wound Therapy Complications</b>	+				+	+	+
<b>Hyperbaric Oxygen Therapy</b>		+	+				
<b>Healthcare Teamwork</b>			+		+	+	+

Conventional wound therapies are explained and described by almost all aforementioned authors [7, 12-14, 16, 17], except Hawthorne [15].

Negative pressure therapy was one of aforementioned wound treatment methods for wound treatment [7, 12-17], or in some cases as a better method for the management of specific wound [7, 12, 17]. Other high-tech methods such as the hyperbaric oxygen therapy had little to no importance as this method [7, 15]. At the same time most of the authors agree that healthcare providers must work as one team so that care strategy would be successful [12-15].

### Comparison of methods used for cardiothoracic wound care

Regarding the studies carried out, a series of differentiated objectives have been observed, that the negative pressure therapy uses subatmospheric pressure generating a sterile environment and minimizing exposure to bacteria [17]. It also favors the appearance of granulation tissue by controlling exudation and reducing the area of the surgical wound which decreases edema and pain [7, 12, 13, 15, 17, 18]. It was found out that, the continuous negative pressure therapy achieves more effective bacterial elimination, edema reduction and the intermittent one, through which a higher amount of granulation tissue is obtained [14, 17]. On the other hand, there is a possibility of life-threatening complications related to negative pressure therapy. Most frequent are bleeding, retained dressing material, infection, pain, allergic reaction, and tissue ischemia [12, 17].

Conventional dressing can also be used to heal cardiac surgical wounds [7, 12, 13, 17], Conventional treatment is based on the use of passive materials as they do not intervene in the healing process, even slowing down and reducing this process, thus increasing the probability of suffering from wound infection [7, 17]. While materials do not have high upfront cost, the accumulated cost of daily bandaging remains significant [7, 12]. In addition, patients undergoing the conventional method treatment suffer from more pain and bleeding due to frequent removal of healthy tissue during redressing [7, 17].

Some dressings, such as alginates or hydrocolloids, are favored because of accelerated healing properties due to dressing sterility, non-adherence, non-toxicity, and higher absorption capacity [7, 20]. Due to the different characteristics of the dressings as alginate, foam, hydrocolloid and hydrogel, its indications and advantages and disadvantages (presented at Annex 1) the whole healthcare specialist team is involved in the treatment decide which method is the most appropriate for each type of wound favoring the recovery of the patient [15].

It can be pointed out, that regarding the results obtained from the following scoping review 3 main aspects have been analyzed - wound healing time which can vary depending on the type of wound management; cost-effectiveness of wound management taking into account the days of stay of the patient in the hospital or the materials used for the healing of wounds; the presence or absence of various complications while using more conventional methods or on the contrary, some more innovative methods like negative pressure therapy (Table 3).

Table 3. Main aspects of wound management

	Maitret-Velázquez et al, 2018	G. Domínguez-Saavedra et al, 2021	B. Hawthorne et al, 2021	M.L Costa et al, 2020	Andersson Mattox, 2017	Hunt, 2016	Roa Devia, 2017
<b>Wound healing time</b>	+		+				+
<b>Cost-effectiveness wound management (days of hospital, materials)</b>	+	+	+		+	+	+
<b>Fewer complications (pain, bleeding, retained dressing material)</b>	+			+	+		+

It was found out, that one author investigated, that the use of NPWT reduces the time of wound healing [14]. At the same time other authors state that there is not enough evidence to ensure faster healing as this is not an impervious affirmation considering that there are no clear differences in healing time when using NPWT or conventional dressing [16]. However, NPWT is an optimal resource to treat those wounds that require more complex care and, despite the advantages this method is not suited for all patients, since the specific characteristics of each type of wound must be considered, evaluating each particular case [7, 12, 13 17].

Finally, NPWT has shown complications - bleeding, infection and retained dressing material [12, 14, 16, 17]. These results reflect by comparing NPWT according to the modality used, bleeding has a higher incidence in those patients treated with continuous negative pressure compared to those treated with intermittent therapy.

The study showed, that there is a division as which method would be most appropriate to treat cardiothoracic surgical wound. Some authors consider NPWT as an equal or more beneficial therapy than the use of conventional therapies [7, 17].

## Discussion

Wound management has always been a topic of general importance, causing a great impact on society both in terms of quality of health care and cost management [5]. To solve these problems different methods have been

used for wound management and multiple studies have been carried out with the aim of finding appropriate treatment [6]. NPWT has been recognized as an effective therapy for acute and chronic wounds, being a safe clinical and cost-effective intervention, thus having successful outcomes. Despite these good results one should not forget to take each case individually since characteristics of each patient and their wound must be assessed [12, 14]. As this is relatively new therapy, the evidence regarding its emerging complications is limited and it is not possible to establish a cause-effect relationship, hence this method should continue to be studied [12, 13]. Difference is the use of more conventional dressings versus those that are more up-to-date since they provide greater adaptation to the wound environment, through more advanced and specific materials, according to their needs [6, 15]. Most authors agree that proper cooperation and coordination from the healthcare team is necessary to provide treatment, regardless of selected methods [12-15].

## Limitations

Subsequent studies could be taken into account of the risk factors and characteristics of each patient influence of wound management method used, when comparing the effectiveness of each therapy. Due to limitation of not using paid full text for a scoping review, some research results were not analyzed. Selected publications have not been assessed by qualitative criteria.

## Conclusions

Two cardiothoracic wound management methods were found. First method consists of a more conventional wound management, which is based on the use of dressings for wound healing. While more innovative therapies are developed among which are mainly NPWT or hyperbaric oxygenation. If we look at the analyzed publications results after comparing both methods authors point out that no differences were found in the use of one or the other. However, some authors point out that NPWT in some cases show good results, not that much in terms of the quality of wound management, but rather in terms of healing time and cost-effectiveness of this particular technique.

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