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# Postoperative Wound Complications in Obstetrics and Gynecology. Treatment and prevention methods

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## ABSTRACT

**Introduction and purpose:** Postoperative wound complications are a prevalent issue in obstetrics and gynecology, particularly with the global rise in cesarean section rates, which in Poland exceed 40%, significantly above the World Health Organization's recommended 10–15%. These complications, such as surgical site infections (SSI), wound dehiscence, and delayed healing, negatively impact patient recovery, emotional well-being, and healthcare costs. The aim of this study is to analyze and evaluate the effectiveness of current methods for preventing and treating postoperative wound complications, with a focus on cesarean sections. This research aims to highlight innovative approaches, assess their effectiveness, and identify knowledge gaps to guide further studies.

**Description of the State of Knowledge:** The most common postoperative wound complications in obstetrics and gynecology include SSI, wound dehiscence, and fistula formation. These issues are particularly prevalent in patients with comorbidities such as diabetes, obesity, and hypertension, or in emergency cesarean sections. Factors such as maternal health, surgical techniques, and wound management strategies significantly influence healing outcomes.

Despite advances in surgical techniques and materials, there is no consensus on the best approach for managing wounds in high-risk patients. Techniques like continuous suturing and mass closure have been shown to reduce the risk of incisional hernias. Additionally,

innovative methods, such as Negative Pressure Wound Therapy (NPWT) and active dressings (hydrogel, hydrocolloid, and alginate), offer promising results in enhancing wound healing and minimizing complications. However, discrepancies in study findings and a lack of standardized guidelines highlight the need for further research to optimize care.

**Materials and Methods:** A comprehensive literature review was conducted using databases such as PubMed, Medline, and Cochrane, including studies on wound healing, surgical techniques, and advanced dressing materials.

**Results:** Key findings highlight the importance of continuous suturing and mass closure techniques in reducing hernia risk. Innovative solutions like Negative Pressure Wound Therapy (NPWT) and active dressings (e.g., hydrocolloid, alginate, and hydrogel) show potential in improving healing and minimizing infections, particularly in high-risk patients. However, evidence supporting their routine use remains inconsistent.

**Summary:** Optimizing surgical techniques and postoperative wound care protocols is crucial for reducing complications. Further research is needed to establish standardized guidelines and explore the effectiveness of innovative therapies in obstetrics and gynecology.

**Keywords:** “suture”; “closure”; “method”; “technique”; “material”; “complication”; “surgical site infection”; “bioscreen.”; “wound-healing technologies “; “active dressings”; “Negative Pressure Wound Therapy”.

## 1. Introduction and objective

Postoperative wound complications represent a significant challenge in the care of patients undergoing obstetric and gynecological surgeries. Procedures such as cesarean sections, hysterectomies, or perineal reconstructions require proper management of postoperative wounds to minimize the risks of infection, delayed healing, and long-term complications, such as fistulas or keloids.

This issue is particularly critical in light of the increasing number of cesarean sections worldwide, including in Poland, where the cesarean section rate has reached approximately 40% (according to WHO data from 2022). This significantly exceeds the recommended optimal cesarean section rate of 10–15% of all births. With the rise in cesarean sections, the number of postoperative complications has also increased, adversely impacting patients both physically and emotionally, as well as financially increasing healthcare costs.

The aim of this study is to provide a detailed analysis of the available methods for treating and preventing postoperative wound complications in obstetric and gynecological surgeries, with particular emphasis on cesarean sections—the most commonly performed operation in obstetrics. The analysis is based on current literature data. The authors hope not only to provide an overview of the latest advancements in this field but also to identify knowledge gaps that may serve as a basis for further research.

Special attention is given to surgical techniques and the evaluation of the effectiveness of innovative methods, such as Negative Pressure Wound Therapy (NPWT), active dressings (hydrogel, hydrocolloid, alginate), and modern wound-healing technologies, particularly in

high-risk obstetric and gynecological patients. This topic is especially important in the context of the growing number of cesarean sections and the increasing challenges of postoperative care.

This study aims to not only summarize the current state of knowledge but also highlight controversies and unexplained aspects in this field. As such, it is intended to serve as a tool for clinicians and researchers, supporting therapeutic decision-making and inspiring further research in managing postoperative wounds in obstetrics and gynecology. Optimizing the closure of abdominal wall incisions can help prevent postoperative hernias and provide significant savings in healthcare costs by reducing hospitalization time.

## 2. Methods

A literature search was conducted using the PubMed, Medline, OVID, and Cochrane databases with the following keywords: “suture”; “closure”; “method”; “technique”; “material”; “complication”; “surgical site infection”; “bioscreen.”; “wound-healing technologies “; “active dressings”; “Negative Pressure Wound Therapy”.

The study analyzed guidelines, systematic reviews, and original research articles examining wound healing mechanisms, types of wound closures, and the treatment of surgical wound complications.

No restrictions were applied regarding language, publication date, or research location.

## 3. The State of Knowledge

Studies indicate that the most common postoperative wound complications are Surgical Site Infections (SSI), wound dehiscence, and the formation of fistulas. These complications are particularly prevalent when cesarean sections are performed under emergency conditions. Although standard management of these clinical situations includes dressings, antibiotic therapy, and appropriate surgical techniques, there is a lack of consistent guidelines for managing wounds in patients with risk factors such as obesity, diabetes, or other comorbidities. Discrepancies exist in the literature regarding the effectiveness of various preventive and therapeutic methods.

While advancements in surgical techniques and wound care materials have improved outcomes, the management of postoperative wounds in high-risk patients—such as those with diabetes, obesity, or other comorbidities—remains inconsistent. Key factors influencing wound healing include maternal health conditions, surgical techniques, and wound management strategies. Despite the availability of methods like Negative Pressure Wound Therapy (NPWT) and active dressings, discrepancies in the literature highlight a lack of consensus on their effectiveness.

Studies suggest that continuous suturing and mass closure techniques reduce the risk of incisional hernias compared to interrupted sutures or layered closure. Similarly, active dressings, including those containing silver, Manuka honey, or hydrogel, show potential in preventing infections and promoting healing, but their applications and efficacy in obstetrics require further investigation. NPWT has emerged as a promising tool, particularly in managing wounds in obese patients, yet evidence supporting its routine use remains limited.
In light of the ongoing challenges and gaps in standardized guidelines, there is an urgent need for further research to optimize surgical techniques, develop advanced wound care protocols,

and address the unique needs of high-risk populations. The findings of this study aim to contribute to this growing field of knowledge by synthesizing existing literature and identifying avenues for future exploration.

## 4. Results

The percentage of patients experiencing difficult and prolonged wound healing remains very high, despite growing knowledge about the physiology of the wound healing process and advancements in surgical techniques. Complications such as wound dehiscence occur in 0.2–6% of cases [1]. This exposes patients to numerous complications, extends hospitalization periods, and generates additional treatment costs. It is crucial to identify risk factors for complications associated with wound dehiscence.

Many factors influence postoperative wound healing, and they depend on patient characteristics and comorbidities. The highest frequency of dehiscence was observed in patients undergoing emergency surgeries and those with cancer [2].

Patient- and comorbidity-related factors play a more significant role in postoperative wound healing than the suturing technique or the type of surgical materials used.

Risk factors affecting wound healing after cesarean sections include:

- Chronic maternal diseases (diabetes, obesity, hypertension, immunosuppression, anemia, smoking).
- Increased blood loss during the procedure.
- Malnutrition.
- Preeclampsia.
- Chorioamnionitis (in the case of cesarean sections).

Wound healing may also depend on the number of cesarean sections the mother has undergone [3].

Technical difficulties during surgery, which prolong the overall procedure time, are also significant factors [4][5][6]. Furthermore, the size, shape, and location of the wound, as well as the type of materials used for closure, play a crucial role.

Improper suturing techniques are also among the risk factors for postoperative wound complications, as discussed later in this study.

This study reviews the literature to identify the optimal closure techniques, ideal suture materials, and postoperative management practices.

Among the known risk factors, the only factor directly controlled by the surgeon is the surgical technique used during cesarean sections.

### 4.1 Wound Closure Techniques

The first issue concerns the method of suturing the fascia: continuous sutures versus interrupted sutures.

The most recent meta-analysis, published by Diener in 2010, included five systematic reviews and 14 studies involving 7,711 patients (6,752 midline incisions) [7]. Of these 14 studies, four presented results comparing interrupted closure with continuous closure. Among patients undergoing elective primary midline laparotomy, the continuous technique significantly reduced the risk of postoperative hernias (OR 0.59, 95% CI: 0.43–0.82).

Both meta-analyses concluded that continuous suturing for midline laparotomy closure was beneficial compared to interrupted closure. Diener et al. reported a significantly lower rate of incisional hernias with continuous sutures (OR 0.59, $p = 0.001$) during elective surgeries [7]. However, most studies included in the analysis had a high risk of bias, as the interrupted arm used rapidly absorbable multifilament sutures, while the continuous arm used either non-absorbable or slowly absorbable monofilament sutures.

van't Riet et al. included studies on emergency laparotomy and found no difference in the frequency of incisional hernias between interrupted and continuous suturing. Continuous suturing was recommended because it was significantly faster [8].

#### 4.1.1. Mass, Layered, or Single-Layer Closure

According to the European Hernia Society guidelines [9], the following wound closure methods are distinguished:

- **Mass closure**: The incision is closed with sutures encompassing all layers of the abdominal wall except the skin.
- **Layered closure**: The incision is closed in more than one separate layer of fascia.
- **Single-layer fascial closure**: The incision is closed by suturing only the abdominal fascia in a single layer.

Two meta-analyses comparing the impact of mass closure versus layered closure on the frequency of hernias were identified [10][11]. Additionally, an experimental study compared the impact of mass closure versus single-layer closure on wound healing [12].

Weiland's meta-analysis included nine studies comparing mass and layered closures, involving a total of 3,321 patients [10]. The meta-analysis showed a significant increase in hernia frequency with layered closure ($p = 0.02$). This finding was also confirmed by a meta-analysis conducted by Rucinski in 2011 [11]. The authors concluded that the optimal technique for fascial closure after laparotomy is continuous mass closure.

In an experimental study conducted by Cengiz [12], researchers examined wound edge separation in midline laparotomy incisions closed with either mass sutures or fascial sutures only. After three hours of increased intra-abdominal pressure, the lateral edges of wounds separated by an average (SD) of 5.6 (1.3) mm for mass sutures and 0.5 (0.6) mm for fascial sutures only ($p < 0.001$). Muscle and peritoneal tissue included in the mass suture were compressed, darkened, and showed signs of hemorrhage.

#### 4.1.2. Absorbable vs. Non-Absorbable Sutures

Diener et al. [7] reported a significantly lower frequency of incisional hernias when slowly absorbable sutures were used (OR 0.65, $p = 0.009$) during elective surgeries.

A subgroup analysis by van't Riet et al. [8], comparing only studies involving continuous sutures, identified a single RCT conducted by Wissing [13], in which continuous sutures were used in both study arms. This study, which included 21% emergency surgeries, showed a significantly higher incidence of incisional hernias with rapidly absorbable sutures compared to non-absorbable sutures ($p = 0.001$) and slowly absorbable sutures ($p = 0.009$).

#### 4.1.3. Non-Absorbable vs. Slowly Absorbable Sutures

No significant difference in the incidence of incisional hernias was observed between the use of slowly absorbable and non-absorbable sutures for continuous midline wound closure ($p = 0.75$) [8]. However, an increased incidence of long-term postoperative pain ($p < 0.005$) and fistula formation on the surgical site ($p = 0.02$) was observed with non-absorbable sutures [8].

In another meta-analysis (which included non-midline incisions), no difference was found in the incidence of incisional hernias between slowly absorbable polydioxanone sutures and non-absorbable sutures (OR 1.10, $p = 0.43$) [14]. However, with non-absorbable sutures, the risk of developing fistulas on the surgical site was significantly higher (OR 0.49, $p = 0.01$) [14].

#### 4.1.4. Suture Size

No studies directly comparing the size of sutures used for closing abdominal wall incisions were identified during the literature search. However, for the "small bites" technique, Isrealsson et al. [15] suggested using USP size 2/0 sutures (USP = United States Pharmacopeia).

#### 4.1.5. Drainage of the Wound

Studies conducted by Mark C. Alanis, MD, MSCR, and Margaret S. Villers, MD [16], revealed potential harm associated with subcutaneous drainage during cesarean sections. Several theories explain this phenomenon: first, the use of subcutaneous drains involves an additional incision, increasing tissue damage; second, the drain provides a pathway through which bacteria can access the subcutaneous space; third, cesarean sections are classified as clean-contaminated procedures, and drains may act as carriers of biofilm and reservoirs for microorganisms.

Other studies [17] confirm the role of avoiding subcutaneous drainage as a potential strategy to reduce the risk of complications after cesarean sections.

In cases where a drain is absolutely necessary (to control bleeding or an inflammatory process), it should not be placed through the primary abdominal incision, as this weakens the wound, predisposing it to future surgical site infections and dehiscence.

### 4.2. Postoperative Recommendations

Healing of appropriately managed postoperative wounds is a completely natural and physiological process. Wound healing progresses through successive stages: inflammatory, proliferative, and epithelialization phases. Local wound management should mimic all stages

of the natural healing process. Efforts should focus on eliminating local factors that inhibit healing.

Management of postoperative wounds depends on the type of procedure performed. Postoperative wounds from cesarean deliveries should be dressed with a standard primary dressing in the operating room. The primary dressing should not remain in place for longer than 48 hours.

In clinical practice, clinicians may aim for undisturbed wound healing (UWH) followed by the use of advanced dressings to prevent scar formation [17][18]. Advanced dressings may include combinations such as hydropolymers, hydrocolloids, and silicone, while conventional dressings include gauze and tape [19].

**W.A.R. Scale for Infection Risk**

The Centers for Disease Control and Prevention (CDC) classify obstetric and gynecological postoperative wounds as clean-contaminated wounds [20]. The incidence of Surgical Site Infections (SSI) in obstetrics and gynecology ranges from 3–12% [21–25].

To assess the potential risk of infection, the W.A.R. scale is used, which evaluates risk factors and predispositions for infection, thus enabling appropriate therapeutic or preventive actions to be taken. This scale was developed by an international group of experts specializing in wound treatment [26].

If the total score assigned to risk factors is equal to or exceeds 3, the wound is considered at risk of infection, and appropriate therapeutic actions must be undertaken.

For wounds at risk of infection (a score above 3 on the W.A.R. scale), it is necessary to use topical medicinal products containing surfactants and antibacterial substances, as well as specialist dressings with or without antibacterial agents.

Proper management of infected wounds involves a multi-stage process that includes cleaning, lavaseptics, and the use of topical and/or systemic agents depending on the severity of the infection.

### 4.3. Antiseptic Solutions (Lavaseptics)

Lavaseptics involve irrigating wounds with an antiseptic solution that helps remove remnants of wound-associated tissues, pathogens present in wound exudates, and residual wound treatment agents [9][10]. According to studies by Müller [27], octenidine demonstrates good antibacterial activity, particularly against *Escherichia coli* and *Staphylococcus aureus*, with relatively low toxicity toward tissues.

Antibiotic resistance is increasing to dangerous levels worldwide, threatening treatment options for successful patient outcomes. In this context, antiseptics represent a suitable tool, not only in infection prevention by reducing the transmission of drug-resistant microorganisms in hospitals but also in local therapy. However, for some commonly used antiseptics, decreased bacterial susceptibility and even (cross) resistance to antibiotics have recently been reported [28].

### 4.4. Active Dressings

Active dressings play an important role in the modern concept of managing infected and hard-to-heal wounds in obstetrics and gynecology, particularly postoperative wounds (e.g., after cesarean sections, laparotomies, or episiotomies). Due to their properties, these dressings support the healing process, reduce the risk of infection, and improve patient comfort.

#### 4.4.1. Antibacterial Dressings

Antibacterial dressings contain substances with antimicrobial properties, such as ionic silver, Manuka honey, iodine, or PHMB (polyhexamethylene biguanide). They help combat bacterial infections and prevent biofilm formation.

**Applications in Obstetrics and Gynecology:**

- **Post-cesarean section wounds**, particularly in cases of Surgical Site Infections (SSI).
- **Treatment of episiotomy wounds** and other perineal tissue injuries (e.g., after vulvectomy or abscess drainage).
- **Infection prevention in hard-to-heal wounds** following gynecological surgeries.

Silver-containing dressings are the most well-documented group and represent a modern method of local therapy for infected and hard-to-heal wounds [29].

Among published reports on the use of silver dressings for infected wounds, only a few are based on prospective, randomized studies involving appropriately large patient groups. Most consist of in vitro studies, case reports, or clinical observations with small groups of patients, which do not allow definitive conclusions to be drawn. The same is true for studies describing the use of silver in the treatment of infected postoperative wounds in obstetrics and gynecology.

The use of silver-containing dressings in the treatment of cesarean section wounds was the subject of research by Connery et al.
Connery et al. conducted a retrospective study evaluating the effectiveness of dressings composed of polymer fibers coated with metallic silver deposited via electroless plating in preventing infections in postoperative wounds after cesarean sections [30]. Of the 72 patients included in the study, 36 formed the control group, where wounds were treated traditionally with gauze dressings. During the observation period, postoperative wound infections occurred in two patients in the test group and two patients in the control group. The results did not show that silver-containing dressings significantly reduced the risk of postoperative wound infections after cesarean sections. However, since the test group included a significantly higher number of patients with comorbidities impairing normal wound healing, the authors suggested that the results may not fully reflect the effectiveness of the tested dressings.

In a more recent double-blind, randomized clinical trial by Connery et al. [31] conducted in 2019, silver-nylon dressings were not found to be more effective than gauze in reducing the risk of superficial SSI after cesarean sections. Among 657 participants, the primary outcome was similar in both groups (4.6% in the silver-nylon group compared to 4.2% in the gauze group, $P = 0.96$). Participants were recruited for the study from 3 years, women with vertical skin incisions were excluded. The enrolled participants were randomly assigned to either

silver-nylon or gauze dressings of identical appearance. Wounds were assessed in outpatient clinics 1 week and 6 weeks postpartum.

In a second study by Connery et al. [32] conducted in 2023, the use of silver-nylon dressings after cesarean sections was not associated with a reduction in postoperative pain. Among 649 participants, the amount of opioid and non-opioid analgesics administered was similar between the group assigned to silver-nylon dressings and the group with gauze dressings (morphine milligram equivalent [82.5 vs. 90 mg, $P = 0.74$], intravenous nonsteroidal anti-inflammatory drugs [NSAIDs] [120 vs. 120 mg, $P = 0.55$], and oral NSAIDs [4800 vs. 5600 mg in the gauze group, $P = 0.65$]).

Based on the results of the above studies, silver-ion dressings are not considered the optimal solution for wound management in obstetrics and gynecology.

**Manuka Honey Dressings**
The nectar of *Leptospermum* plants, from which Manuka honey is derived, exhibits varying levels of antiseptic activity.

**Properties:**

- Antibacterial, anti-inflammatory, and tissue regeneration-supporting effects.
- Facilitation of autolytic wound debridement.

**Applications in Obstetrics and Gynecology:**

- Infected wounds with resistant bioscreen layer.
- Hard-to-heal wounds after cesarean sections or gynecological procedures.

Dressings containing medicinal-grade Manuka honey are particularly used in the treatment of hard-to-heal wounds with resistant biofilm, including wounds after vulvectomy, and their effectiveness is supported by clinical studies [33].

The activity of honey designated for medical purposes is measured in Unique Manuka Factor (UMF) units. Honey with a 1 UMF rating has antiseptic activity comparable to a 1% phenol solution [33]. For medical use, honey with activity levels above 10 UMF (UMF 12+ to 14+) is utilized.

Manuka honey dressings produced with Activon technology demonstrate high bactericidal and fungicidal activity. The antibacterial properties of honey are primarily attributed to the action of the enzyme glucose oxidase. The effectiveness of Activon+ technology has been proven in studies against a wide range of microorganisms infecting wounds, including MRSA, VRE, and *Pseudomonas aeruginosa* [33].

### 4.4.2 Hydrogel Dressings
Hydrogel dressings are advanced wound care products that provide a moist environment, which supports the autolytic debridement process. They consist primarily of water embedded in a polymer network, making them particularly effective for wounds requiring hydration, cleaning, and pain relief.

In obstetrics and gynecology, hydrogel dressings are used to treat surgical wounds with dry necrosis, perineal tears, episiotomy wounds prone to drying, and chronic wounds.

Hydrogels lower wound temperature, and their high water content helps soothe the wound, which is particularly important in treating dry wounds.

Hydrogel dressings contain 70–90% water, embedded in a matrix of hydrophilic polymers such as polyacrylamide, polyethylene glycol, or polyvinyl alcohol. They offer several benefits:

- **Maintaining moisture:** They prevent the wound from drying out.
- **Autolytic debridement:** Facilitate the removal of necrotic tissue.
- **Cooling effect:** Relieve pain and reduce inflammation.
- **Non-adherence:** Minimize trauma during dressing changes.

**Applications in Obstetrics and Gynecology:**
Hydrogel dressings are effective in treating wounds after cesarean sections, especially in cases of superficial infections or to support healing of closed surgical sites.

**Clinical Evidence:**
In a retrospective cohort study on hydrocolloid dressings after cesarean sections, Scheck SM and Sircar S [34] compared their effects with standard contact dressings over three months. The researchers assessed wound swabs with significant bacterial growth, survey results from obstetric and nursing staff, and the cost per dressing, as well as the number of dressing changes before hospital discharge. In the hydrocolloid group (n=94), significant bacterial growth in wound swabs was observed in four patients (4.3%, 95% confidence interval [CI]: 0–10.6%), compared to six patients in the basic contact group (n=117) (5.1%, 95% CI: 1.0–7.1%). Only 45% of midwives reported liking hydrocolloid dressings, compared to 90% who preferred standard contact dressings, mainly due to the difficulty of removing the former. After accounting for the number of dressing changes in the ward, the cost of treatment following cesarean sections was lower for hydrocolloid dressings than for basic contact dressings. This study demonstrated promising results regarding SSI rates and cost reduction. However, these benefits must be weighed against dressings that are potentially harder to remove, which resulted in reduced satisfaction among midwives and nurses.

**Other Uses:**
Hydrogel dressings can also be used to treat vulvar ulcers caused by conditions such as lichen planus, Behçet's disease, or infections. Their cooling effect provides pain relief, while the moist environment promotes healing. A review study by Francesko A, Petkova P, and Tzanov T [35] summarized advancements in hydrogel-based dressing development.

**Advantages of Hydrogel Dressings in Obstetrics and Gynecology:**

- **Pain reduction:** Cooling effects alleviate pain, especially in perineal and episiotomy wounds.
- **Faster healing:** A moist environment supports granulation and epithelialization.
- **Non-adherence:** Dressings do not stick to the wound, reducing pain during removal.

- **Versatility:** Can be used for various types of wounds, including surgical wounds, abrasions, and ulcers.

**Limitations of Hydrogel Dressings:**

- **Limited absorption:** Not suitable for wounds with heavy exudate.
- **Risk of infection:** If not changed regularly, the moist environment can promote bacterial growth.
- **Cost:** Hydrogel dressings are often more expensive than traditional solutions like gauze.

### 4.4.3 Hydrocolloid Dressings

Hydrocolloid dressings are among the most commonly used products in advanced wound therapy. They consist of an outer layer (often waterproof) and an inner layer containing hydrophilic substances, such as pectin, gelatin, or carboxymethylcellulose. Due to their ability to create a moist environment that supports the healing process, these dressings are used in the management of various wounds, including surgical, hard-to-heal, and childbirth-related wounds. In obstetrics and gynecology, hydrocolloid dressings are increasingly used for their protective properties, ability to promote regeneration, and capability to minimize the risk of infections.

Hydrocolloid dressings are characterized by the following features:

- **Gel formation:** Upon contact with exudate, hydrocolloids transform into a gel that absorbs the exudate and prevents adhesion to the wound.
- **Moisture retention:** Accelerates granulation and epithelialization processes.
- **Wound isolation:** Creates a barrier against bacteria and external contaminants.
- **Convenience:** Easy to apply, require less frequent changes, and minimize patient discomfort.

**Applications of Hydrocolloid Dressings in Obstetrics and Gynecology**

**Treatment of Post-Cesarean Section Wounds**

Post-cesarean section wounds can be prone to infection and slow healing, particularly in patients with obesity or diabetes. Hydrocolloids, with their protective properties and ability to absorb moderate exudate, provide an effective solution for managing these wounds.

The most recent and first randomized controlled trial in 2024 by Tsubouchi, Hiroaki [36], studied the effectiveness of hydrocolloid dressings in preventing hypertrophic scars after cesarean sections. The study included 47 patients (23 in the intervention group and 24 in the control group). The intervention group began applying hydrocolloid dressings to the wound on the 7th or 8th day post-surgery and continued weekly dressing changes for six months. The control group refrained from using any dressings but was monitored. Wound conditions in each group were evaluated at the 6th and 12th months post-surgery using the Japan Scar Workshop Scar Scale 2015 and the Patient and Observer Scar Assessment Scale. The use of

hydrocolloid dressings effectively reduced hypertrophic scarring after cesarean sections, while vertical midline incisions were identified as a risk factor.

**Treatment of Chronic Vulvar and Vaginal Wounds**
In patients with chronic vulvar wounds (e.g., associated with lichen sclerosus or diabetes-related ulcers), hydrocolloid dressings can support regeneration and limit infection development.

In a study by Jurić Vukelić D and Jurić J [37], the association between the use of hydrocolloid dressings in chronic wound treatment and patient quality of life was evaluated. The study included 33 outpatient participants. The authors developed a questionnaire assessing the level of daily functional impairment and quality of life. Participants rated pain levels, reduced independence in daily activities, sleep disturbances, difficulties maintaining hygiene, and odor caused by chronic wounds. Significant differences were found in all aspects of quality of life disturbances caused by chronic wounds after using hydrocolloid dressings: pain levels ($t$ (23)=4.14), independence in daily activities ($t$ (23)=5.01), sleep disturbances ($t$ (23)=3.89), hygiene ($t$ (23)=3.00), and unpleasant odor ($t$ (23)=3.66) ($p$<0.01 for all). According to physicians, chronic wound treatment with hydrocolloid dressings significantly improved patient conditions in 84.8% of cases.

**Advantages of Hydrocolloid Dressings in Obstetrics and Gynecology**

- **Pain and discomfort reduction:** Do not adhere to the wound, reducing pain during dressing changes.
- **Longer wear time:** Hydrocolloid dressings can remain on the wound for several days, offering convenience to the patient and reducing treatment costs.
- **Reduced infection risk:** Create a protective barrier against bacteria.
- **Aesthetic benefits:** Support better scar formation.

**Limitations of Hydrocolloid Dressings**

- **Not suitable for wounds with heavy exudate:** In such cases, more absorbent dressings may be necessary.
- **Risk of skin maceration:** The moist environment can lead to maceration of surrounding tissues if the dressing is worn for too long.
- **Cost:** Hydrocolloid dressings are more expensive than traditional gauze, which may limit their widespread use.

### 4.4.3 Alginate Dressings
Alginate dressings are advanced materials used in wound care, especially for wounds with heavy exudate. They are made from alginate, a polysaccharide derived from brown seaweed. Alginates have the ability to absorb exudate and transform into a gel upon contact with wound fluids, creating a moist environment that promotes healing. In obstetrics and gynecology, these dressings are used for managing postoperative wounds, infections, and hard-to-heal wounds.

**Properties of Alginate Dressings:**

- **Absorbency:** Can absorb up to 20 times their weight in exudate.
- **Gel formation:** Transform into a gel upon contact with wound fluids, maintaining a moist environment.
- **Hemostatic properties:** Alginates help control minor bleeding, which is beneficial in the treatment of surgical wounds.
- **Infection protection:** Act as a protective barrier, with some dressings enriched with antibacterial agents such as silver.

**Applications of Alginate Dressings in Post-Cesarean Section Wound Care**

Post-cesarean section wounds, especially those with heavy exudate or prone to infection, can be effectively treated with alginate dressings. Their ability to manage exudate and support healing is particularly valuable for patients with obesity or diabetes.

In a 2021 study by Yongli Hou, Yan Gao, and Xiaorui Wang [38], 800 women who underwent cesarean sections were divided into two groups: a control group (standard cream + mupirocin) and a treatment group (alginate-aloe/ZnO NPs film + mupirocin). The healing process was assessed at 12 and 24 days using the REEDA wound scale. The findings indicated that using the alginate-aloe/ZnO nanoparticle film in combination with mupirocin could be considered a new method for reducing complications associated with cesarean sections by accelerating the healing process.

A second study from 2022 by Meng X and Li G [39] evaluated the impact of alginate-gelatin hydrogel combined with nano-zinc oxide as an effective dressing for cesarean section wounds. This study included 700 participants who underwent cesarean sections at the Second Affiliated Hospital of Xi'an Jiaotong University Medical College between September 2017 and September 2020. Patients were divided into two groups: a case group (350 participants) treated with alginate-gelatin hydrogel-nZnO antibacterial wound dressing and a control group (350 participants) treated with regular wound healing creams + antibacterial agents. Three and four weeks post-cesarean section, the healing process was assessed using the REEDA wound scale. Patients treated with the alginate-gelatin hydrogel-nZnO dressing had significantly lower scores for redness, ecchymosis, edema, and wound approximation compared to the control group ($P < 0.05$). Over 80% of patients in the treatment group showed no significant symptoms of complications three weeks postoperatively, compared to 50.6% in the control group. No allergic reactions were observed. The study concluded that the use of alginate-gelatin hydrogel-nZnO wound dressings could be a new method for a treatment of reducing postoperative wound complications and accelerating the healing process without causing allergic reactions.

### 4.5. Negative Pressure Wound Therapy (NPWT)

Negative Pressure Wound Therapy (NPWT) is an advanced technique for wound treatment that involves the use of controlled negative pressure to remove exudate, support tissue regeneration, and improve wound perfusion. In obstetrics and gynecology, NPWT is widely applied, particularly in the management of surgical wounds after cesarean sections, perineal wounds, and chronic or infected wounds. This method is gaining increasing popularity due to its proven effectiveness in improving treatment outcomes, shortening healing times, and reducing the risk of complications.

NPWT involves placing a foam dressing or sponge within the wound, which is connected to a device that generates negative pressure. Negative pressure effectively removes fluids, bacteria, and inflammatory products from the wound (exudate reduction). It also promotes the formation of new blood vessels in the wound area, reduces dead space, supports wound closure, and creates a barrier against external contaminants.
In recent years, numerous randomized controlled trials (RCTs) have demonstrated the benefits of NPWT in post-cesarean wound management.
In a systematic review and meta-analysis by Gillespie BM, Thalib L et al., 2021, ten RCTs published between 2012 and 2021, involving 5,583 patients, were included [40]. The results indicated a significant difference in favor of the NPWT group, with an absolute risk reduction of 1.8% among individuals receiving NPWT compared to standard dressings. However, the study also found that the risk of blister formation was significantly higher in the NPWT group (RR 4.13, 95% CI 1.53–11.18, $P$ = 0.005). Additionally, only 40% of studies reported blinding in outcome assessment, and 50% had incomplete outcome data.
A systematic review by Tian Y, Li K, Zeng in 2023 compared NPWT with standard dressings in the treatment of wounds in obese women undergoing cesarean sections [41]. NPWT resulted in a lower incidence of Surgical Site Infections (SSI) compared to conventional dressings (Risk Ratio [RR] = 0.76). The SSI rate for low transverse incisions was lower in the NPWT group compared to the control group ([RR] = 0.76). No statistically significant difference was observed in blister formation ([RR] = 2.91).

## 5. Discussion

The results of the studies suggest that the use of appropriate suturing techniques, such as continuous suturing and mass closure, allows for a significant reduction in the risk of postoperative hernias and other complications. However, it should be noted that the studies were limited by discrepancies in the suture materials used and differences in surgical protocols. The findings of the meta-analyses by Diener et al. [7] and van't Riet et al. [8] show that surgical technique may play a key role in wound healing. However, these studies were burdened with a high risk of systematic bias. Similar limitations were observed in analyses concerning dressings, including those containing silver, Manuka honey, hydrocolloids, and alginates, which demonstrated varying effectiveness depending on clinical conditions.

An important conclusion is the need for special care for patients with risk factors such as diabetes, obesity, or hypertension. These factors significantly increase the risk of Surgical Site Infections (SSI) and prolong wound healing time. The use of innovative methods, such as Negative Pressure Wound Therapy (NPWT), shows promising results, although there is limited evidence regarding its effectiveness in the population of obese women.

In the context of previous studies, optimizing surgical techniques and developing wound care standards, particularly in obstetrics and gynecology, remains crucial. These findings form the basis for further research aimed at improving postoperative care standards.

## 6. Conclusions

This study highlights the importance of selecting the appropriate surgical technique and suture materials in preventing postoperative wound complications. Continuous suturing and mass closure appear to be effective methods for reducing the risk of hernias and other complications.

Modern dressings, such as hydrocolloids and alginates, may play a key role in treating hard-to-heal wounds, especially in patients with comorbidities. Negative Pressure Wound Therapy (NPWT) demonstrates potential in reducing complications after cesarean sections.

## DISCLOSURE

### Author`s contribution:

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### Conflict of Interest

The authors report no conflict of interest.

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