

Negative Pressure Wound Therapy for Surgical Site Infection After Cesarean Section

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Abstract— *In the world Caesarean delivery is one of the most commonly performed procedures. and also, the surgical interventions face an increased risk of developing surgical site infections (SSI). The primary objective of this research was to assess the prevalence and treatment of surgical site infections in patients undergoing caesarean sections. With the vacuum-assisted closure technique now being a well-established method for treating surgical site infection wounds after caesarean section and through this paper by the novel application of negative pressure to surgical site infections (SSI) wounds, resulting in successful closure of the wounds day by day.*

Index Terms— *Caesarean section, NPWT, SSI*

I. INTRODUCTION

According to the World Health Organization (WHO), the proportion of deliveries conducted through caesarean section should ideally be between 10% and 15% of all deliveries and however, numerous studies have reported rates exceeding 40%. Surgical site infections occur due to bacteria entering through incisions created during surgical procedures. Surgical site infections pose a significant risk to the lives of millions of patients annually and play a role in the proliferation of antibiotic resistance. It is strongly advised to implement active surveillance for surgical site infections and to adopt infection prevention strategies to accurately assess the prevalence of Surgical site infections where influenced by the surgical environment, available local resources, and both patient and surgery-related variables. The failure to effectively identify, manage, and monitor women at risk has been pinpointed as one of the contributing factors to the incidence of surgical site infections [1]. Despite the existence of health information regarding the factors that elevate the risk of surgical site infections, women who are at risk continue to experience surgical site infections following caesarean sections. In low- and middle-income nations, 11% of patients who have surgery experience infections as a result. A significant number of these risk factors are well recognized and can be addressed proactively to either eliminate or mitigate the risk of surgical site infections.

NPWT was utilized for a duration of 72 hours at pressures of 0 mmHg, -75 mmHg, and -125 mm Hg, employing either foam or gauze as the wound filler. The mechanical impacts of NPWT were assessed by evaluating the reduction in wound surface area and conducting histological analysis of the tissue in the wound bed. Comparable levels of wound contraction (macro deformation) were observed during NPWT, irrespective of whether foam or gauze was employed.

II. NONTUBERCULOUS MYCOBACTERIA (NTM)

Nontuberculous mycobacteria, pertains to infections that may arise at the site of a caesarean section, resulting in

complications such as skin and soft tissue infections. These infections are classified as hospital-acquired infections and can pose treatment challenges due to the resistance of NTM to numerous standard antibiotics. A wound that remains persistent or fails to heal following a caesarean section, particularly if it exhibits symptoms like purulence or inflammation, may suggest a nontuberculous mycobacteria infection, necessitating specific diagnostic evaluations and prolonged combination therapy. Non-tuberculous mycobacteria encompass a category of bacteria that are ubiquitous in the environment. They are implicated in hospital-acquired surgical site infections (SSIs) subsequent to procedures such as caesarean sections. Mycobacterium abscess is among the most prevalent nontuberculous mycobacteria species responsible for these infections. Nontuberculous mycobacteria infections rank as the second most frequent infectious complication following urinary tract infections after a caesarean section, with reported infection rates ranging from 6.3% to 11.2%. The infection may manifest as a skin and soft tissue infection at the surgical site. A caesarean surgical wound that fails to heal, is painful, reddened, or swollen, particularly if it develops purulence (pus) or other inflammatory lesions. The symptoms may resemble those of a typical wound infection but might not respond to conventional antibiotics.

SURGICAL SITE INFECTIONS

A surgical site infection following a caesarean section is an infection that arises in the incision area, potentially affecting the skin or deeper tissues. This occurs when bacteria infiltrate the surgical site, leading to symptoms such as redness, swelling, warmth, pain, and the presence of pus or cloudy fluid draining from the wound. Infections pose a risk associated with major surgical procedures and can elevate maternal morbidity, extend hospital stays, and increase treatment expenses.

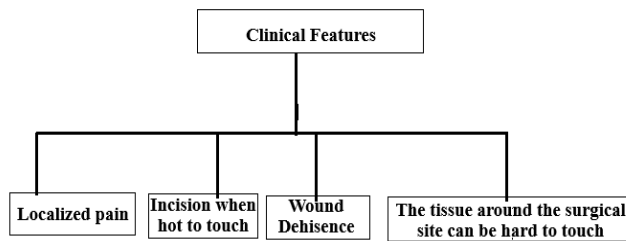


Figure.1. Basic clinical features during surgical site infection

The surgical site infection causes heightened redness, swelling, or warmth surrounding the incision elevated pain or tenderness, presence of pus or unpleasant-smelling drainage from the wound, fever and a general feeling of unwellness fig(1).

In India, monitoring post-discharge follow-up has proven to be a difficult area of surveillance. This challenge is exacerbated by infections caused by Mycobacterium species. postoperative surgical site complications after the caesarean section such as surgical site infections remain a common issue, affecting around one in every ten women. Surgical site infections refer to infections that occur at surgical sites within a timeframe of 30 to 90 days, contingent upon the type of surgery performed and the implants utilized. The global incidence of infections attributed to nontuberculous mycobacteria is increasing and is typically linked to pulmonary infections, skin and soft tissue infections and disseminated diseases (3). The 2019 report from the Centre for Disease Control and Prevention - National Healthcare Safety Network indicates that surgical site infections lead to a significant increase in morbidity and mortality, extended hospital stays, substantial financial burdens, and in some cases, unfavourable prognoses. Several potential sources contributing to the rise in incidence include fomites, iatrogenic factors, or direct contamination of wounds following trauma, aerosolized airway secretions, and contaminated water supplies in hospitals and public areas. The available data from India regarding the incidence rate and risk factors associated with post-caesarean surgical site infections is insufficient. The incidence rate ranges from 3% to 15%, depending on the methods and intensity of surveillance employed for pathogen identification, the patient population, and the use of antibiotic prophylaxis (3).

III. NEGATIVE PRESSURE WOUND THERAPY

Negative pressure wound therapy can be utilized on the closed incision of a caesarean section to assist in preventing surgical site infections and facilitate healing by applying suction to eliminate fluid, diminish swelling, and enhance blood circulation. NPWT has gained popularity as a treatment option for managing various acute and chronic wounds. Sub atmospheric pressure offers numerous advantageous effects on wound healing in animal studies. Contemporary methods aimed at preventing complications related to wounds encompass adequate pre-operative skin preparation,

antiseptic surgical practices, the use of prophylactic antibiotics, and sterile dressings post-surgery (4). Research has indicated that negative pressure wound therapy is effective in lowering the occurrence of surgical site infection in specific demographics, particularly among those undergoing caesarean deliveries. Recently, prophylactic negative pressure wound therapy has surfaced as a potential solution for mitigating surgical wound complications. This specific type of dressing, which received FDA approval in 1995, employs negative pressure at the site of the wound to diminish edema, eliminate exudate, enhance localized blood circulation, promote the growth of granulation tissue, and ultimately expedite the healing process of the wound (5).

Nevertheless, the choice to implement this therapy may be influenced by individual considerations such as the patient's risk factors and the relevant clinical evidence, with some studies presenting contradictory findings in certain groups, including obese women. Negative pressure wound therapy performs where the foam dressing is applied over the closed incision and secured with a film, while a tube links it to a vacuum pump that provides continuous or intermittent suction. And the fluid been removed by the suction extracts excess fluid (seroma, pus) from the wound area, which aids in reducing swelling and inhibiting bacterial proliferation. Negative pressure wound therapy increase the blood flow by the exerting pressure and thus the therapy can enhance blood and lymphatic circulation to the incision, thereby supporting the healing process. The sealed dressing safeguards the incision from external contamination. Negative pressure wound therapy assists in keeping the edges of the wound together, which can lessen tension and minimize the risk of the wound separating (dehiscence). Meta-analyses have demonstrated that the application of NPWT can significantly lower the incidence of SSIs following caesarean sections when compared to standard dressings. In particular, acute open wounds experience advantages from the changes in perfusion and tissue granulation that NPWT facilitates, whereas post-surgical closed wounds are influenced by alterations in perfusion and effective management of exudate. Negative pressure wound therapy may also decrease the likelihood of other wound complications such as seroma and dehiscence. Negative pressure wound therapy promote faster healing by enhancing blood flow and removing fluid, it can expedite the overall healing process.

Negative pressure wound therapy mainly supports for the motherhood preventing wound complications is crucial, as they can adversely affect a woman's recovery, her bonding with her baby, and breastfeeding success.

MACRODEFORMATION PROCESS IN NPWT

Macro deformational process in negative pressure wound therapy represents a category of wound healing devices that utilize a highly porous material applied under suction to the wound surface. Historically, these devices have been known as negative pressure wound therapy. Negative pressure

wound therapy have more accurately termed these therapies as sub-atmospheric wound therapy. While this description correctly reflects the physical nature of these devices, it does not differentiate between those that employ highly porous interface materials. The process in macro deformation in negative pressure wound therapy is shown in figure (6).

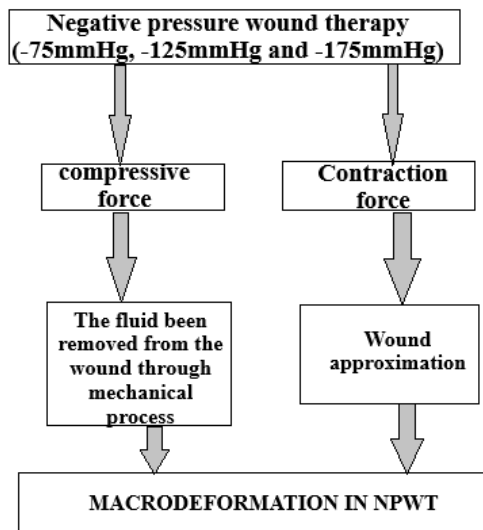


Figure.2. Macro deformation process in NPWT

Macro deformation wound therapy devices facilitate the removal of fluids and toxins, maintain a warm and moist environment for the wound, and assist in approximating the wound edges through macro deformation. In the majority of large medical centres, nursing homes, and home care settings, these Macro deformations wound therapy devices are the preferred option for treating numerous complex and challenging wounds. The swift global adoption can be attributed to the favourable outcomes reported by individual physicians and patients, as demonstrated by a significant number of published, peer-reviewed studies.

Case report:1

In this case the patient 21-year-old women without any known complaints of hypertension, diabetes, asthma or tuberculosis, was admitted for safe institutional delivery. Lower segment caesarean section was planned and healthy female baby was delivered. Suture removal was done POD-7. The patient was discharged by examining that the wound was healthy. A gaping Lower segment caesarean scar with two sinus formation was noted, one at the centre of the wound and the other at the right corner of the wound.

The lab reports chest X-ray appeared clear. The enzyme-linked immunosorbent assay for human immunodeficiency virus (HIV) returned a nonreactive result. The patient was scheduled for sinus exploration, followed by wound debridement under spinal anaesthesia, due to chronic non-healing discharging sinuses potentially caused by an infectious agent or a foreign body reaction to Prolene material. The debridement involved the complete removal of the entire

wound, including two sinus tracts, extending to the rectus sheath, and the Prolene suture material was entirely removed. The wound was subsequently closed using delayed absorbable sutures (7).

Case report:2

A 41-year-old woman, 18 months post-caesarean section, underwent an ultrasound evaluation which revealed the following: Impression: Diffuse subcutaneous edema with minimal interspersed collection observed in the post-operative lower segment caesarean scar region, possibly indicating infective sequelae. The procedure was conducted under SAP and short general anaesthesia, with the patient positioned supine. The surgical area was prepared and draped. An incision was made at both ends of the scar. The sinus tract and abscess cavity located at the left end of the scar were excised. Prolene suture was extracted. Primary closure was performed, and a sterile dressing was applied. A granuloma that arises from a caesarean section is an inflammatory response caused by retained suture material, such as non-absorbable stitches, resulting in a lump or mass at the incision site. Commonly known as a suture granuloma, this benign condition occurs when the body's immune cells accumulate around the foreign material, sometimes leading to symptoms like painful swelling or a persistent discharging sinus. This condition can develop weeks, months, or even years after the surgical procedure. It is essential to understand the causes, clinical manifestations, and diagnostic methods to ensure effective treatment and prevent further complications in patients experiencing Prolene granuloma (8).

CASE PRESENTATION DURING NPWT:

A 41-year-old female with previous history of LSCS and without any known complaints of hypertension, diabetes, asthma or tuberculosis. Lower segment caesarean was planned and healthy female baby was delivered. Suture removal was done post-op day after 11 days. Wound was healthy. After three months on the left side of the caesarean scar with two inches from the LSCS scar sinus formation was noted. Every test was again analysed and the liver and renal function tests were within normal limits. The chest X-ray appeared clear.

The patient was scheduled for sinus exploration, followed by wound debridement under anaesthesia, due to chronic non-healing discharging sinuses potentially caused by an infectious agent or a foreign body reaction to Prolene material. After 5 days from the operation again a pimple like structure formed below the exploration where the Prolene suture and defected tissues been removed fig (3,4&5).



Figure.3. Prolene suture removed and vicryl suture done with the removal of tissues



Figure.4. Removed Prolene suture.



Figure 5. After the removal of Prolene suture and damaged tissues after 25 days again a pimple like structure formed on the left side of the scar

The patient was once again scheduled for sinus exploration, followed by wound debridement under anaesthesia by the report of CT and MRI where more pain and found A 3 *2 *2 cm abscess with necrotic tissue and sinus tract with pus present within it noted in the left side of the previous LSCS scar extending till the red sheath and linea after the procedure done fig (6). By the biopsy report from the hospital this infection was by the NTM-surgical site infection in the previous two operation did for the caesarean and removal of Prolene. As, per the ID doctors the antibiotics been initiated to the patient with the follow of NPWT process.



Figure.6. The tissue when the pimple like structure opened on the left side of the scar

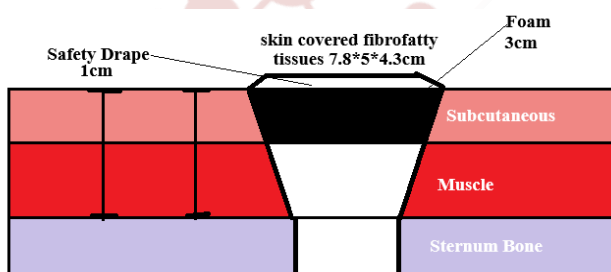


Figure.7. The location of the wound dimension measurements by the report of CT and MRI.

The wounds were dressed by the NPWT process fig (9) and

they were treated thorough cleansing of the wound with normal saline, a piece of autoclaved sponge specifically chosen for the wound was taken, and the perforator of the closed suction drain was inserted to emerge from the opposite side. The sponge was placed over the wound, and the perforator was ultimately withdrawn from the wound at a distance, leaving the suction tube within the sponge fig (8).

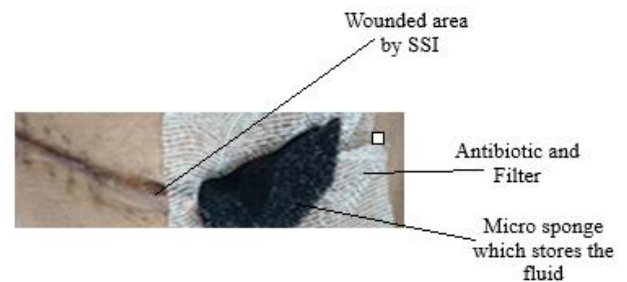


Figure.8. Open wound dresses by NPWT process

The sponge was secured in place with a transparent adhesive sheet and further reinforced with adhesive paper tape. This tape was also utilized to secure the exit tube of the drain, ensuring a completely closed airtight compartment for effective negative suction. The drainage tube was connected to the suction device, and the apparatus was activated. A properly functioning suction system would exhibit a collapsed bellow (drainage chamber) and a depression in the sponge. WEEK 1 the fluid collected from the wound by improving the tissues (3cm to 2.7cm) WEEK 2 the fluid collected from the wound with the improved the tissues (2.7cm to 2.2cm) fig(10&11).

The system was recharged whenever the bellow became deflated, and the patient or their attendant was instructed on how to do this. The dressing was changed every week a once, depending on the volume of secretion present in the chamber, and the collected fluid was sent for culture and sensitivity testing. Antibiotics were initiated based on the sensitivity report, along with other supportive measures being implemented. After three weeks the wound been dressed manually by applying antibiotic spray, filter and micro sponge by covering the wound thoroughly as per the doctor advice.

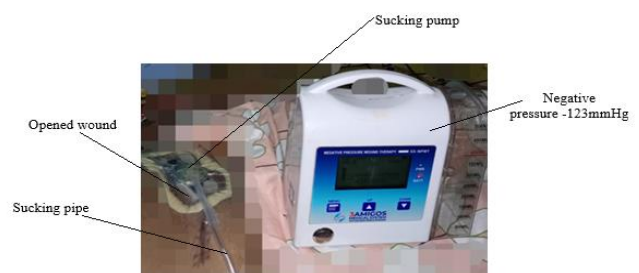


Figure.9. NPWT process was done by giving -125mmHg to the wound

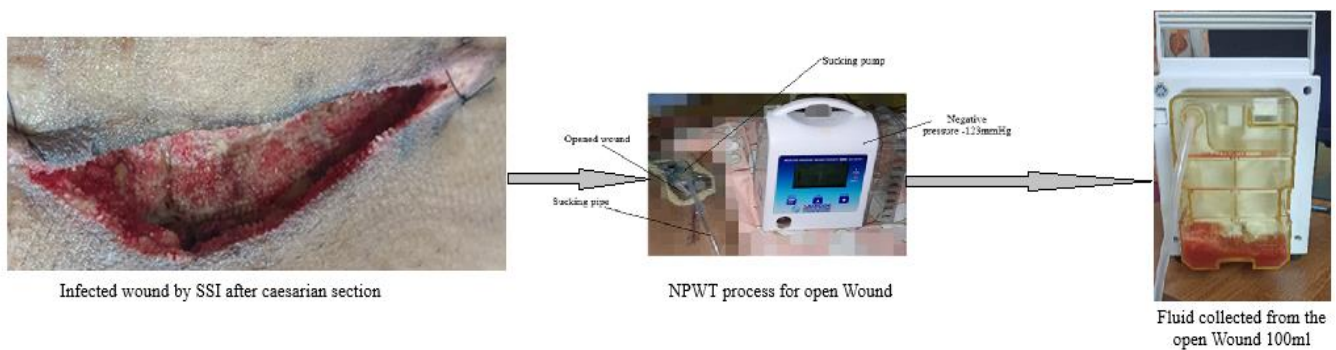


Figure.10. WEEK 1 the fluid collected from the wound by improving the tissues (3cm to 2.7cm)

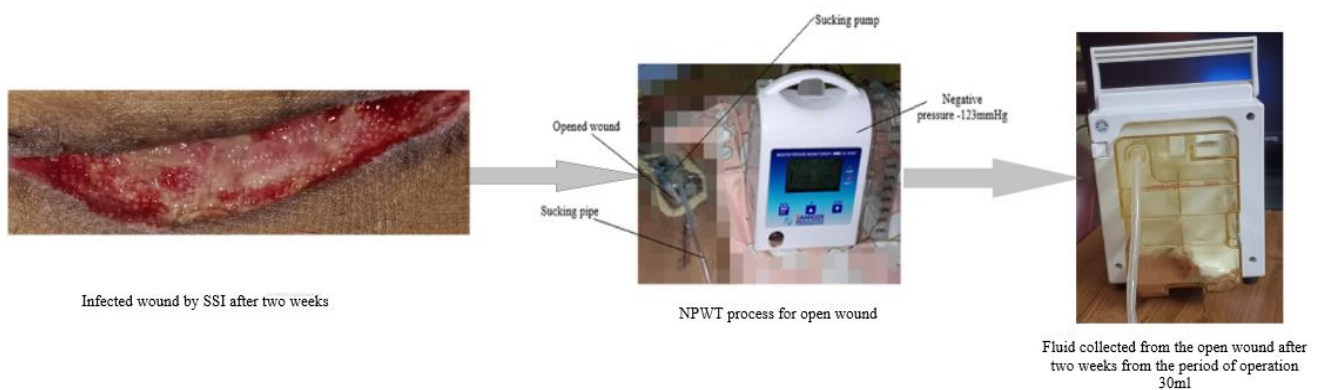


Figure.11. WEEK 2 the fluid collected from the wound with the improved the tissues (2.7cm to 2.2cm)

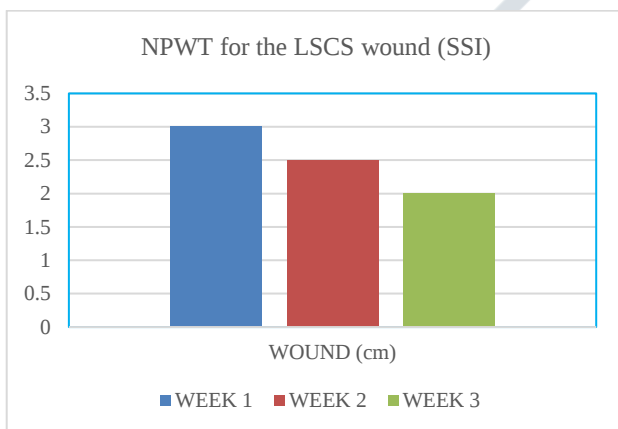


Figure.12. Open wound getting cured by NPWT

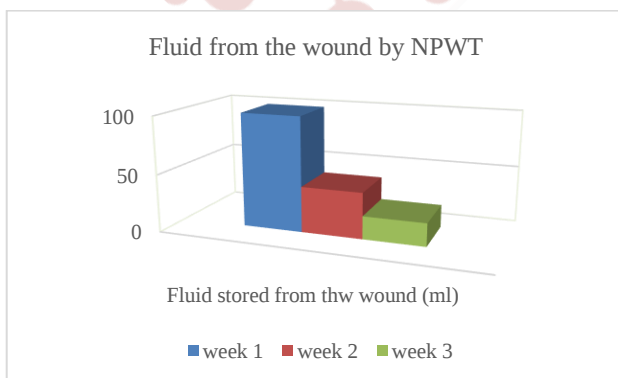


Figure.13. Amount of collected fluid from the open wound by NPWT

IV. CONCLUSION

The most common issue around in the world two in every ten women were affected by the NTM after the lower segment caesarian section such as Surgical Site Infections (SSIs). Surgical site infections rank among the most frequent complications associated with caesarian deliveries, occurring at a rate of 4% to 16% and also for the mother and family substantial financial burden on the healthcare system will take place. Understanding the risk factors linked to surgical site infections (SSIs) is crucial for the implementation of targeted preventive strategies. This paper supports the mother to come up from the wound caused by the SSI after lower segment caesarian section because if a mother affected by this NTM – surgical site infection physically and emotionally they will be stressed. NPWT supports the patient to recover from the SSI by growing the healthy tissues in the opened wound with antibiotics. Even though this therapy was effective but cost wise it is more and also in future in all the country if this NPWT was been given with free of cost for the surgical site infection patients such that they can come out from all burdens.

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