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ORGINAL ARTICLES

Negative Pressure Wound Therapy for Necrotizing Fasciitis and Compartment Syndrome of the Upper Extremity — a case report

Attila Enyedi, Gábor Mudriczki, Tamás Bazsó, Ferenc Győry, Zsolt Susán, László Damjanovich, Zsolt Szentkereszty

CASE REPORT

***Abstract*— Background: Necrotizing fasciitis (NF) is a life-threatening infection of the subcutaneous tissues that spreads along the underlying fascia. Despite the early and aggressive surgical fasciotomy and necrectomy, its mortality rate is still high. In NF the negative pressure wound therapy (NPWT) shows good effects on wound healing and on the primary closure of the concomitant extended tissue defects.**

Case report: A 32-year-old male patient was admitted with a four-day history of fever (39.1°C), pain, swelling, erythema of the right elbow and the upper arm. On admission, extensive erythema and swelling were seen on the right forearm, arm, and the pectoral region with superficial skin bullae. Based on the clinical symptoms and laboratory tests immediate surgery was indicated. Extended fasciotomy and necrosectomy were performed on the full extremity and pectoral region. Negative pressure wound therapy was started immediately afterward with -120 mmHg concomitantly with antibiotic therapy.

Results: After five cycles of NPWT the patient recovered without needing any plastic surgical intervention. The functional and aesthetic results were excellent.

Conclusion: In the case of extended NF of the upper extremity the aggressive surgery and NPWT are relatively safe and effective.

***Keywords*—negative pressure wound therapy with installation, necrotizing fasciitis**

I. Introduction

NECROTIZING fasciitis (NF) is a relatively rare, but life-threatening disease. The extremities are most commonly affected, followed by the trunk.[1–5] It has monobacterial (β-hemolytic *Streptococcus*), polymicrobial or fungal etiology.[1, 4, 6–8] Local symptoms are pain, erythema, tenderness, swelling, induration, and crepitation.[2, 3, 6] In advanced cases, skin bullae and necrosis can develop. General symptoms are fever, hypotension, diaphoresis, and anxiety.[2]

The effective treatment based on the early diagnosis is the aggressive surgical debridement and fasciotomy, broad-spectrum antibiotic therapy and supportive intensive care. Despite the adequate surgical and conservative therapy, NF has a high rate of mortality which ranges between 6–67% of cases as reported in the literature.[2, 3, 5, 6, 9]

The aggressive surgical debridement and fasciotomy often result in widespread tissue defects that need plastic surgical reconstruction.[1–3, 6] Negative pressure wound therapy is a frequently used method in the treatment of necrotizing fasciitis based on its advances in complex wound care. It has positive effects on wound healing, bacterial decontamination, removal of excessive, toxic fluid from the wound, angiogenesis and tissue perfusion.[1, 10] In the last decade, the use of NPWT has become the gold standard in the treatment of NF.[1, 3, 4, 6, 9]

We present a successful negative pressure wound therapy in case of extended necrotizing fasciitis and compartment syndrome of the right upper extremity.

II. Case Report

Four-day history of pain, swelling, erythema of the right elbow and upper arm and fever (39.1°C) were reported by the patient. On admission, extensive erythema and swelling were seen on the right forearm and arm. Some superficial skin bullae were also observed without skin necrosis (Fig. 1A–D). The extremity movement was painful and limited at the elbow, shoulder, and wrist. Laboratory results showed elevated white blood cell count (16.08 G/L), C-reactive protein (513.67 mg/L), procalcitonin (6.4 μg/L), creatinine (147 μmol/L), glucose (10.6 mmol/L) and decreased level of sodium (132 mmol/L) and hemoglobin (135 g/L) were observed. The LRINEC (Laboratory Risk Indicator for Necrotizing Fasciitis) score was calculated to be 11 indicating a high risk of necrotizing fasciitis. The ultrasound and X-ray excluded osteomyelitis and deep vein or arterial obstruction. Chest CT scan showed only some axillary lymph node enlargement and no intrathoracic involvement. 32-year-old male patient reported shunt operations for hydrocephalus and inguinal hernia reconstruction in the childhood.

Broad-spectrum antibiotic therapy (imipenem with vancomycin) was started on admission and immediate surgery was indicated. The incision was started from the pectoral region to the carpal tunnel on the medial surface of the arm and forearm. The carpal tunnel was also explored (Fig.

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Figure 1. The view of the right arm and chest wall at admission

Figure 2. A: The volar incision, necrosectomy, B: The ulnar incision, C–D: The application of the NPWT

2A). Another ulnar incision was performed on the forearm. During the wide incisions, the finger test was positive (lack of resistance to blunt dissection). Blunt finger separation along the fascia plane was performed. The involved spaces were explored to decrease the pressure. The necrotic fascia was removed, and widespread debridement was performed (Fig. 2B). The margin of fascia resection was the visual assessment of tissue viability and satisfactory bleeding from the edges of resection. During the first dressing change, necrosectomy was necessary.

The surgical site was washed out with high-pressure saline solution. Macroscopically total debridement was possible so negative pressure wound therapy (Vivano Med®, Paul Hartmann AG. Germany) was inserted into the surgical site. Shallow, superficial (16 mm) foam was used partly manually adapted (Fig. 2C–D). Continuous suction with -120 mmHg pressure was started and the patient's local and general status was closely observed. Intensive care was performed, the hypotension was treated with Arterenol. On the second postoperative day the patient was extubated, the circulatory support was finished. The laboratory tests began to normalize. Locally there were no signs for the spread of the disease so the first dressing was only performed on the 4th postoperative day. Only the first two dressing changes were made in general anesthesia.

The first 3 days for analgesia Würzburg cocktail (400 mg tramadol, 4 g metamizole sodium, and 2.5 mg droperidol) in injection pump for 24 hours was administered. After that nalbuphine 10 mg/ml was required and at discharge diclofenac 100 mg/day twice daily was administered.

After the 5th day, the patient was transferred from ICU to the general department. The wound surface was clean, there was no new necrosis and tissue granulation was observed. 4 more dressing changes were performed on every fourth day. On the first postoperative day, the amount of exudation was approximately 800 ml. On the 2nd postoperative day, it was 400 ml and 150 ml on the 3rd postoperative day. In addition, 5 NPWT cycles were conducted and 2 negative pressure devices were used in consecutive dressing changes. After the second NPWT, the wound started to close progressively with single sutures (Fig. 3A–D). There was no necessity for skin preparation during closure of skin wound. The short forearm's wound was closed first followed by the large one. The result of bacterial culture was *Streptococcus pyogenes*, without anaerobic bacterial and fungal infection. Empirically clindamycin (600 mg three times daily) and penicillin-G (6 times 4 MU) therapy were used for 9 days. Based on microbiological culture results the antibiotic therapy was changed to intravenous amoxicillin with clavulanic acid 3 times 1.2 g for 10 days followed by oral therapy for 7 days.

The dysfunction of the 4th finger became obvious during the treatment. Systematic (full-body) physiotherapy was performed from the 3rd postoperative day. The involved extremity was not spared from it, additional passive rehabilitation and manual lymphatic massage were performed at the beginning of each therapy session and the patient was transferred from ICU to the general department. The patient did not report any adverse reactions other than the

Figure 3. A–D: During the dressing changes the wounds were closed step by step from the edges to the center.

Figure 4. A: The skin defect on discharge, B–D: The final view of the upper extremity after a 30-day followup

dysfunction of his 4th finger.

On the 24th postoperative day, the patient was discharged. The residual 3 cm by 6 cm skin defect which was treated conservatively (Fig. 4A–D). The sensory and functional status of the extremity was nearly normal. After 30 day follow-up the patient was free of complaints, the function of the right upper extremity was normal with the except of his 4th finger's palmar flexion which was restricted to 30%.

III. Discussion

Necrotizing fasciitis is a life-threatening severe infection characterized by extensive soft tissue necrosis along fascial planes involving the subcutaneous region and skin.[1–5, 11] NF can appear on various body regions, but most often on the extremities.[3, 4, 11] It is often caused by monobacterial (*Streptococcus pyogenes*) infection but polymicrobial or fungal origins are not rare either.[2–4, 6–8] Thrombocytopenia, advanced age, liver diseases, acute renal failure, low serum albumin level, and smoking are risk factors for NF and increase mortality rate.[4, 6]

The clinical complaints are the pain, swelling, erythema, tenderness and due to the generalization of the local infection fever and signs of sepsis. In advanced cases, skin bullae and necrosis can develop.[2–4, 11] In advanced cases, anxiety can develop as a sign of generalized septic-toxic signs.[8] When the disease is localized in the extremities, concomitant compartment syndrome is often observed.[4] The early diagnosis is a crucial step in the treatment algorithm. Wong et al. proposed a scoring system (LRINEC) for early diagnosis of the disease[5] based on the level of C-reactive protein, white blood cell count, hemoglobin, sodium, creatinine, and glucose.[5, 6] In the presented case the LRINEC score was 11. The intraoperative diagnosis was confirmed by grey colorization and necrotic deep fascia (without bleeding), lack of resistance during blunt dissection and presence of pus with odor.[1, 2, 5]

The successful treatment is often based on the early aggressive surgical debridement, fasciotomy, and supportive therapy.[1–6, 9, 11] Broad-spectrum antibiotics and intensive care assistive measures are needed for stabilizing the vital functions of the severely septic patient.[1–3, 6, 11] During the conventional surgical treatment, wound dressings should be changed at least daily. Due to the aggressive debridement, extensive tissue defect may remain as an adverse therapy outcome that may in the future need a reconstructive plastic surgical intervention.[3, 6, 11]

Nowadays, negative pressure wound therapy is a widely used method in complex wound care.[1, 10] There are not many publications about NPWT in necrotizing fasciitis. Some authors suggest using NPWT only a few days after the primary operation.[1, 6] Others reported good results with prompt use of negative pressure wound therapy.[3] In the presented case the prompt use of NPWT for extensive necrotizing fasciitis of the upper extremity was successful. The NPWT provided also a positive effect on the acute compartment syndrome of the extremities.[4, 7, 10] In NF cases the NPWT with installation

(NPWTi) seems to be more effective than conventional NPWT.[4, 9] In the presented case the authors didn't use installation, because the first necrosectomy seemed to be complete. The NPWT-assisted skin traction can facilitate the primary closure of the skin.[11] The used pressure is recommended between -100 and -450 mmHg, but the most commonly used negative pressure is -125 mmHg.[1, 3, 4, 6, 9] In the present case the authors used -125 mmHg negative pressure with continuous suction.

Despite the complex surgical, antibiotic and intensive care the mortality rate in patients with necrotizing fasciitis is still high up to 75–100%.[1–6, 11]

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From fistula to disability. Severe infection due to anal fistula treated with NPWT — case report

Mateusz Szyntor, Radosław Wojciechowski, Magdalena Surudo

CASE REPORT

***Abstract*— Negative pressure wound therapy (NPWT) is increasingly used to facilitate wound healing. There are various wound types — primarily closed or open, clean or infected, superficial or deep-penetrating, open abdomen, enteroatmospheric fistulae, burns, etc. and almost each of these might be healed with the help of NPWT. It seems to be the most beneficial in hard-to-heal wounds. Using sub-atmospheric pressure, one can significantly accelerate the separating of necrotized tissues, stop inflammation, promote granulation, and drain the difficult wounds effectively. Typically, an optimum pressure range of -80 to -125 mmHg is administered. Few contraindications for the use of NPWT are challenged by new reports showing benefits in situations where NPWT was previously forbidden, (i.e. malignancy or bleeding in the wound), increasing the quality of life and avoiding wound infections. There is a growing body of data for new methods of treating anal fistula in the literature, but there are no data for elective treatment with NPWT. Attempts to develop NPWT protocols are problematic due to the diversity of cases and the frequent need for a personalized therapeutic approach.**

This paper presents a 56-year-old male patient suffering from severe, purulent inflammation of groin, inguinal, anal and left gluteal sites; septic, malnourished, depressed, in continuously worsening general status since 3 years. Computed tomography and colonoscopy did not reveal pathology except for purulent inflammation. At the beginning, the patient was treated symptomatically with antibiotics, colostomy and surgical excision facilitated with NPWT. Anal fistulae were found after a large tisue excision. A medium-thick skin transplantation was performed and well accepted in over 90%. This case presents a 103-day-long hospitalization with numerous complications. Finally, the wound healed completely and the patient was restored to his full physical abilities and his quality of life benefited greatly.

NPWT used in this case allowed for inflammation control, extensive wound healing and closing the anal fistula with no recurrence.

***Keywords*—anal fistula, VAC, negative pressure wound therapy**

I. Introduction

ANAL fistula is a tract from the rectum or anus, with an internal opening that communicates with the skin around the anus at the external opening.[1] Latest literature reports an incidence as high as 21/100,000. Anal fistulae occur most frequently between 30 and 50 years of age and are 2–6 times more prevalent in males than females.[2] In 1976, Parks et al.[3] classified anal fistulae into four types by the tract course: extrasphincteric, suprasphincteric, transsphincteric and intersphincteric; further classifications added the submucosal type, which also was diagnosed in the described case. Since transrectal ultrasound (TRUS) and magnetic resonance imaging (MRI) became more available, the authors of newer papers have used it to classify fistulae into 5 grades.[3–5] Symptoms include pain, difficulty sitting and purulent or bloody discharge when perianal abscesses are present. Patients may also have systemic sepsis.[6] There are many therapeutic options for anal fistula. However, fistulotomy is the mainstay of treatment. Elective treatment is recommended, when active inflammation or abscesses are not present.[7, 8]

Negative pressure wound therapy (NPWT) is used in all wound types and is especially useful when a hard-to-heal wound is to be treated. Its benefits include draining exudate, contracting the wound edges, stimulating angiogenesis, reducing tissue edema, stimulating the formation of granulation tissue, and creating a moist environment. By altering the blood flow in the wound edges and stimulating the wound bed, NPWT improves drug penetration.[9, 10] Using sub-atmospheric pressure accelerates the separating of ischemic tissues. Typically, an optimum pressure range of –80 to –125 mmHg is administered, but in the case described we decided to used –200 mmHg to reduce superficial bleeding and to keep the dressing tight.

The PubMed and Cochrane databases showed no results for a search of ‘anal fistula’ with ‘NPWT’. There are reports on enteroatmospheric fistulae being treated with NPWT, which are a valuable source of knowledge, but the conclusions cannot be extrapolated entirely to anal fistulae. This paper presents a severe groin and perianal infection treated with a large excision and skin transplantation preceded with NPWT. Anal fistulae were found to be the cause relatively late during the therapy process.

II. Case Report

A 56-year-old male patient with no other comorbidities was admitted to a surgical ward due to a massive, non-healing buttock and perineum inflammation. The first symptoms had

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Figure 1. Status at admission: proper examination was possible under anaesthesia. Extensive soft tissue phlegmon in groin, scrotum, both inguinal, perianal and left gluteal site

Figure 2. Subtotal excision of phlegmon tissues with margin. The perianal site was saved to keep tightness with NPWT dressing using adhesive gel patches. The anus was still excreting.

Figure 3. NPWT dressing. Two separated areas were connected with one processor by 3 soft ports. Adhesive gel patches applied perianally.

appeared 3 years previously as a small abscess on the scrotum base spreading superficially to both inguinal, anal and left gluteal sites. At this time, the patient had been treated in an out-patient clinic as well as hospitalized on infectious disease and dermatology wards; the patient did not deliver any past medical history reports. He had undergone multiple antimicrobial therapies combined with dressings and locally-acting antiseptic agents. There had been no satisfactory clinical improvement, and the disease progressed as his general status had gradually worsened. He presented with chronic fever, lost approximately 20 kg of body weight and had to cease his academic job due to the inability to sit and continued worsening of his general status.

On admission, the following were noted: bed-ridden, lower limb contractures, fever >38°C, pulse rate of approximately 110/min, BMI 20.45 kg/m^2 (decreased from 26,3 during last 12 months; height 185 cm, weight 70 kg). Locally – extensive soft tissue phlegmon in the groin, scrotum, both inguinal sites, left gluteal site and perianally (Fig. 1), with voluminous purulent leak. In computer tomography and colonoscopy, no signs of anal fistula or any other pathologies were noted. In the other body areas, the skin was healthy. The patient had been examined by urologists on several occasions because of primary purulent fistula on the scrotum. Urological disease was excluded.

The patient was qualified for surgery. In the first step, the skin covering the left buttock was excised deeply to the

Figure 4. NPWT finished after 6 dressing changes. The wound was infected and covered with advanced biofilm, while there were positive blood samples with *S. epidermidis* and *C. tropicalis* - high risk of skin transplant rejection, systemic and local antimicrobial therapy was needed.

Figure 5. Satisfactory cleanliness before skin transplantation.

muscular fascia and an NPWT dressing was applied (pressure –125 mmHg, continuous mode). After 5 days, tissues from the groin, scrotum and inguinal sites were excised with the margin (Fig. 2). The perianal site was saved to maintain tightness with NPWT close to the excreting anus. A sub-atmospheric dressing was placed on the whole wound with 3 soft ports (Fig. 3). Tightness was achieved using adhesive gel patches.

During dressing changes over the next 5 days, a significant improvement was observed. Local inflammation was reduced and the wound was granulating. In accordance with the presumed long starving period, laparoscopic sigmoid colostomy was performed. Oral feeding was restored. Without natural defecation, it became possible to excise perianal tissues radically and large abscesses in the mesorectum were emptied. Furthermore, filamentous transsphincteric and submucosal fistulae without internal aperture were found, which had previously been imperceptible. Fistulae were marsupialised. All spaces and fistulae tracts were filled with NPWT sponge and after 6 dressing changes (27 days), the negative pressure therapy was finished (Fig. 4). The main difficulty was a recurrent decompression of the dressing. Because of the pain, dressings were changed under anaesthesia. There were attempts to recover the tightness by adding more stoma paste, then drapes, and increasing the negative pressure (–125 mmHg was further decreased to even –200 mmHg, continuous mode) and this was successful. The right half of the wound was sealed in one position and it was relatively easy. The left, larger half of the wound forced changing the patient's position from right-sided to gynaecological and back during the procedure. Leaking serous and bloody exudate made it difficult to keep the surrounding skin dry for applying the drape and the procedure needed to be performed very quickly.

The preparation of the wound for skin transplantation was impeded by infection. Dressings with Bacitracin, Neomycin, Povidone-iodine (transient hypersensitivity to iodine) and liquid paraffin were changed every 2-3 days. Silver-containing dressings had a poor clinical effect: biofilm and infection returned. Finally, satisfactory wound cleanliness was achieved (Fig. 5). On the 62nd day of treatment a medium-thick skin transplantation on the buttock was performed, and on the 84th day, this was done on the whole groin area. It was accepted in over 90% and the whole wound and healed. No problems with the healing donor sites were observed. During hospitalization, the patient underwent the anaesthesia procedure for 32 times and the dressings were applied in opioid analgesia only.

Patient was discharged after a 103-day-long stay (Fig. 6) in a good general condition, walking supported with crutches, without contractures, eating a full oral diet fortified with oral nutritional supplementation, educated on how to change dressings. Good complience to the therapy was observed during weekly out-patient controls, which resulted in immediate restoration of previous mental and physical abilities, including sexual activities. Regular controls were discontinued after 5 months (Fig. 7). Pathological examination of a sample taken from the wound bed during follow up revealed severe inflammation features. There were no symptoms of anal fistula during the follow-up. The patient stays in contact with surgical and proctological clinics and awaits stoma closure.

Important parts of the treatment were early admission and aggressive nutritional therapy. Immediately on admission and before surgery the patient qualified for complete intravenous nutrition, because of two reasons: the first was to keep the wound clean and latter to turn a severe catabolism to anabolism. Due to chronic general inflammation and periodically worse renal function, the tolerance of intravenous nutrition was limited. Oral feeding was restored after performing colostomy, which allowed the intravenous dosage to be decreased. Delivery of whole caloric and protein needs became possible after combining oral with intravenous nutrition. Intravenous nutrition was finished after limiting general inflammation and protein loss through the wound. As a bed ridden patient, he was administered an enhanced oral diet (5 meals) fortified with enteral nutrition (commercial product Cubitan, Nutricia) 1-2 times a day and 1970 ml of parenteral nutrition (commercial product SmofKabiven, Fresenius Kobi), which equals 4,663 kcal daily. During his whole stay, the patient received almost 140,000 kcal

Figure 6. Discharge status. Medium-thickness skin transplant accepted in >90%, partly healed by granulation and epithelialization.

intravenously — assuming a mean of 7000 kcal per 1 kg of body weight. The patient avoided 20 kg weight loss. His body mass index on discharge was similar to that on admission, but with no edema and after large excision. The patient had gained over 30 kg body mass by the 5th-month follow-up.

Such a long and multimodal treatment had varied complications. In addition to difficulties with dressing, there was a problem with stoma. On the 3rd day after formation, it necrotized because of a too narrow fascia aperture. There was no need for relaparoscopy and the problem was solved by widening the aperture from the outside and shortening the colon by a few centimetres. Central venous ports for intravenous nutrition entailed more difficulties. There were recurrent sepses with *S. epidermidis* and *C. tropicalis* treated according to antibiograms with linezolid 0.6 g/10 days i.v. twice daily and fluconazole 0.4 g/21 days i.v. once daily. At the end of intravenous nutritional therapy, the right carotid, subclavian and axillary veins developed thrombophlebitis, which was treated successfully with enoxaparin 60 mg twice a day for 3 months.

III. Discussion

The use of NPWT after a large skin excision seemed the only possibility to stop or merely slow down the natural progression of the patient's disease. The clinical view of the affected skin was unquestionable in need of surgical intervention. Having experience with NPWT, we administered it on the extensive wound. We started with the standard protocol

Figure 7. Follow-up after 5 months. Achieved skin elasticity with no contractures, full mobility of lower limbs with no pain. The regular outpatient control was finished.

of –125 mmHg, continuous mode. The intermittent mode was useless because it caused an air leak. It was necessary to take a risk and increase the pressure to –200 mmHg near to the rectum (without unsheathed mucosa) for the purpose of keeping air-tightness. This appeared as effective therapy, which also decreased the exudate, as describe in the literature.[11] Unfortunately, it was associated with severe pain and forced morphine use. When we found two simple anal fistulae without internal openings, we decided to fill them with sponge simultaneously, which resulted in proper healing of the tract without any recurrence.

Forming colostomy has recently became controversial; it seems to be an overtreatment in the face of modern management.[12] The final effect which undoubtedly increased patient's quality of life suggests that NPWT might be a highly appropriate treatment option in very advanced cases. CT, colonoscopy and final pathological examination did not confirm the cause of fistulae, thus it seems that the proper diagnosis was spontaneous anal fistula spreading from anus, although there is no answer to the question why it spread so much in the adult patient without risk factors. We did not perform MRI because of the need for further anaesthesia, and the outcome of this diagnostic procedure would not change the therapy regimen.

Negative pressure wound therapy (NPWT) is especially beneficial for hard-to-heal wounds.[13] There are papers where its benefits are challenged. There are also reviews of primarily clean or potentially infected wounds which compared incisional NPWT to standard therapy and no significant differences between groups were shown.[14, 15] The case presented in this paper cannot be compared to others as we did not find any similar reports.

Due to the lack of data on healing anal fistula with negative pressure, we tried to compare our case with site-similar wounds. A study of pilonidal disease showed the benefits of incisional NPWT.[16] Moreoiver, papers discussing enteroatmospheric fistulae present the benefits of such an approach.[17, 18] Using multiple dressings seems to be expensive, but Hampton in his cohort case study gives reasons for cost-

effectiveness of such an approach.[19]

IV. Conclusion

Negative pressure wound therapy applied to treat hard-to-heal wounds significantly accelerates the recovery process. Because of the diversity of cases, a procedure protocol is difficult to develop and each case needs personalized approach. Applying NPWT in severe cases of anal fistula should be considered and requires further studies.

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The role of negative pressure wound therapy in the treatment of pilonidal disease

Jan Chmielecki, Josephine Ferenc, Tomasz Banasiewicz

ORGINAL ARTICLE

***Abstract*— Pilonidal disease is a particularly difficult disorder to treat. Guidelines and recommendations for the treatment of pilonidal disease neglect the use of negative pressure wound therapy (NPWT), but studies strongly support the role of NPWT in preventing surgical site infection in high-risk patients.**

During a webinar on the pilonidal disease, we asked 51 participants to complete a questionnaire about the treatment of pilonidal disease. They answered questions about treatment practices for patients with a pilonidal disease, and the use of NPWT.

The study showed that a relatively large number of surgeons use NPWT to treat patients with the pilonidal disease. The majority of them are satisfied with maintaining the tightness and effectiveness of a vacuum dressing and would use the single-use NPWT systems if they were more easily available and affordable. It seems that the NPWT in the pilonidal disease is increasingly used and this method is gaining popularity among practitioners.

***Keywords*—pilonidal disease, pilonidal cyst, negative pressure wound therapy, NPWT, vacuum therapy,**

I. Introduction

THE pilonidal disease is a particularly difficult disorder to treat. It is significantly more likely to affect men more than women and it is worth noting that it often presents during periods of increased personal and professional activity.[1] The chronic and recurrent nature of pilonidal disease effectively decreases patient's quality of life and often poses a challenge to surgeons.

Previously published guidelines and recommendations for the treatment of pilonidal disease neglect the use of negative pressure wound therapy (NPWT) as a potential therapeutical approach.[1–3] While treatment guidelines outlined by the Italian Society of Colorectal Surgery[4] reference a study on the use of NPWT by Biter et al.,[5] the technique is not actually officially recommended by international societies in any of the current management guidelines.

NPWT as a treatment regimen for the pilonidal disease has been reported in the literature since 2003. Duxbery et al. first described a case of a patient who was treated with a vacuum dressing after pilonidal sinus excision over an open wound.[6] The patient's wound healed over a period of 8 weeks and the recurrence wasn't observed in one year. In the following years, publications about successfully treated patients using NPWT started to appear.[7–11] Mainly NPWT had been applied after wide excisions to stimulate healing and the production of granulation tissue,[7–9] but Lynch et al. also described the use of NPWT to support the healing of intermediate thickness skin grafts following the excision of pilonidal sinus.[10] In 2007, Bandewald et al. published a report on pilonidal disease and suggested that primary NPWT may be a simpler alternative to more complicated procedures (such as primary closures with flap reconstructions).[11] Further researches established that the use of NPWT is helpful in reducing the incidence of surgical site infection and wound dehiscence in the setting of wounds that have been primary closed.[12] NPWT is also successfully used to treat certain complications following surgical intervention of a pilonidal sinus, such as the development of wound dehiscence after Limberg flap.[13]

At our medical center, we have been relying on the use of NPWT to treat patients with pilonidal disease for over 10 years. Initially, we restricted the application of NPWT to the wounds with extensive exudation, lacking adequate granulation tissue development, and those in which we did not observe the progression of healing (Fig. 2, left). The positive effects of the chosen therapy led us to implement the use of vacuum dressings more widely, immediately following the surgical excision. We are also keen on using small, comfortable and portable, disposable devices (Fig. 2, right). In addition to the fact that the procedure improves wound healing, the benefits of NPWT are further substantiated by patients reporting less pain during the early postoperative period.[14] Procedurally, the vacuum dressing is first applied in the operating room and then changed every 3 days, or earlier in case of extensive wound drainage (Fig. 3, left). It is important to remember not to use disposable dressings which have been filled by drainage as it compromises the vacuum function of NPWT. Experience has shown that there are particular cases requiring more fastidious care. Due to the uncomfortable location, maintaining dressing tightness might sometimes be problematic (the wound drape alone is not enough to facilitate air-tightness). We have found that the use of ostomy paste helps the film to adhere more tightly to the wound (Fig. 1).

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Table I
QUESTIONNAIRE COMPRISED OF A SURVEY ANSWERED IN REAL TIME BY 51 RESPONDENTS DURING A WEBINAR HELD ON 12.03.2019

Question	Answers	
Have you ever had a patient with a pilonidal disease whom you treated surgically? (Fig. 2, left)	Yes No	49 2
What methods have you used in the treatment of pilonidal sinus? (Fig. 2, right)	Drainage Excision and leaving open Excision + NPWT Bascom II Kardykais Method Limberg Flap	29 32 13 25 10 14
Have you ever used NPWT to treat a patient with a pilonidal disease?	Yes No	16 32
Which NPWT systems have you used in the treatment of pilonidal disease?	Stationary - large device with a canister Disposable Both	11 6 2
Have you ever experienced any problems with maintaining the tightness of the vacuum dressing? (Fig. 3, left)	Never Sometimes, without affecting treatment Often, complicated treatment Always, almost always	10 15 13 0
Would you use a disposable NPWT if the patient brought one with him/her to the hospital for surgery? (Fig. 3, right)	Yes No	45 2
How did you hear about the possibility of using NPWT in the treatment of pilonidal disease?	Publication Conference Colleague Advertisement Personal Initiative Patient	7 23 4 6 5 0

In March 2019, our department (The General and Endocrine Surgery and Gastroenterological Oncology Department of Heliodor Swiecicki Clinical Hospital at the Karol Marcinkowski Medical University in Poznan) organized a webinar for Polish surgeons on the subject of pilonidal disease that became the basis for a survey regarding the use of NPWT in the treatment of this disorder.

II. METHODS

During an interactive online meeting (webinar) on the various methods used in the treatment of pilonidal disease, we invited 102 participants to complete a questionnaire created by our department. 51 webinar-participants chose to take part in our survey, 49 of which reported having operated on patients suffering from a pilonidal disease in the past (Fig. 2, left). The survey was comprised of multiple-choice questions (Tab. I)

Nearly all participants answered all the questions. It is worth noting that participants were able to choose more than one answer, and therefore we collected more answers than there were participants. The full survey, complete with questions and results is included in (Tab. I).

Figure 1. Ostomy paste (Stomahesive® ConvaTec) was used around the margins of the hydrofiber dressings in order to achieve a better seal and improve the effectiveness of the NPWT course.

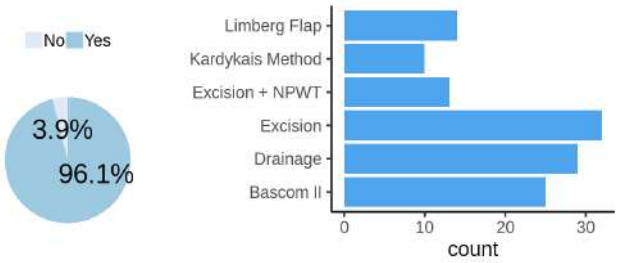

Figure 2. Have you ever had a patient with a pilonidal disease whom you treated surgically (left)? What methods have you used in the treatment of pilonidal sinus (right)?

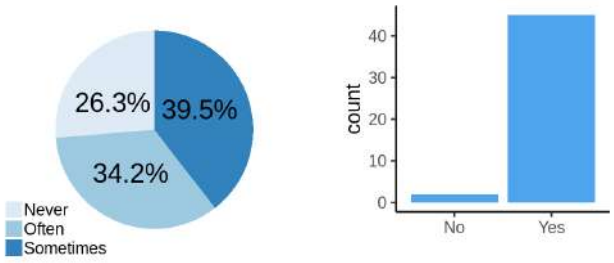

Figure 3. Have you ever experienced any problems with maintaining the tightness of the vacuum dressing (left)? Would you use a disposable NPWT if the patient brought one with him/her to the hospital for surgery (right)?

Figure 4. A pilonidal sinus was surgically removed with primary closure 2 months ago. Partial wound dehiscence with chronic inflammation of the surrounding skin can be observed. The lack of proper healing in this wound resulted in recurrent exudation, as well as chronic pain for the patient.

Figure 5. NPWT was introduced using Avelle^{TM} ConvaTec, UK. NPWT dressings were changed every 3-4 days, depending on the volume of exudation from the wound as well as the sealing of the vacuum.

III. Discussion and Analysis

We successfully obtained information regarding the most frequently used operative methods in the treatment of pilonidal disease (Fig. 2, left). Our data show that respondents more commonly surgically excise the pilonidal sinus and leave the wound open, allowing it to heal by secondary intention. All resections with plastic surgery closures are used 50% less often. Although skin plastic surgical methods are outlined in the management recommendations, the difficulty of these procedures discourages surgeons, especially since the incidence of postoperative complications is similar to other methods.

A relatively large number of surgeons who use the combination of simple excision of the pilonidal sinus with NPWT (13/49) draws attention. This, compared to 16 out of 49 who responded positively when asked if they had ever used NPWT, indicates that surgeons are not only using NPWT to improve healing by stimulating granulation tissue production following pilonidal sinus excision, but also for secondary support of healing processes (possibly after other surgeries such as flap-plasty). Such a treatment course was described by Sukru et al. after a medical team was able to successfully treat wound dehiscence by applying NPWT. The dressing was changed 3 times every 3 days. On the 10th day NWPT was removed and the sutures were sewn in accordance with the skin-plasty made during the initial surgery.[13]

Analysis of the reported procedures used in the treatment of pilonidal disease indicates that excision and open wound healing is the most common procedure (32/49). In our opinion, this is potentially the optimal group to support healing with NPWT. It seems that lack of NPWT use is not due to lack of knowledge or skills, but rather restricted access to NPWT devices and materials. This issue is indirectly associated with the lack of reimbursement for this form of treatment. It was interesting to find that 45 out of 49 respondents reported that they would employ the use of vacuum therapy system if a patient came to the hospital with his own disposable NPWT device (Fig. 3, right).

It is worth noting that the majority of surgeons using NPWT are satisfied at maintaining the tightness and effectiveness of a vacuum dressing, what was initially considered a technical limitation of this method (Fig. 3, left). Only 13 out of 49 surgeons reported problems with NPWT sealing that complicated the course of treatment, compared to 25 out of 49 surgeons who reported that they had either no problems at all or problems that did not negatively impact patients' health outcomes (Fig. 3, right).

When it comes to the choice in NPWT systems, our data show that most surgeons still prefer to use stationary systems

Figure 6. Following a 3 week period during which the patient underwent NPWT, a significant reduction in exudate, pain, and inflammation could be observed. Healing processed and the margins of the skin were closed over the majority of the wound. NPWT was not continued and further treatment of the wound was supportive, with typical wound dressings being regularly changed for the next 2 weeks, at which point final closure of the wound could be seen.

that are provided by some hospital departments. Single-use, disposable devices are less commonly used. It seems to be related to the lack of reimbursement, but the common opinion that NPWT is dedicated only to hard-to-heal wounds also impacts this decision. Research strongly supports the role of NPWT to prevent surgical site infections across high-risk patient-groups.[15–17]

Use of NPWT disposable systems after the pilonidal sinus surgery, due to the nature of the disease (chronic and extensive infection and location that makes the maintenance of proper hygiene difficult) is an example of preventing surgical site infection. Figures (Fig. 1, 4 - 6) give an anecdotal example of how the use of NPWT in the treatment of pilonidal cyst may contribute to the successful therapeutic outcome.

IV. Conclusion

Our survey determined that knowledge regarding NPWT among surgeons for the treatment of pilonidal disease is increasing and there is a great potential in using this method, despite the low availability across the Polish hospitals. It seems that the simplicity of use and the effectiveness in the treatment of pilonidal disease should earn NPWT a position in recommendations and guidelines.

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