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A Multidisciplinary Team Approach in a Complicated Infected Pressuresore Following Paraplegia. A case report¹Alaa Alshaibat, MD Surgery¹Mohamed Ghilani, MD Surgery²Mohammad Sidiq, PhD Scholar³Wadha Alenazi, BPT.³Mohammad Qasim, MPT.⁴Mehrunnisha Ahmad, M.Sc. Nursing⁵Faizan Kashoo, MPT.**ABSTRACT**

Background: A 15-year-old boy met with a road traffic accident in October 2016. The patient sustained a complete spinal cord injury at T11, resulting in paraplegia.

Case Description: Later in 2019, the patient was admitted to our hospital with bilateral recurrent infected pressure sore. The patient underwent extensive wound debridement, antibiotic therapy (intravenous and impregnated beads), acetabular curettage, and resection (Girdlestone procedure) of the left proximal femur followed by gluteus maximus flap grafting to fill the dead space. In addition, the patient received education and counseling, nursing care and nutritional intervention, and comprehensive physical therapy treatment, which includes exercises, ultraviolet-C irradiation, Tension therapy, extracorporeal therapy, education. The patient was discharged in a wheelchair after two months. The follow-up after three months showed the complete healing of pressure sore with improvement in the quality of life.

Outcome Measures: Outcome measures were hematological reports, Pediatric Quality of Life, Spinal Injury Association (ASIA) impairment scale, and range of motion by goniometer at the time of admission and discharge.

Conclusion: We conclude that pressure sores can be a life-threatening medical complication following spinal cord injury; timely multidisciplinary teamwork is crucial to prevent its reoccurrence.

Keywords: Pressuresore; surgical management; paraplegia; nutrition; physical therapy modalities; nutrition.

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INTRODUCTION

Pressure ulcers are a common preventable complication affecting the majority of patients around the world [1]. A large portion of this population is comprised of patients with spinal cord injury [2]. The lifetime incidence of pressure sores in people with paraplegia reaches up to 86% [3]. Following a spinal injury, many patients show hypercatabolic responses. Such metabolic change leads to loss of lean body mass, increased susceptibility to infections, and reduced wound healing. Spinal cord injured patients suffer from reduced physical activity, paralysis of muscles, and loss of skin sensation, making them prone to pressure ulcers [4]. Proactive, holistic patient management that includes medical and surgical management, dietary intervention, nursing care, physical therapy exercises, patient and family education would significantly reduce the chances of pressure sores [5]. Secondary complications were less encountered by patients who remain active post morbidity, attend counseling and education about pressure sore prevention strategies [6]. One of the most preventable complications post-spinal cord injury is pressure sores. To the best of our knowledge, this is the first case report that describes the medical and comprehensive multidisciplinary management of a patient with bilateral recurrent pressure sores.

Patient information

In November 2019, the patient was admitted to the hospital with three infected pressure sores (Stage 4) and a high-grade fever (figure 1). In addition, the patient had paraplegia and was wheelchair-bound for four years due to a complete spinal cord injury at the T11 level.

Figure 1: First surgical closure of wounds after the resolution of infection.



Physical Examination:

The patient was entirely dependent on self-care activities and had no control over bowel and bladder. In addition, bed mobility was limited since the development of pressure sores. The range of motion measurement was evaluated by a measuring instrument known as a goniometer, and for the upper limb active range of motion was normal.

However, passive hip flexion with knee flexion (right and left) was limited to 60°, right hip abduction was 30°, and left hip abduction was 25°, right knee extension lag 30°, left knee extension lag 30° and calf muscle tightness with right and left ankle joint held at 13° and 11° of plantar flexion respectively.

Diagnosis and assessment:

Hematological report: The hematological report indicated high levels of inflammatory factors (Table 1). The serum albumin level was 1.8 g/dl, indicating nutritional deficiency. There were two pressure sores on the left side on examination: one located at the sacral region (6x7cm) and the other over the trochanteric area (9 x 8 cm). The latter had a fistula communicating with the left hip joint. The third pressure sore was over the right trochanteric region about 6 x 8 cm in diameter. X-rays and the MRI showed evidence of septic arthritis, osteomyelitis, soft-tissue edema, and heterotopic ossification of the left hip joint. The wounds were infected by *Staphylococcus aureus*, *Escherichia coli*, and *Proteus mirabilis*.

Table 1: Hematological reports

Blood	Unit	Normal value	Admission	Discharge
Neutrophils	x10/L	1.8-8	10.08	3.10
Basophils	x10/L	0-0.2	0.6	0.13
Platelets	X10/L	150-450	909	418
Monocytes	X10/L	0-0.8	0.70	0.75
RBC	X10/L	4.4-5.5	3.45	5.02
Lymphocytes	X10/L	0.8-3.5	1.75	4.01
HB	g/dl	12.8-16	7.0	10.0
HCT	%	37.3-47.3	24.3	33.1
MCH	pg	26.5-32.6	20.3	20.0
MCHC	g/dl	30-37	28.7	30.3

HB, Hemoglobin; RBC, Red Blood cells; HCT, Hematocrit; MCH, Mean Corpuscular hemoglobin; MCHC, Mean Corpuscular hemoglobin concentration;

Sensory and motor examination: American Spinal Injury Association (ASIA) impairment scale (A) indicated no sensory or motor function is preserved and no sacral sparing. The patient scored 36 points on both sides for light touch and pin-prick sensory examination (C2-T10 dermatome). There was no sensation below the umbilicus. The patient scored 20 points on motor examination on both sides with manual muscle testing grade 4 for C5, C6, C7, C8, and T1 myotome. Deep Anal Pressure testing was performed with a sterile glove and a lubricated index finger. A gentle pressure applied to the internal anorectal wall was not perceived by the patient indicating loss of functional pudendal nerve.

Quality of life assessment: Pediatric Quality of Life 4.0 Generic Scales (validated Arabic version) was used to assess the quality of life at the time of admission and on discharge. There are 23 items categorized into four broad areas: physical functioning with 8-items, remaining

emotional, social, school functioning with five items each. Every item was scored on a 5-point Likert scale, zero (0) indicating never and five (5) almost always. The items were transformed to a 0-100 scale by reverse scoring (0-100, 1=75, 2=50, 3=25, 4=0). Higher scores on the questionnaire indicated a better quality of life. The scores for each dimension were calculated by adding all the scores for each item divided by the number of items answered. On admission, the patient scored 12.5 for physical functioning, 15 for emotional functioning, 10 for social functioning, and 10 for school function dimension.

Interventions:

1st Week: The patient underwent antibiotic therapy (Levofloxacin INJ 500mg (Dose 1.Vial), frequency one daily for four weeks, Piperacillin 4 gm + Tazobactam INJ (Dose 3.375 g) frequency every eight hourly for four weeks) along with topical treatment for the pressure sore from resolving the infection. The patient underwent a first operative procedure consisting of ulcer debridement. Physical therapy management included the Ultra Violet C therapy, exercises to the upper limb and lower limb, bed mobility, and positioning. The nursing management included the skin inspection and administration of antibiotic therapy. During rehabilitation, a physical therapist visited the patients twice a day for eight weeks. Each session lasted for 1.5 hours.

Exercises:

Upper limb activities were performed with dumbbells and thera-band for 10-15 minutes [7]. The exercises included all the upper limb muscles with an emphasis on shoulder depressors and elbow extensors. In addition, the patient was assisted to stand in the parallel bar with Hip-knee-foot orthosis. All the exercises were performed in 3 sets, with each set of 8-10 repetitions. The weight of the dumbbell was determined based on the comfort of the patient and tolerance of the patient to performed at least 12 repetitions with ease. Initially, the weight of the dumbbell was 2 pounds, and then gradually, the weight was increased to a maximum of 8 pounds till the 8th week. The upper limb activities were carried out in the supine position for five weeks. After the wound closure, the activities were carried out in a sitting position on the treatment couch and wheelchair.

Lower limb activity includes mild passive stretching to the hamstring, hip flexors, quadriceps, and ankle plantar flexors [8]. The stretch was held for 10-15 seconds for each muscle group. A different position was chosen for each muscle group, and the therapist chose the intensity of the stretch. The stretching exercises progressed to mat activities which involved self-stretching, supine lying bridging, and rolling activities. However, the patient had good trunk control; the therapist used various activities to further improve the trunk control, such as throwing and catching a ball while sitting. All the physical activities were completed within 30 minutes.

Ultraviolet-C irradiation:

We used the recommended UVC dosage to cause the antibacterial effect of an infected wound [9]. We used dosage parameters recommended for stage 4 pressure sore as E42.7J/cm² for the duration of 180 seconds for three weeks on alternative days before the wound closure (1st to 3rd week after admission). On the left side, two wounds received irradiation together, while the right side received irradiation separately. The patient received seven sessions in total.

Dietary intervention:

The patient was underweight (14 BMI) with a serum albumin level of around 1.8 g/dl at the time of admission in 2019. Therefore our goal was to improve the albumin level from 1.8 to 4 g/dl. To achieve the target goal patient was given 1.8 to 3.0 g/kg/day protein, with oral or intravenous supplementation as needed. A balanced diet was provided in consultation with the dietician to provide vitamins and minerals. Additionally, supplements such as Vitamin C (500 mg twice daily), zinc (11 mg/day), and arginine (2 to 3 grams three times a day) were given. Upon discharge, the eight-week nutritional plan increased serum albumin level from 1.8 g/dl to 2.9 g/dl. Research suggests that a serum albumin goal of greater than 2.0 g/dl is required to promote adequate healing [10].

2nd Week: The proximal femur resection with debridement of surrounding tissues and acetabular curettage (Girdlestone's procedure) for the left side (figure 2). The huge cavity (dead space) was filled with the gluteus maximus muscle flap followed by a Vacuum-assisted closure therapy (VAC) (figure 3) which promotes healing through the application of negative pressure (120 mmHg) [11]. The wound was impregnated with antibiotic beads into the dead space. The nursing and physical therapy treatments were the same as in the first week except for an introduction of extracorporeal shock therapy (ESWT) and tension therapy.

Figure 2: Left femoral head and neck was removed as in (Girdlestone's procedure)

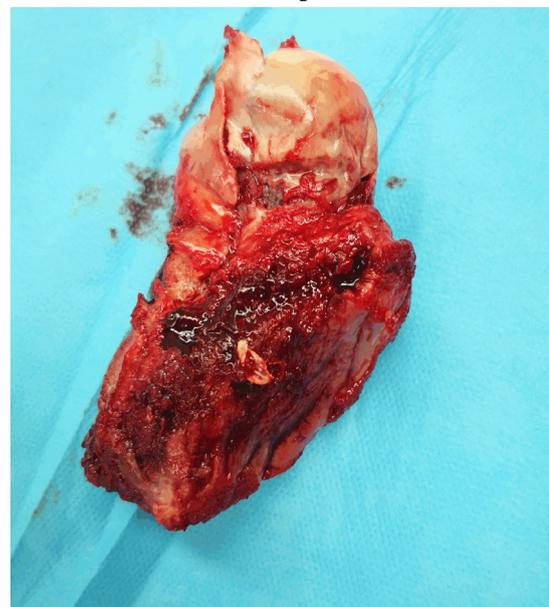


Figure 3: After the first debridement and (Girdlestone's procedure) of the left hip and application VAC system



Figure 4: In the second operation insertion, the antibiotic-impregnated beads in the left hip.



Figure 5: In the third operation, insertion of the antibiotic-impregnated beads in the right hip dead space.



Extracorporeal Shock Wave Therapy:

We followed similar treatment parameters used in a study to treat foot ulcers in paraplegic patients [12]. Shock wave therapy was administered one day after debridement of the wounds. The DermaGold device (Atlanta, GA; USA) was calibrated to deliver 0.1mj/mm² of energy level and a frequency of 5 pulses/ second. Sterile ultrasound gel and unfocused lens shock wave head increase the delivery and cover the complete wound area. The patient received a total of two sessions in two weeks (2nd and 3rd week after admission) before the wound closure. Three pressure sores were treated separately on the same day.

Tension therapy:

We followed the Goldstein procedure to administer tension therapy [13]. The patient was in a supine position with both hips exposed to the waist. The therapist would passively perform flexion at the hip and knee joint with one hand support the foot, and the other hand placed over the knee joint. The passive movement was performed slowly till the skin over the sacral and trochanteric region become blanched. The limbs returned to a neutral position after holding the position for 5 seconds. This maneuver repeated 10-15 times for each limb. The treatment lasted for 10 minutes and started from the 2nd week till the 8th week.

3rd Week: The second surgical procedure included wound debridement on the right (figure 5) and left side (figure 4, 8) and insertion of antibiotic-impregnated beads. The pus was drained by surgical debridement of the wounds. A fistula communicating between the left sacroiliac ulcer and the cavity under the muscle was found and excised. The physical therapy intervention commenced with the daily wound dressing change (morning and evening). The physical therapy procedures were similar to the intervention done in the 2nd week.

4th Week: The healthy granulation tissue appeared on the wounds without the sign of local or systemic infection. The third surgical procedure was carried out to approximate the edges of the wound. Similar physical therapy intervention was carried out as in the third week except for extracorporeal shock therapy.

5th to 8th week: The nursing, dietary intervention, patient and parent education, and introduction of wheelchair activities. The patient performed wheelchair activities after surgical closure of the wound (5th week after admission). The patient performed cross-body, forward, and lateral reach in the upright-plane activity. Additionally, trunk balance activities involved 10 minutes of catching and throwing a Swiss ball. The therapist would stand 3-4 meters away while sitting on the wheelchair or couch. The 25 cm Swiss ball was thrown at the patient in different directions to catch. The patient would throw the ball back at the therapist. Self-examination of the skin was carried out by the patient with the help of a held hand mirror and was supervised by a therapist. These activities were carried out

to improve the trunk balance, increase skin tolerance over sacrum and trochanter, and train self-examination of the skin.

Prophylactic dressings and microclimate control:

A polyurethane foam dressing was applied over bony prominences such as over the right trochanteric area, heels, and sacrum to reduce the chances of developing new pressure sore. We found that the patient's skin remained moist at high-risk areas due to clothing and the wrong seating of a wheelchair. The dress material and seating on the wheelchair were replaced with a high perforated material to improve airflow, which results in the dissipation of body heat and moisture. Changes in the seating and modification of bedding were carried out in the first week of admission.

Patient Education

The patient was educated about the importance of pressure-relieving techniques. The therapist demonstrated the correct transfer technique from bed to a wheelchair, from wheelchair to floor and back. Pressure dispersion cushions and extra- padding to high-risk areas were placed on a wheelchair and various other seating surfaces. An alternating airflow mattress was used during sleep. The patient was educated on the correct posturing of legs during sleeping to avoid muscle contractures. Initially, the patient was recommended to sleep in a prone position which then progressed to a side-lying position and supine position. Soft pillows were placed to avoid cross-over position of legs and tension over vulnerable areas. He was changing the body position every two hourly was implemented to relieve pressure over the vulnerable area. The patient and his family members were educated about the warning signs of pressure sores such as a change in skin color, skin breakdown, skin blister, discharge, or an unusual smell from the ulcer site and any body part of the patient.

At discharge: After two months of intervention, the wound was healed, and the reconstruction was excellent (Figure 6). The X-ray showed no signs of infection. (Figure 6). The patient was able to sit in a wheelchair. There was complete healing of pressure sores with no sign of infection or tropic changes. BMI improved from 14.1 to 16.3. The Patient showed Improvement in muscle strength of the upper limb for grade 4 to grade 5. There was a significant increase in the passive range of motion in the lower limb. Passive hip flexion with knee flexion increase from 60 to 120 degrees for right and 100 for left hip joint; hip abduction was 30 degrees to 45 degrees on the right and 25 degrees to 34 degrees on the left side, knee extension lag reduced from 30 to 10 degrees for both sides and calf muscle tightness with ankle joint from 13 degrees of plantar flexion to neutral ankle position for both sides. Quality of life improved scored from 12.5 to 50 for physical functioning, 15 to 25 emotional functioning, 10 to 50 for social functioning, and 10 to 50 for school function dimension.

Figure 6. The wounds after four weeks from healthy granulation tissue.



Figure 7: X-ray showing no signs of infection (Girdlestone's procedure)



Figure 8: During the second operation, the insertion of the antibiotic-impregnated beads in the left hip.



Follow-up and outcome:

Follow-up was scheduled after three months from discharge. Again, the patient showed no reoccurrence of pressure sores.

DISCUSSION

The patient with recurrent pressure sores over the sacral and trochanteric area was entirely healed after two months of surgical, medical, nutritional, and comprehensive physical therapy intervention. There was an improvement in nutritional status, closure of the wound, and improvement in the quality of life within a short period of 8 weeks.

Multiple pressure sores at proximity are challenging to treat, especially when it's complicated by a secondary infection such as osteomyelitis [14]. In this case, a multi-stage debridement was performed, leaving an ample residual dead space. In addition, muscular grafting was essential to fill the dead space to avoid the development of hematoma or seroma to improve healing and decrease the chance of recurrence. In this case, three surgical procedures were performed. In the first stage, extensive debridement of the three wounds, antibiotic therapy, physical therapy modalities, nursing intervention, patient education, nutritional therapy, and contact surface modification. In the second stage, surgical resection of infected bone (left proximal femur) and flap muscular grafting fill the dead space along with vacuum therapy to improve circulation and healing. The third and final operation procedure was performed to approximately the wound edges.

The use of foam dressing is reported to reduce the risk of pressure sores in ICU patients [15]. Foam dressing consists of polyurethane that is porous and contains high absorbent material to absorb wound exudates. In our case, we used polyurethane foam dressing over the prone areas to avoid the development of new pressure sores during the hospital stay. The electrotherapeutic modalities used in this case were ESWT and UVC radiation therapy. Both modalities are reported to be tissue healing. The ESWT is reported to have a healing effect in pressure ulcers [16], and UVC radiation is reported to have an antibacterial effect [17]. Active exercises with the help of dumbbells and thera-band immediately following surgery in patients with various conditions have been reported effective [18]. In this case, a patient performed upper limb active exercises and lower limb passive exercises to avoid contractures and improve blood circulation. Tension therapy is a form of manual therapy where the skin is intermittent stretching and release is reported to improve healing and reduce the size of scar tissue after healing.

The education of the patient and the parents of the patient is of paramount importance in reducing the chance of reoccurrence. In addition, an active lifestyle, social engagement, and a positive attitude are essential to cope with the stress of disability following spinal cord injury. In this case, the patient underwent a series of counseling sessions in 8 weeks.

CONCLUSIONS

The pressure sores are preventable secondary complications post spinal cord injury. Inadequate pressure sore management is the main reason for reoccurrence. Multidisciplinary teamwork ensures success and

prevention. The team must include a surgeon, physician, nutritionist, nurse, counselor, and physical therapist play and crucial role to promote quick healing and reduce the risk of reoccurrence. The current case has shown excellent improvement in physical, level of activity, quality of life. However, the level of neurologic deficit remained unchanged.

Author Contributions:

Author/s testifies that all persons designated as authors qualify for authorship and have checked the article for plagiarism. If plagiarism is detected, all authors will be held equally responsible and will bear the resulting sanctions imposed by the journal after that

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