

## The Hemicorporectomy in 2020: A Case Report and Recent Advances

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### Abstract

Chronic decubitus ulcers are a common problem in spinal cord injury (SCI) patients. Late-stage ulcers often lead to chronic osteomyelitis, which carries high rates of morbidity and mortality, as well as significant healthcare costs. Refractory decubitus ulcers are most commonly seen in the pelvis and pose a clinical challenge to provider teams caring for SCI patients. With long-term disease, surgical and antibiotic therapies may fail, which places patients at risk for entering a terminal disease state. A radical treatment for this condition was described in the early 20th century and involves amputation of the lower half of the body. This procedure, the hemicorporectomy, continues to be performed today in a very small, select group of patients. Here, a case report is described of a 39-year-old female T12 paraplegic with refractory decubitus ulcers and terminal pelvic osteomyelitis that underwent hemicorporectomy as definitive treatment. The procedure was successful and the patient was safely discharged to a long-term rehabilitation facility.

### Introduction

Hemicorporectomy involves amputation of the pelvis and lower extremities, typically done by disarticulation through the lumbar spine. Concomitantly, the spinal cord, aorta, and inferior vena cava are also transected [1]. This transaction is performed at a level that enables the patient to “sit” in a custom fit bucket prosthesis, usually L3-L4, L4-L5, or L5-S1 [2]. This procedure was first proposed by Kredel in 1950 for treatment of locally invasive cancer, but first completed by Kennedy et al. in 1960, although the patient did not survive [3, 4]. The first hemicorporectomy documented with long-term survival was from Aust and Absolon in 1962, and again by Aust and Page in 1985 [5, 6]. According to a review from Janis et al in 2009, 57 reported cases of this procedure have been documented. Forty of these procedures were performed for malignant disease, 14 for benign disease, and 3 for trauma [1]. Hemicorporectomy is the last resort in the treatment of locally invasive malignant disease and has been more commonly used in recent years for terminal pelvic osteomyelitis [1].

### Case Report

A 39-year-old female with a past medical history of type II diabetes, hypertension, vitamin D deficiency, and chronic pain presented to our institution 10 year’s prior after a motor vehicle collision which resulted in T12 ASIA A paraplegia. She underwent a T7-pelvis posterior spinal fusion at the time of her initial trauma to stabilize a three-column spinal cord injury. Her spinal cord injury (SCI) history includes a neurogenic bladder with chronic indwelling catheter, neurogenic bowel status post colostomy, and multiple refractory pelvic decubitus ulcers (Figure 1). Her decubitus ulcers led to chronic osteomyelitis of the bilateral femurs and pelvis and required multiple debridements and soft tissue coverage procedures for treatment. Unfortunately, these treatments failed, and her osteomyelitis continued and ultimately led to bilateral hip resection arthroplasties. Over the last year (2019), she was treated for her chronic and acute medical conditions at an outside hospital when the discussion of hemicorporectomy as a possible definitive treatment was broached.



**Figure 1:** Clinical photo depicting large decubitus ulcer which had been refractory to local wound care and surgical therapies Figure 1: Clinical photo depicting large decubitus ulcer which had been refractory to local wound care and surgical therapies

In early 2020, she developed a new right pelvic fluid collection which led to presentation at our institution. At presentation, she was found to have an elevated white blood cell count to 18.3 ( $10^9/L$ ), ESR 37 (mm/hr), and CRP 325.4 (mg/L). She was found to have extensive pelvic osteomyelitis and multiple soft tissue abscesses within the pelvic girdle associated with her chronic ulcers. During this admission, she was medically stabilized, and definitive care discussions were held with the patient regarding debridement and reconstructive procedures versus hemipelvectomy. Extensive counseling was provided from our rehabilitation psychologic services to ensure she understood the long-term mental, physical, and emotional stresses associated with each procedure. Given the definitive potential for hemipelvectomy, she elected to proceed with this procedure.

Her surgical course consisted of a two-stage procedure. The first procedure included initial exploratory laparotomy with pelvic exenteration, ileal conduit, omental flap, peritoneal flap, and colpocelesis. This was performed by our General and Urological surgery colleagues. Post-operatively she was admitted to the ICU for advanced care. Once stable, she returned to the operating room with Orthopaedic, Plastic, and General surgery for left, followed by right, sided hemipelvectomy with bilateral thigh myocutaneous flap closure. At the time of surgery, we elected to perform the posterior pelvic osteotomies through the sciatic notch, not the traditional lumbar spine disarticulation, to allow for her spinopelvic hardware to be maintained and provide a more robust sitting surface (Figures 2 and 3). Her hospital course was complicated by providencia stuartii bacteremia necessitating a 14-day course of Ertapenem. Post-operatively there was slight, superficial wound dehiscence which was treated with local wound care and healed well (Figures 4 and 5). The patient was hospitalized in our facility for 36 days prior to being stable for discharge to an LTAC facility. She was last seen at 6-month follow-up where she was tolerating

sitting protocols well and had expectedly healing flaps.



**Figure 2:** Radiographs prior to hemipelvectomy demonstrating post-surgical changes status-post hip resection arthroplasty and previous spinopelvic fixation



**Figure 3:** Radiographs depicting pelvic morphology following hemipelvectomy. Osteotomies through the sciatic notches can be visualized.



**Figure 4:** Clinical photo depicting flap closure at 5 day's post-operative.



**Figure 5:** Clinical photo depicting continued healing of flap closure at 3.5 weeks post-operative.

### Discussion

Chronic pelvic osteomyelitis is a highly morbid condition and places patients at high-risk for spontaneous septicemia. Sacral decubitus ulcers, which are most commonly seen in paraplegic patients, facilitate this condition as they allow passage of pathogenic microorganisms to deeper tissues. Early stages of decubitus ulcers can often be treated with local wound care, simple debridement, and frequent position changes. However, in more late-stage disease, extensive debridement, diverting ostomies, and reconstructive flap procedures may be needed to treat these complex tissue defects. The importance of nutritional, psychosocial, and rehabilitation factors can also not be overstated, as deficiencies in these alone can lead to treatment failure. As ulcers progress, the underlying bony pelvis becomes prone to infection due to the loss of the outer skin and soft tissue barrier. In an effort to mitigate the bacterial burden, chronic pelvic osteomyelitis patients are often treated with prolonged intravenous and/or oral antibiotic therapies. While these treatments are quite effective, resistance, patient tolerance, and compliance can compromise the long-term sustainability. Once antibiotic therapy fails, and patients are no longer surgical candidates, their disease can enter a more terminal phase.

If left untreated, patients with terminal pelvic osteomyelitis will succumb to their disease. Janis et al. defined terminal pelvic osteomyelitis as biopsy proven pelvic osteomyelitis with associated chronic decubitus ulcers refractory to antibiotics and surgical treatments [1]. A terminal disease such as this can have severe morbidity and mortality in afflicted patients and can create profound psychological impacts [7]. A radical treatment for this condition involving translumbar amputation has been described [4] and is colloquially known as a hemicorporectomy. The opportunity to improve a patient's quality of life, and often prolong life

in relation to no treatment, affords a scenario in which a radical treatment such as hemicorporectomy may be indicated.

Determining which patients may benefit from a hemicorporectomy poses tremendous challenge. General surgery, Plastic surgery, Neurosurgery, Urology, Orthopaedics, Anesthesiology, Psychiatry, Physical Medicine and Rehabilitation, Nutrition, Wound Care Nursing, Ostomy Care Nursing, and Infectious Disease specialists are all needed to provide a comprehensive multi-disciplinary approach to these patients. Historically, hemicorporectomies were indicated for patients with locally invasive pelvic malignancy otherwise refractory to other treatments [4]. This is less commonly used as an indication for hemicorporectomy in modern years, primarily due to the advancements in nonsurgical cancer therapies (i.e. chemotherapy and radiation) [1]. In recent years, terminal pelvic osteomyelitis has become a common indication for hemicorporectomy. Criteria proposed by Janis et al. in 2009 (modified from Terz et al.) can be helpful when considering patients for hemicorporectomy [1, 7].

### This Criterion Includes:

1. Diffuse pelvic osteomyelitis confirmed by clinical history, imaging, and tissue diagnosis (i.e. biopsy)
2. Normal life expectancy after hemicorporectomy and achievement of a quality of life that would be expected for someone of equal disability without terminal pelvic osteomyelitis, and
3. The emotional and psychosocial capacity to accommodate the extensive physical, functional, and emotional disability resulting from the loss of the lower half of the body [1]. Once a patient amenable to this treatment is identified, extensive pre-operative optimization must take place along with a thorough, multi-disciplinary surgical and post-operative plan.

The surgical technique used at the authors' institution typically involves a "back-to-front" approach with lower lumbar or lumbosacral disarticulation as initially described by Barnett et al. [8]. This approach involves early division of the vertebral structures and spinal cord, which prevents Batson's plexus engorgement and minimizes blood loss and neurogenic hypotension. In addition, the back-to-front approach allows the patient to be positioned laterally, which greatly improves exposure of the pelvic vessels and creates a technically less challenging procedure [8]. In the case report described here, a similar approach was used, but with posterior pelvic osteotomies made through the sciatic notch and not the traditional lumbar or lumbosacral spine. This was performed with the hopes of allowing a more robust sitting surface to be maintained given her previous spinopelvic hardware. The large myocutaneous thigh flaps allowed for excellent soft tissue cushioning over her remaining sciatic bony prominences.

Early post-operative mortality following this procedure has improved significantly over the last half-century [1]. Prompt recognition of pulmonary edema and abnormal fluid status is critical to prevent catastrophic respiratory failure in the short-term recovery period. Historical literature from the 1960s first identified pulmonary edema as one of the primary culprits in early post-operative mortality [9]. Multiple complex factors are thought to influence post-operative fluid status. The physiologic specifics are highly intricate and involve multiple organ systems, which is out of the



scope of this case report. Briefly, it is thought that the substantial loss of muscle mass and interstitial space leads to reduced fluid capacity and ability to maintain acid/base homeostasis [10]. Additionally, the large reduction in circulating blood volume, along with baseline decreased systemic pressures seen in paraplegics, places these patients at high-risk for over resuscitation in the early post-operative period. Intra-operative ligation of the large iliac and femoral vessels distally also acutely increases cardiac afterload, which may add to the risk of pulmonary edema [11, 12]. Bake et al. described the effects of hemicorporectomy on pulmonary function testing and found that total lung capacity can be reduced by >35% following this procedure [13]. This may also play a significant role in peri-operative respiratory health. Even small changes in respiratory status can have immense consequences in these patients, as their ability to compensate and respond to environmental stressors is significantly reduced [14].

Once the acute peri-operative period has passed, and patients begin weight bearing on their residual torso, physical therapy and functional rehabilitation become essential [15]. Upper extremity strengthening, torso control, ability to offload sensitive skin, and donning/doffing of prostheses become the focus of early physical therapy [16]. Occupational therapy works to reestablish skills in activities of daily living based on the patient's pre-surgical levels [17]. The patient in this case report began working with physical and occupational therapy on post-operative day 5, and ultimately was discharged to a long-term acute care (LTAC) center where she will continue her rehabilitation. At her most recent follow-up (6-months post-operative), she was tolerating her sitting protocols well and was progressing appropriately from a functional perspective [18, 19].

## Conclusion

Spinal cord injury patients often suffer from chronic decubitus ulcers which can lead to pelvic osteomyelitis. When this pelvic osteomyelitis becomes chronic and refractory in nature, it is deemed terminal. A radical, historical procedure known as the hemicorporectomy has been described as a potential definitive treatment in very select patients with this condition. It involves amputation of the lower half of the body. Determining which patients may be candidates for hemicorporectomy is a challenge, and a multi-disciplinary approach is needed to ensure physical, metabolic, and psychosocial factors are optimized. Here, a case report is described of a 39-year-old female T12 paraplegic who underwent hemicorporectomy for terminal pelvic osteomyelitis related to refractory sacral decubitus ulcers. The patient in this case report had a successful 6-month post-operative course and was rehabilitating appropriately with long-term assisted care at last follow-up. While preliminarily successful in this patient, the hemicorporectomy procedure is one of the most radical procedures in all of surgery and should only be considered in extreme cases. Further research is needed to better refine and optimize the clinical decision making in complex spinal cord injury patients with terminal pelvic osteomyelitis.

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