

Hip Disarticulation for Severe Lower Extremity Infections

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Abstract Hip disarticulation is rarely performed for infections and variable mortality rates have been reported. We determined the number of deaths following hip disarticulation for severe lower extremity infections in 15 patients. Indications for hip disarticulation were necrotizing soft tissue infections in seven patients and persistent infections of the proximal thigh in eight patients. The most common microorganism was *Staphylococcus aureus*, present in eight patients. Hip disarticulation was performed emergently in seven patients and electively in eight patients. All patients survived the operation and at 1 month postoperatively 14 of 15 patients were alive. Hip disarticulation for these severe infections had high survival, even when performed emergently for life-threatening infections. We believe hip disarticulation is a reasonable option treating severe infections of the lower extremity and should be part of the armamentarium of the orthopaedic surgeon.

Level of Evidence: Level IV, therapeutic case series. See Guidelines for Authors for a complete description of levels of evidence.

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Each author certifies that his or her institution has approved the human protocol for this investigation and that all investigations were conducted in conformity with ethical principles of research.

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Introduction

Hip disarticulation accounts for only 0.5% of lower extremity amputations in the United States and is mostly performed for malignant musculoskeletal tumors, limb ischemia, and severe trauma [4]. Hip disarticulation for severe infections of the lower extremity is rarely performed but has been described for gangrene [6, 14], necrotizing fasciitis [9, 10], infection following hip arthroplasty [7], extensive osteomyelitis of the proximal femur [15], infected vascular grafts [3], and severe decubitus ulcers in paraplegics [8]. Most of the patients who have undergone hip disarticulation for infection are presented in the literature as case reports or as small parts of larger series. One clinical study has specifically focused on hip disarticulation for infectious complications [7] and two described a large subgroup of patients who underwent the procedure for such indications.

Mortality after hip disarticulation remains controversial. Fenelon et al. did not report any perioperative deaths in 11 patients who underwent hip disarticulation for severe infections following hip arthroplasty [7]. In contrast, Unruh et al. reported an overall 44% mortality rate following the procedure in 34 patients (38 disarticulations) [15]; infection was present in 23 patients (25 disarticulations) and 12 of these 23 patients died. Endean et al., describing the outcomes of disarticulation in 53 patients (26 of 53 patients had infections), reported a 33% mortality rate when it was performed emergently (10 of 30 patients died) compared to 4% when it was performed electively (one of 23 patients died) [6].

Hip disarticulation is infrequently performed and hip disarticulation for necrotizing infections was reported in 7 patients in the series by Endean et al. [6] and in 2 patients in the series by Takahira et al. [14]. Therefore, few

orthopaedic surgeons have expertise or familiarity with the procedure. Furthermore, the complexity of the procedure and the high mortality rates reported by some authors [6, 15] may create reluctance on the part of the treating surgeon to perform the procedure, especially as an emergent procedure on a patient with hemodynamic instability and medical problems, as in the case of necrotizing infections. Subjectively based on our experience, we presumed the mortality after hip disarticulation for infections of the lower extremity was not as high as reported in other series [6, 15], even when the procedure was performed emergently for life-threatening infections on unstable patients.

Therefore, we first determined the intraoperative and 1-month postoperative mortality of hip disarticulation for treating severe infections of the lower extremity and then determined the mortality when the procedure was performed emergently for necrotizing infections.

Materials and Methods

We retrospectively reviewed the medical records of all 15 adult patients who underwent 15 hip disarticulations to treat severe lower extremity infections from 1994 to 2007. Infections were characterized as severe based on the following: (1) presence of septic shock and hemodynamic instability of the patient (Group 1), or (2) persistent nature and extent of the infection in the proximal thigh that precluded control by local débridement and/or more distal level of amputation (Group 2). No patient had bilateral procedures performed. There were 10 male and five female patients with a mean age of 48 years (range, 18–82 years). Fourteen of 15 patients were compromised hosts and had one or more comorbidities (Table 1). Intravenous drug abuse was the most common comorbidity, present in seven patients. Diabetes mellitus was present in six patients, smoking in four patients, malignant neoplasms in two patients, and hepatitis B, hepatitis C, and HIV infection in one patient each. We had prior IRB approval to review the medical records.

The indications for hip disarticulation were necrotizing soft tissue infections associated with septic shock in seven patients (necrotizing fasciitis in four patients and gas gangrene in three patients) and persistent extensive infections involving the proximal thigh in eight patients: two patients had an infected femur endoprosthesis, two patients had wound infection, stump breakdown, and persistent ulcers following an above-knee amputation, two patients had subsequent wound infection after initial débridement for necrotizing fasciitis, one patient had an infected synthetic iliofemoral bypass graft, and one patient sustained gunshot injuries to the involved lower extremity resulting

in femoral vessel injury, sciatic nerve injury, muscle necrosis, proximal femur osteomyelitis, and proximal thigh abscess.

Hip disarticulation was performed emergently as a life-saving procedure in seven patients who presented in septic shock due to necrotizing infections (Group 1). Patients in Group 1 had a mean preoperative, before incision, systolic blood pressure of 90 mm Hg (range, 65–109 mm Hg) and a diastolic blood pressure of 48 mm Hg (range, 35–66 mm Hg). The mean pulse was 132/min (range, 90–163/min). The mean white blood cell count was $21.9 \times 10^3/\text{mm}^3$ (range, $18.1\text{--}25.6 \times 10^3/\text{mm}^3$). Hip disarticulation was performed electively, following previous débridement procedures or more distal amputations in eight patients (Group 2). The procedure was performed according to the described techniques in the literature [2, 13]. After isolation and ligation of the femoral neurovascular bundle, the muscles crossing the hip joint are progressively incised and finally the ligamentum teres is incised, thereby separating the femoral head from the acetabulum and completing the amputation, which ablates the lower extremity in its entirety.

The infections were monomicrobial in five patients and polymicrobial in 10 patients. In five of the 10 polymicrobial infections there was a combination of Gram-positive, Gram-negative, and anaerobic organisms. The most common organism overall was *Staphylococcus aureus*, which was present in eight patients; five of these eight pathogens were oxacillin-resistant (Table 2).

Results

All patients survived the operation and there were no intraoperative or immediate postoperative deaths, even in Group 1 patients, who presented with hemodynamic instability due to septic shock. Fourteen of the 15 patients survived at least one month. One patient with gas gangrene died 29 days following hip disarticulation from multiple organ failure. The hospital stay of the remaining patients averaged 41 days (range, 24–107 days) in Group 1 and 24 days (range, 6–49 in Group 2).

When performed emergently six of seven patients survived while eight of eight survived when the procedure was performed electively.

Discussion

Hip disarticulation is a complex procedure, is performed infrequently for infection and has been associated with high mortality rates in some series [6, 15]. This generates concerns for high surgical risk, especially when the

Table 1. Patient demographics, comorbidities, indications for surgery, and outcome

Patient #	Gender	Age	Comorbidities	Indication for surgery	Patient status	Timing of procedure	Outcome
1	F	33	IVDA, hepatitis B, hepatitis C, smoking	NF	Unstable	Emergent	Survived
2	F	37	IVDA	GG	Unstable	Emergent	Survived
3	M	34	IVDA, DM with diabetic ketoacidosis	NF	Unstable	Emergent	Survived
4	M	51	DM, smoking	GG	Unstable	Emergent	Died
5	M	35	IVDA, smoking	NF	Unstable	Emergent	Survived
6	M	55	IVDA	NF	Unstable	Emergent	Survived
7	M	50	IVDA	GG	Unstable	Emergent	Survived
8	M	41	HIV infection, IVDA, smoking	Subsequent wound infection after initial debridement for NF	Stable	Elective	Survived
9	M	53	DM	Subsequent wound infection after initial debridement for NF	Stable	Elective	Survived
10	M	18	none	Proximal femur osteomyelitis, thigh abscess with muscle necrosis, sciatic nerve injury	Stable	Elective	Survived
11	F	55	DM	Infected synthetic iliofemoral bypass graft	Stable	Elective	Survived
12	F	82	Lymphoma	Wound infection and stump breakdown after AKA	Stable	Elective	Survived
13	F	54	DM	Wound infection and stump breakdown after AKA	Stable	Elective	Survived
14	M	80	DM	Infected femur endoprosthesis	Stable	Elective	Survived
15	M	42	Chondrosarcoma	Infected femur endoprosthesis	Stable	Elective	Survived

AKA: above-knee amputation, DBP: diastolic blood pressure, DM: diabetes mellitus, GG: gas gangrene, HIV: human immunodeficiency virus, IVDA: intravenous drug abuse, NF: necrotizing fasciitis, P: pulse, SBP: systolic blood pressure.

Table 2. Microbiology of infections treated by disarticulation of the hip

Pathogens	Number
Gram positive cocci (n = 16)	
Staphylococcus aureus—oxacillin resistant	5
Staphylococcus aureus—oxacillin sensitive	3
Streptococcus alpha-hemolytic	4
Enterococcus faecalis	3
Staphylococcus epidermidis	1
Gram-negative rods (n = 9)	
Pseudomonas aeruginosa	4
Acinetobacter baumannii	1
Proteus mirabilis	1
Other Gram-negative rods	3
Anaerobes (n = 13)	
Microaerophilic streptococcus	5
Prevotella intermedia	3
Peptostreptococcus	1
Fusobacterium	1
Propionibacterium acnes	1
Bacteroides	1
Clostridium perfringens	1

procedure needs to be performed emergently on a patient with a necrotizing infection and hemodynamic instability. We hypothesized mortality after hip disarticulation for infection is not as high as previously reported [6, 15], even for emergent procedures for life-threatening infections on unstable patients. We determined the intraoperative and 1-month postoperative mortality following hip disarticulation for severe lower extremity infections, and also assessed mortality when the procedure was performed emergently for necrotizing infections.

The primary limitation of our study is the small number of patients. Moreover, patients comprised two heterogeneous groups. Approximately half of our patients (Group 1, 7 of 15) were unstable and underwent the procedure emergently, whereas the remaining patients were stable and had disarticulation performed electively. With these small numbers we can not establish and compare mortality rates in the two groups, but we contribute to the limited number of cases in the literature. Another limitation is the lack of data regarding the functional outcome of the amputees. However, the aim of the study was to provide data regarding the mortality associated with the procedure.

Mortality rates following hip disarticulation have varied considerably in the literature (Table 3). Pack reported no operative deaths in 96 patients who underwent the procedure for malignant tumors [12], and similarly Fenelon et al. had no deaths in 11 patients who had hip disarticulation for

Table 3. Mortality of hip disarticulation as reported in the literature

Authors	No of patients with HD	Age [mean (range)] in years	No of patients with HD for infection	No of patients with HD for NI	Mortality	Timing of mortality	Mortality in urgent/emergent procedures	Mortality in elective procedures	Mortality when infection present	Mortality when infection absent	Mortality in HD for NI
Endean et al. [6]	53	56 (13–87)	26	7	11/53 (21%)	Data not presented	10/30 (33%)	1/23 (4%)	6/26 (23%)	5/27 (19%)	1/7
Fenelon et al. [7]	11	62 (33–75)	11	0	0/11	N/A	N/A	0/11	0/11	N/A	N/A
Pack [12]	94	N/A (3–72)	0	0	0% (0/94) (intraoperative mortality)	N/A	N/A	0% (0/94)	N/A	0% (0/94)	N/A
Takahira et al. [14]	2	44 (27–60)	2	2	1/2	Data not presented	1/2	N/A	1/2	N/A	1/2
Unruh et al. [15]	34	50 (20–95)	23	0	15/34 (44%)	Data not presented	Data not presented	Data not presented	12/23 (52%)	3/11	N/A
Zalavras et al.	15	48 (18–82)	15	7	1/15	1 death on 29 th PO day	1/7	0/8	1/15	N/A	1/7

N/A: not applicable, HD: hip disarticulation, PO: postoperative, NI: necrotizing infections.

severe infections following hip arthroplasty [7]. However, Unruh et al. reported an overall 44% mortality rate in their series of 34 patients, which was higher in the presence of infection; 12 of 23 patients with preoperative infection died compared to three of 11 patients without infection [15]; specifically, two of nine patients with femoral osteomyelitis died, six of 10 died with limb ischemia and infection, and four of four died with lower extremity trauma and infection [15]. In the series of Endean et al., the mortality was 33% (10 of 30 patients) when hip disarticulation was performed emergently, compared to 4% (one of 23 patients) when it was performed electively [6]. These large variations in mortality among studies and within subgroups of the same study may be attributed to variability in indications for the procedure and condition of the patient. Emergently performed procedures may be associated with systemic instability of the patient. The diagnosis of limb ischemia may result from acute vascular trauma and be associated with hemodynamic instability, or it may result from peripheral vascular disease, in which case heart disease may coexist. Endean et al. reported the presence of heart disease was notably associated with postoperative mortality [6].

The low mortality in our series becomes especially important, given the severity of the infections and the emergent nature of the procedure in Group 1 patients. Gas gangrene and necrotizing fasciitis are life-threatening infections and inadequate or delayed surgical débridement increases mortality [1, 5, 16]. In these grave infections, hip disarticulation may be a life-saving procedure.

We presume the expertise and multidisciplinary care available at our institution may have been a contributing factor to the low mortality in our series. Our institution is a busy academic level I trauma center with a dedicated musculoskeletal infection ward and a surgical intensive care unit routinely taking care of critically ill patients. Patients with necrotizing soft tissue infections were evaluated and operated by senior surgeons, which may have led to prompt diagnosis and optimal surgical management. In addition, these patients were managed postoperatively in an intensive care unit, with involvement of an intensive care specialist, an infectious disease specialist, and a clinical dietician, which may have optimized their postoperative recovery. Therefore, our results may not be generalizable to institutions with less experience caring for these often ill patients. On the other hand, our patients overall may have been less ill compared to patients in other series in the literature, leading to lower mortality. It should be noted our series was heterogeneous and approximately half of our patients (8/15) were in stable condition (Group 2) and underwent the procedure electively. Moreover, none of our patients had

a history of heart disease, compared to 19 of 53 patients (36%) in the study by Endean et al. [6].

Hip disarticulation is a major ablative procedure resulting in cosmetic problems, discomfort when wearing the prosthesis, and difficulty with walking. Energy consumption during walking increases by 82% in patients with hip disarticulation compared to normal individuals [11]. As a result, a patient may lose his/her ability to walk and may become wheelchair dependent. Unruh et al. reported only four of 19 survivors in their series ambulated with a walker, whereas 12 used a wheelchair and three were confined to bed [15]. However, the procedure is performed as a life-saving measure for elimination of an extensive infectious process for which no other satisfactory treatment exists [7].

We believe hip disarticulation is a reasonable option for treating severe infections of the lower extremity and should be part of the armamentarium of the orthopaedic surgeon treating these infections.

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