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Hip Hemiarthroplasty for Fractures of the Neck of the Femur in Patients with Myasthenia Gravis: A Retrospective Study

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SUMMARY

Background. Myasthenia gravis (MG) is a relatively rare autoimmune disease characterized by muscle weakness, increased risk of falls, and immune suppression secondary to chronic steroid therapy. All these factors may raise concerns after hip arthroplasty.
Purpose. With the absence of dedicated studies, the purpose of this study is to report the clinical outcomes of hip hemiarthroplasty in a series of patients with MG**.**
Patients and methods. Nine patients, with a mean age of 79.2 years, who had been diagnosed with MG and received hip hemiarthroplasty for femoral neck fractures were included in this study. Patients' radiographs and surgical and clinical data have been reviewed for all patients to extract the data relevant to this study.
Results. After a mean follow up of 61.8 months, eight patients were able to fully bear weight with or without assistive devices and one patient had limited mobility. Four patients (44.4%) suffered significant recurrent falls associated with other skeletal fractures, two patients (22.22%) had periprosthetic infections and one patient (11.1%) had heterotopic ossification.
Conclusions. MG patients should be warned about the high incidence of recurrent falls postoperatively, and the high risk of periprosthetic infections with chronic steroid use.

KEY WORDS

Myasthenia gravis; femoral neck; fracture; hip hemiarthroplasty; Neuromuscular diseases.

INTRODUCTION

Myasthenia Gravis (MG) is an autoimmune disease characterized by the presence of antibodies against acetylcholine receptors at the neuromuscular (NM) junction leading to a deficiency of NM transmission (1). With an estimated pooled prevalence rate of 77.7 per million population, it is a relatively rare condition that leads to muscle weakness and fatigability (1, 2). Patients with MG have a normal life expectancy with the currently available treatment options, which include cholinesterase inhibitors, corticosteroids, plasmapheresis, immunoglobulin injections, and thymectomy (2, 3).

It has been proven that patients with MG have an increased risk of falls (4, 5) due to the associated muscle fatigue and weakness of the eyelids, arms, and legs (4-7). There is also an increased risk of osteoporosis in patients with MG secondary to chronic corticosteroid therapy (8, 9). Although not specifically associated with overall increased fracture risk (8, 10, 11) the increased risk of falls, osteoporosis, and steroid-induced immunosuppression may be particularly concerning in arthroplasty patients.

Hip hemiarthroplasty (HA) is the preferred treatment option for femoral neck fractures in the elderly (12-14). Given the paucity of studies that review the impact of MG on hip HA, this study aims to review the outcomes of hip hemiarthroplasty for femoral neck fractures in patients with Myasthenia Gravis by reviewing the incidence of recurrent falls, implant stability, refracture risk, revision surgery, and incidence of periprosthetic joint infections in association with steroid therapy.

PATIENTS AND METHODS

After Institutional Review Board approval (GIRB: 2024-0166 – date of approval: February 27, 2024), all cases of hip HA that were performed in a single health system from 1988 to July 2024 were independently reviewed. Any patient who had a diagnosis of MG either before or after their hip HA was included in this study. A chart review of clinical notes, operative details, serial radiographs, and complications was completed for each patient.

A total of nine cases of hip HA in nine patients diagnosed with MG were included in this study. Five patients were female and four were male. The mean age was 79.2 years (range 71-92) at the time of surgery. The total number of relevant medical comorbidities of all the patients are shown in **table I**. The mean BMI for all patients was 25.65 (range, 20.6-31.9).

Five patients had a diagnosis of MG at a mean of 59.3 months before the index HA surgery, and four patients were diagnosed with MG at a mean of 18.4 months after the index HA surgery. Eight patients received pyridostigmine for MG. Five patients additionally received oral (4 patients) or parenteral steroids and one patient additionally received immunoglobulin G.

RESULTS

Nine hip HA cases in nine patients were included in this study. All patients had a femoral neck fracture secondary to a fall from standing height. On presentation, patients had variable degrees of muscle wasting (**figure 1**) affecting the lower extremity musculature. Seven patients received a bipolar hemiarthroplasty, with four being cemented and three being cementless. Two patients received a cemented unipolar hemiarthroplasty. Surgeries were performed by nine different surgeons, utilizing the posterior approach in eight cases, and the anterolateral approach in one case. Surgery was performed on the same day of injury in two cases, on the first day after injury in six cases, and on the third day after injury in one case. The mean total length of stay for all patients was 7 days (range, 3-16).

Functional outcomes

The mean follow-up for all patients was 61.8 months (range, 2.4-131.9). Three patients expired at a mean of 5.4 months postoperatively from the index HA surgery (range, 2.4-10.2), while six patients are alive for a mean of 90 months postoperatively (range, 38-110.5). At the last follow-up, eight patients were able to fully bear weight with or without assistive devices and one patient had limited mobility from bed to wheelchair. The mean calculated Parker Mobility Index (PMI) for all patients was 5.8 (range, 2-9).

Recurrent, subsequent falls

Four patients (44.4%) suffered recurrent falls that resulted in other musculoskeletal fractures (**figure 2**) that necessitated hospital admission, occurring at a mean of 30 months after the index surgery (range, 0.76-66.5 months). The associated injuries and outcomes are presented in **table II**.

Periprosthetic joint infections

Two patients (22.2%) suffered deep periprosthetic joint

Table I. Medical comorbidities for all patients

Condition	Number of cases
DM	4
Dementia	3
Hypothyroidism	3
Heart failure	2
Chronic Kidney disease	2

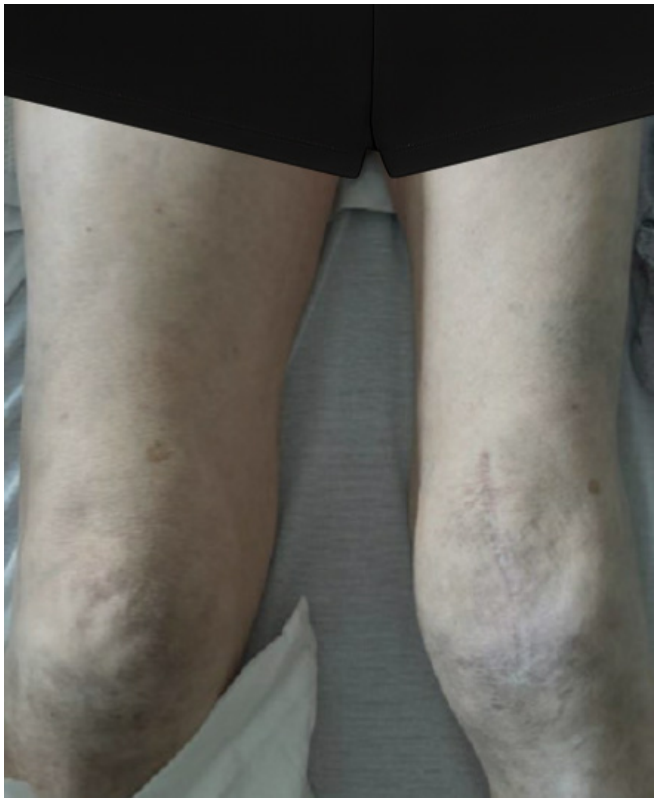


Figure 1. Postoperative clinical photo of a patient with Myasthenia Gravis.

Note the marked muscle wasting on the left side. Muscle wasting is evident also on the right side despite the edema after surgery.

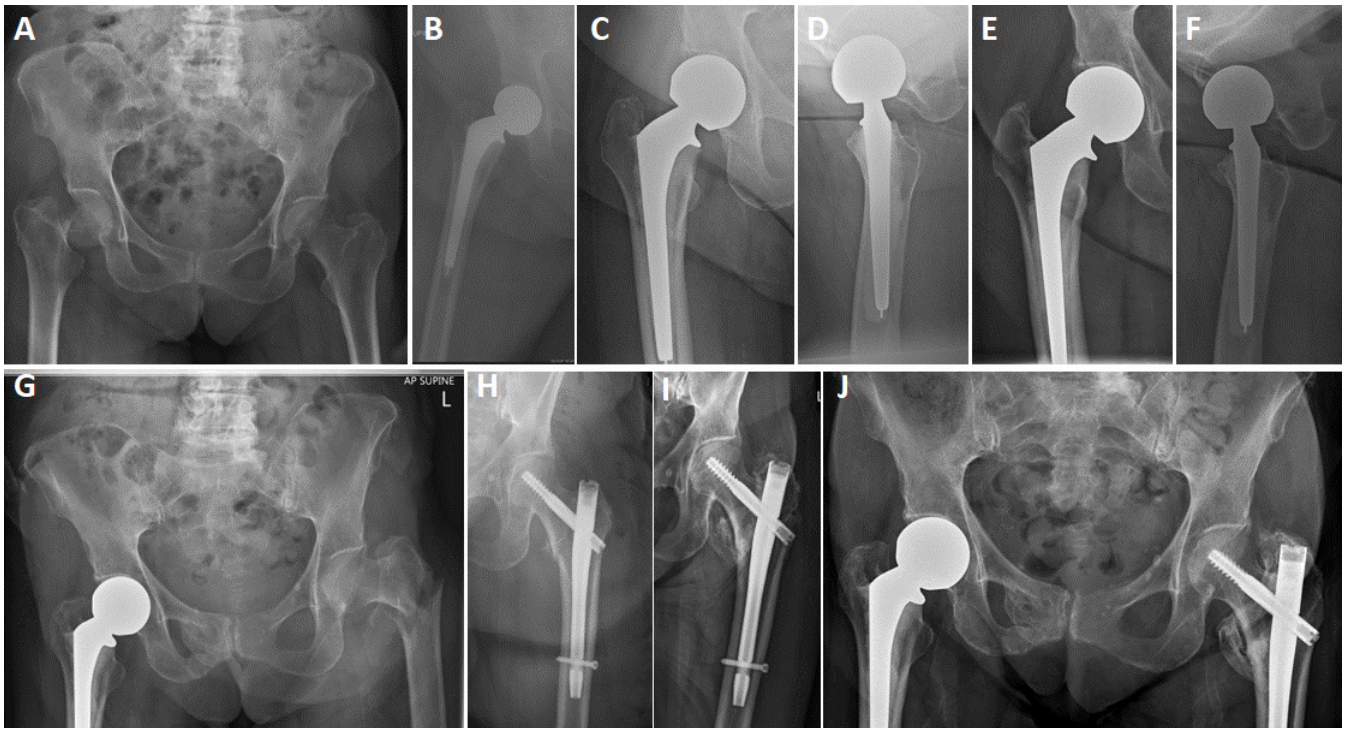


Figure 2. (**A**) Plain pelvis X-ray of a 76-year-old female with MG and right femoral neck fracture; (**B**) One-day postoperative plain hip X-ray showing unipolar HA; (**C, D**) Six-week; (**E, F**) 13-month follow-up postoperative plain hip radiographs showing stable HA components; **(G)** Plain pelvis X-ray 44.7 months after the index HA surgery showing a contralateral reverse oblique intertrochanteric fracture secondary to a fall at home, which was treated with a cephalomedullary nail; (**H, I**) Five month follow up plain left hip X-ray showing healing of the trochanteric fracture; (**J**) 74-month follow up plain hip radiograph after the index HA surgery showing stable HA components.

infections. Both cases were receiving oral corticosteroid therapy. The first patient (**table II**-Case 2) was a 71-year-old female who presented three weeks after her left hip cemented HA surgery with wound swelling and incisional drainage. She underwent one surgical debridement and irrigation. Tissue cultures at the time of surgical debridement revealed *Staphylococcus aureus* necessitating a six-week course of antibiotics. Four years later, this patient presented with a contralateral septic knee that was managed with surgical debridement and irrigation. Ten months later, the patient presented with left hip pain and swelling. Hip aspiration revealed Methecyllin-resistant *Staphylococcus aureus* infection. The patient was managed with irrigation and debridement, hemiarthroplasty removal, and insertion of an articulating spacer. The second stage revision to a cementless total hip arthroplasty was performed 3 months later (57 months after the index HA surgery).

The second patient (**table II**-Case 3) was a 76-year-old female who was found to have a wound infection after an open reduction of her dislocated HA following a fall. Tissue cultures at the time of surgical open reduction revealed infection with multiple organisms. The decision was made to avoid further surgical intervention and maintain oral antibiotic suppression. At the last follow-up, her PMI was 2, and the patient expired 10.6 months after the HA surgery.

Other complications

One patient, a 91-year-old male, developed a postoperative foot drop that resolved 2 months after the index HA without further interventions. One other patient, a 76-year-old female, developed asymptomatic grade IV heterotopic ossifications around the hip, which did not require surgical intervention at his last follow up.

DISCUSSION

This is a retrospective study of nine hip hemiarthroplasty cases in nine patients who were diagnosed with MG during their course of management. After a mean follow up of 61.8 months, four patients (44.4%) suffered five falls that required

Table II. Time and results of recurrent falls.

Case	Clinical features	Time of recurrent fall	Result and outcome
1	Female, 76, hypothyroidism BMI 25.2, PMI* 6. Medications: Pyridostigmine, occasional steroid injections and IgG	44.7 months after index HA surgery	Contralateral intertrochanteric fracture, treated surgically with cephalomedullary nail
2**	Female, 71, CKD, Psoriasis, DM, BMI 22.4, PMI* 6. Medications: Pyridostigmine and oral steroids	8.7 months after index HA surgery	Ipsilateral hip and thigh contusion, managed conservatively
3**	Female, 76, was FWB with assistive devices. BMI 27. Medications: Pyridostigmine, chronic oral and occasional parenteral steroids.	3 weeks after index HA surgery	Hemiarthroplasty dislocation with posterior wall acetabular fracture. Managed by closed reduction, re-dislocated, followed by open reduction. Re-dislocated with wound infection and the patient decided no further surgical intervention. The patient expired 10.5 months later
4	Female, 88, heart failure, hypothyroidism BMI 28.5, PMI* 6. Medications: Pyridostigmine	Two occasions 2- and 5 years after index HA surgery	Proximal humerus fracture, then severe ankle sprain, managed conservatively.

*PMI: Parker Mobility Index; **Patient also presented with infection.

hospital admissions, with two developing deep periprosthetic joint infections and one presenting with a dislocation of the HA surgical side requiring an open reduction.

MG is an autoimmune disease that affects the neuromuscular junction. The disease itself has been linked to an increased incidence of falls (4-6), due to a patient's associated muscle weakness, fatigability, and visual impairment due to bulbar muscle involvement and/or chronic corticosteroid therapy (6, 15). Particularly in patients undergoing arthroplasty, these factors may have significant implications, with increased complications after arthroplasty in visually impaired patients (16) and the poor consequences of chronic steroid therapy on arthroplasty survival and infection risk (17, 18).

When it comes to arthroplasty and MG, no studies discussed the outcomes of HA while only a few studies discussed the inpatient and 90-day postoperative outcomes of total hip and total knee arthroplasty in patients with MG (19-21). Murotani *et al.* (19) reported a case of myasthenic crisis-induced THA dislocation that occurred 3 months postoperatively and was managed with closed reduction without further consequences. The authors attributed the dislocation secondary to the myasthenic crisis in the affected limb which enabled excessive passive motion and joint hyperlaxity. In another study that reviewed the inpatient and early postoperative complications in patients with different neuromuscular (NM) conditions using a nationwide inpatient sample, including 2190 THA cases in patients with MG, Cichos *et al.* (20) found increased odds of inpatient medical complications such as acute postoperative anemia, altered mental status, urinary tract infection, and deep vein thrombosis along with increased early postoperative prosthetic complications including wound dehiscence in patients with MG and different neuromuscular conditions in comparison to patients without NM conditions. Another similar study (21) utilized a national database and reviewed the 90-day postoperative outcomes in 372 total hip and knee arthroplasty cases in patients with MG and found a 1.6-15% higher rate of cerebrovascular events, pneumonia, respiratory failure, sepsis, myocardial infarction, acute renal failure, anemia, and deep vein thrombosis during the in-hospital time and at 90 days post-discharge, as well as the

increased 90-day incidence of aseptic loosening in comparison to non MG patients. The authors did not mention how many THAs with MG exactly were included. As mentioned, the previous studies, which were presented given the lack of evidence about HA in MG, discussed the outcomes of total joint arthroplasty in patients with MG and other NM conditions. It is important to mention, however, that THA and HA are different entities. The surgical setting of a traumatic injury and the characteristics of patients treated with HA, who tend to be older and frequently have more medical comorbidities may be potential factors behind the reported higher incidence of PPI after HA compared to elective total joint replacement (22, 23). To our knowledge, this is the first case series that reports the short and mid-term outcomes of hemiarthroplasty for femoral neck fracture patients with MG.

Patients with MG often describe generalized fatigue and lack of energy (central fatigue) that is not related to the degree of muscle weakness (6, 24, 25). Consequently, the role of muscle training or nerve stimulation has been theoretically questioned to avoid increasing muscle weakness with repetitive use of the weak, inflamed muscle (26). Several clinical studies, however, found a significant improvement in muscle strength, functional capacity, and ultrasound muscle thickness in patients with MG after 8-12-week muscle strengthening programs that include aerobic and resistance training along with pulmonary rehabilitation (24, 27). As proven to increase muscle strength, and muscle cross-sectional area along with enhancing protein synthesis biomarkers in the elderly (28), resistance training with blood flow restriction (BFR) could be a promising technique for muscle strengthening in patients with MG. Given their beneficial role in improving sensorimotor function, frequency, step length symmetry, muscle thickness, and perceived exertion in patients with neuromuscular diseases involving the brain or the spinal cord (29), physical therapy professionals may consider implementing resistance training with BFR in the rehabilitation protocols of MG patients and dedicate research for studying its effect.

The result of our study shows a high incidence (44.4%) of falls following HA surgery in MG patients. This also highlights the importance of implementing fall prevention and safety education rehabilitation programs that focus on daily functioning activities, including standing, walking, and light lifting (27), along with patient education regarding the use of assistive walking devices (30), handheld reaching tools, and the removal of tripping hazards from the home to improve balance and decrease the risk of falls (31) in MG patients. Furthermore, regular eye examinations should be performed to detect and manage any associated visual impairment due to MG or corticosteroid therapy (32). In the presence of fractures, it is reasonable that MG patients on corticosteroids should be referred to fracture liaison services for adequate medication management of their potentially associated osteoporosis.

Patients with MG who utilize chronic corticosteroid therapy and undergo hip HA for femoral neck fracture management should also be aware of the high risk of periprosthetic joint infection. In this study, two cases of deep periprosthetic joint infection occurred in patients who were under chronic corticosteroid therapy. Overall, 22.2% of the population developed a deep periprosthetic joint infection, and subgroup analysis demonstrates that 50% of patients on chronic oral corticosteroid therapy developed a deep periprosthetic joint infection. Proper patient optimization for surgery and management of associated medical comorbidities, as well as other perioperative measures, such as proper prophylactic antibiotic administration, preoperative chlorhexidine surgical-site wipes; modified instrument care, decreasing perioperative hospital stay, and utilization of antibiotic-loaded cement, could be utilized to decrease the risk of postoperative periprosthetic joint infection (33-37).

To note, this study reports a case of heterotopic ossification (HO), noticed 1 year postoperatively. It is unclear whether MG, the surgical approach (the only case that received an anterolateral approach), or other factors were the reasons behind HO. Interestingly, one study (38) reported the occurrence of bilateral HO in a native hip in a patient with MG, although the correlation between the two conditions is unclear. Consequently, it may be reasonable to prescribe anti-HO prophylaxis such as NSAIDS or radiotherapy (39-41) for MG patients undergoing hip arthroplasty.

This study has several limitations. The primary limitation is the small number of patients included in the study, which precluded statistical analysis calculations for risk factors and their correlation with patient outcomes. The non-comparative nature of the study, along with the small sample size, also decreases the clinical significance of the study. Ideally, a multicenter case-control study reviewing a large number of hemiarthroplasty cases in patients with MG would conclude more solid evidence. Furthermore, the risks of infection and falls may be confounded with other risk factors in this patient subset, which may also require careful interpretation of the study outcomes.

CONCLUSIONS

The findings of this case series suggest a high incidence of postoperative falls in Myasthenia Gravis patients who undergo hip hemiarthroplasty for femoral neck fractures.

Proper patient education for fall prevention and proper patient optimization before surgery should be utilized to decrease the incidence of associated morbidities and infection in this patient population.

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None.

DATA AVAILABILITY

Data are available under reasonable request to the corresponding author.

CONTRIBUTIONS

ANM: conceptualization, investigation, writing – original draft. DS, GM , AN: writing – review & editing. DSH, MS: conceptualization, investigations, writing – review & editing.

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Investigations were performed at Geisinger Medical Center, Danville (PA), U.S.A.

CONFLICT OF INTERESTS

The authors declare that they have no conflict of interests.

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