Morbid obesity and 1-year costs after elbow dislocation[☆]

Dhanur Damodar^{a,*}, Derek D. Berglund^b, Rushabh M. Vakharia^b, Dragomir Mijic^b, Steven P. Kalandiak^a, Jonathan C. Levy^b

^a University of Miami Hospital, Department of Orthopedic Surgery, Miami, FL, 33136, USA

^b Holy Cross Hospital, Orthopedic Institute, Ft. Lauderdale, FL, 33308, USA

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ABSTRACT

Background: Morbid obesity has been linked with serious associated injuries following dislocations of the knee. While similar devastating injuries have been observed following elbow dislocations in the obese, no study to date has characterized the financial impact of elbow dislocations in the morbidly obese population.

Purpose: The purpose of this study is to determine the impact of morbid obesity on 1-year costs related to elbow dislocation.

Methods: A retrospective query of the Medicare Standard Analytic Files database was performed for patients sustaining elbow dislocation from 2005 to 2014. 1-year reimbursement costs from the initial open or closed reduction procedures were compared for morbidly obese (BMI ≥ 40 kg/m²) patients versus those without morbid obesity (BMI < 40 kg/m²). Cohorts were matched based on age and gender. Total reimbursement costs associated with a diagnosis of elbow dislocation and/or reduction were analyzed.

Results: We identified 182 morbidly obese patients and 422 patients without morbid obesity who underwent open or closed reduction for elbow dislocation. 102 patients with 1-year cost data remained in each cohort after matching. Mean 1-year reimbursement costs related to elbow dislocation were significantly greater in morbidly obese patients (\$6227.43 vs \$4225.71, $p = 0.006$).

Conclusion: 1-year costs related to elbow dislocation are significantly higher in morbidly obese patients. The increased costs likely reflect the complexity of managing dislocations in the obese population. Difficulties maintaining closed reduction, longer and more challenging surgeries with a higher likelihood on intra- and post-operative complications, and a higher risk of peri-operative medical complications may all contribute to these increased costs.

1. Introduction

The elbow is the second most commonly dislocated joint after the shoulder, with an overall incidence of 5.2 per 100,000 people in the United States (USA).¹ Morbid obesity has been associated with devastating low velocity knee dislocations.² While similar injuries occur in this patient population following dislocations of the elbow, no study has looked at the effects of obesity on elbow dislocations, and no study has focused on the financial impact of morbid obesity on the cost of managing dislocations. These elbow dislocations can be quite challenging to manage, as joint reduction, maintenance of elbow stability, methods of immobilization and surgical intervention all have unique challenges related to the arm weight and size. Furthermore, the injury

pattern in this patient population, much like following knee dislocations,² may be more severe. Obesity is a not only a growing epidemic,³ but has been associated with a significant rise in medical cost, with greater than 100 billion dollars spent annually attributed to obesity.⁴ Through the examination of the cost of care following elbow dislocations, it is possible to gain appreciation of the impact of morbid obesity on elbow dislocations. The purpose of this study is to determine the effect of morbid obesity on 1-year cost of care related to elbow dislocations.

2. Methods

A retrospective query of Medicare Standard Analytic Files database

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* Corresponding author.

E-mail addresses: ghanurdamodar@gmail.com (D. Damodar), berglund.derek@gmail.com (D.D. Berglund), rush.vakharia@gmail.com (R.M. Vakharia), dragomir.mijic@gmail.com (D. Mijic), SKalandiak@med.miami.edu (S.P. Kalandiak), JonLevy123@yahoo.com (J.C. Levy).

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Table 1
International Classification of Disease, 9th Revision (ICD-9) diagnosis codes for elbow dislocation.

ICD-9 code	Definition
832.00	Closed dislocation of elbow, unspecified
832.01	Closed anterior dislocation of elbow
832.02	Closed posterior dislocation of elbow
832.03	Closed medial dislocation of elbow
832.04	Closed lateral dislocation of elbow
832.09	Closed dislocation of elbow, other
832.10	Open dislocation of elbow, unspecified
832.11	Open anterior dislocation of elbow
832.12	Open posterior dislocation of elbow
832.13	Open medial dislocation of elbow
832.14	Open lateral dislocation of elbow
832.19	Open dislocation of elbow, other

was performed using the PearlDiver supercomputer (PearlDiver Inc, Colorado Springs, CO). International Classification of Disease, 9th Revision codes were used to identify patients who sustained an elbow dislocation (Table 1) and subsequently underwent open (ICD-9 79.82) or closed (ICD-9 79.72) reduction. Patients were stratified into two cohorts based on body mass index (BMI). Patients with a BMI ≥ 40 kg/m² were defined as morbidly obese, while patients with a BMI < 40 kg/m² were categorized into the non-morbidly obese group. Prior to analysis, patients with cost data related to elbow dislocation were selected from these two cohorts and matched based on age and gender at a 1:1 ratio.

Mean 1-year costs for morbidly obese and non-morbidly obese groups were calculated using Medicare reimbursement data. Data for reimbursement costs were only included if they were incurred within 1 year of the elbow relocation procedure and if a CPT code for elbow dislocation or the corresponding relocation procedure was included in the same billing record. Statistical analysis was performed via the R statistical package. T tests were utilized to compare Charlson Comorbidity Indexes (CCI), length of stay (LOS), and mean costs between the two study cohorts.

3. Results

3135 patients sustaining an elbow dislocation followed by a relocation procedure were identified. Among the patients with BMI data also available, 422 elbow dislocation patients were identified in the non-obese cohort, and 182 patients in the morbidly obese cohort. 200 (47.39%) patients in the non-obese cohort and 102 (56.04%) in the morbidly obese cohort had complete 1-year data for costs directly related to the elbow dislocation. 102 patients remained in each group after matching for age and gender.

The two cohorts each had 89 females, 12 males, and 1 unknown gender. Mean CCI ($p = 0.119$) and LOS ($p = 0.725$) did not differ significantly between the two groups. Mean 1-year reimbursement costs were found to be significantly higher in morbidly obese patients (\$6227.43 vs. \$4034.68, $p = 0.006$) (Fig. 1).

4. Discussion

This study demonstrated that the costs associated with management of elbow dislocations in the morbidly obese population are significantly higher than in those without morbid obesity. While there may be a multitude of contributing factors for this finding, the impact of morbid obesity on the cost of care for elbow dislocations is significant.

Morbid obesity has been well studied within the knee dislocation population as a cause of devastating, “low-velocity” injuries with significant consequences. Carr et al.² noted that when compared with non-obese patients, operative treatment of morbidly obese patients with knee dislocations is fraught with increased incidence of complications,

including neurovascular injury, intraoperative and postoperative surgical complications, and worse patient outcome scores. Severity of injuries associated with low velocity trauma in the obese population is similar to those seen only with high velocity trauma in the non-obese population.

Similar observations are likely to be seen in this population following elbow dislocations. Giannicola et al. identified obesity as one of three negative prognostic factors related to obtaining satisfactory outcomes following management of the terrible triad injury.⁵ Soft tissue injuries from low-velocity injuries often mimic high-energy trauma in this population, making both non-operative and operative management more challenging. Cast or splint immobilization is often poorly tolerated or ineffective at maintaining joint stability secondary to the size and weight of the arm. Furthermore, surgical techniques for restoring elbow stability can be fraught with complications related to exposure, strength of ligament repair, and maintenance of post-operative stability.

The impact of obesity on the cost of care has been seen in many areas of Orthopaedic Surgery. Roche et al.⁶ analyzed 5-year reimbursements and complications associated with knee arthroplasty based on BMI, noting that morbidly obese patients had the highest overall 5-year mean reimbursement of \$11,521 and the highest overall mean 5-year deviation from normal BMI patients of \$3300. Similar findings were seen following total shoulder arthroplasty as total charges and length of stay were significantly higher in the morbidly obese cohort, with a higher incidence of pulmonary complications.⁷

Recent analysis of obese and non-obese Medicare patients who underwent elbow arthroscopy demonstrated increased risk of infection, nerve injury, stiffness, and medical complications in the obese cohort.¹⁰ Baghdadi et al. studied outcomes after total elbow arthroplasty in the obese (BMI > 30) and nonobese population and found significantly higher rates of implant revision as well as decreased implant survivorship at 10 years post operatively in the obese group.¹¹

Obese patients have also been shown to have an increased incidence of diabetes, cardiovascular disease, hypertension, hyperlipidemia, obstructive sleep apnea, cerebrovascular disease, and several other medical comorbidities.^{8,9} Undoubtedly, surgical and non-surgical management after simple or complex elbow dislocations can also be complicated by these comorbidities.

In the current study increased costs associated with elbow dislocation in the morbidly obese cohort likely stem from several factors. Higher incidence of medical comorbidities in this population are often associated with increased postoperative complications. Within the 90-day postoperative period, Griffin et al. identified a higher rate of venous thromboembolism and infection in obese and morbidly obese TEA patients.¹²

Giannicola et al. prospectively studied outcomes of 26 terrible triad injuries treated with open reduction and internal fixation. They found that complications occurred more often in obese patients. This was attributed to challenges related to use of the postoperative elbow brace, increased forearm weight, and a lack of adherence to proper rehabilitation protocol.⁵ Additionally, intraoperative factors related to morbid obesity may have impacted the costs associated with the procedure. Large soft tissue envelope and additional dissection required to expose the elbow in morbidly obese patients could lead to longer operative time and intraoperative complications, thus increasing operating room costs. Similarly, increased risks of postoperative complications in obese patients undergoing shoulder arthroplasty have been previously described with increased blood loss and consequent blood transfusion.¹³

This study has several limitations. As with all database studies, this review is at risk for reporting bias, as it requires the input of various data points into a complex coding system, creating many opportunities for faulty coding or under reporting. Additionally, the use of a database such as Pearl Diver confers several intrinsic limitations. Risk factors that are not recorded in the database, such as a history of surgical

Fig. 1. Comparison of 1-Year Costs After An Elbow Dislocation in Morbidly Obese Patients Compared to Patients With a Body Mass Index < 40 kg/m².

procedure cannot be assessed. In addition, pre-existing elbow pathology (patients with previous dislocations/fractures) may not have been recorded, which could keep a high risk population in the cohort. In addition, morbidly obese patients tend to have several medical comorbidities which may have independently affected their 1 year costs; however, matching the study cohorts by CCI should have minimized the impact of this limitation.

5. Conclusion

1-year costs following elbow dislocation are significantly higher in morbidly obese patients. The increased costs likely reflect both the increased complexity of managing these dislocations either with or without surgery, as well as the increased likelihood of non-surgical perioperative complications in the obese population.

Conflicts of interest

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