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Down Syndrome Increases the Risk of Short-Term Complications After Total Hip Arthroplasty

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A B S T R A C T

Background: Down syndrome is the most common chromosomal abnormality and is associated with degenerative hip disease. Because of the recent increase in life expectancy for patients with this syndrome, orthopaedic surgeons are likely to see an increasing number of these patients who are candidates for total hip arthroplasty (THA).
Methods: Using Nationwide Inpatient Sample (NIS) data from 1998 to 2010, we compared the short-term adverse outcomes of THA among 241 patients with Down syndrome and a matched 723-patient cohort. Specifically, we assessed: (1) incidence of THA; (2) perioperative medical and surgical complications during the primary hospitalization; (3) length of stay; and (4) hospital charges.
Results: The annual mean number of patients with Down syndrome undergoing THA was 19. Compared to matched controls, Down syndrome patients had an increased risk of perioperative (OR, 4.33; $P < .001$), medical (OR, 4.59; $P < .001$) and surgical (OR, 3.51; $P < .001$) complications during the primary hospitalization. Down syndrome patients had significantly higher incidence rates of pneumonia ($P = .001$), urinary tract infection ($P < .001$), and wound hemorrhage ($P = .027$). The mean lengths of stay for Down syndrome patients were 26% longer ($P < .001$), but there were no differences in hospital charges ($P = .599$).
Conclusion: During the initial evaluation and pre-operative consultation for a patient with Down syndrome who is a candidate for THA, orthopaedic surgeons should educate the patient, family and their clinical decision makers about the increased risk of medical complications (pneumonia and urinary tract infections), surgical complications (wound hemorrhage), and lengths of stay compared to the general population.

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Down syndrome, also known as trisomy 21, is the most common symptomatic chromosomal abnormality compatible with survival into adulthood [1], with an annual incidence of 8 to 14 cases per 10 000 live births worldwide [2–4]. Clinical manifestations include a characteristic facial appearance, variable levels of intelligence and self-care skills, and multiple organ system failures [5,6]. Patients with Down syndrome can also present with musculoskeletal abnormalities including muscle hypotonia [7,8], upper cervical spine instability [9–11], pes planus and first ray deformities [12,13], gait abnormalities [14,15], decreased bone density [16,17], generalized ligamentous laxity [18], and hip abnormalities including decreased acetabular abduction and anteversion [19]. Patients with Down syndrome are also at an increased risk of symptomatic degenerative hip pathologies, including hip joint subluxation or dislocation, slipped capital femoral epiphysis, posterior acetabular deficiency, and idiopathic osteoarthritis [20–22].

For these patients, hip instability is a challenging musculoskeletal complaint, as the presentation is variable and treatment decisions depend on the patient's age and the degree of joint degeneration [23]. Bennet described four phases of degenerative changes in these patients: (1) the initial phase, from 0 to 2 years of age; (2) the dislocation phase, from 2 to 8 years of age; (3) the subluxation phase, from 8 to 15 years of age; and (4) the fixed phase, at ages greater than 15 years [20]. Management is subsequently dictated by the phase: (1) reduce the dislocated hip in the initial phase; (2) stabilize the hip and prevent the development of secondary acetabular dysplasia in the dislocation phase;

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Ethical Review: A copy of the letter from our institution's ethical review board regarding the exempt status of this project has been attached.

Authorship: KI, MRB, AVM and MAM designed the study. MRB, DCP and KI gathered the data. MRB, DCP and BHK analyzed the data. MRB, BHK, DCP, KI, AVM and MAM wrote the initial draft. MAM and AVM ensured the accuracy of the data and analysis.

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(3) reduce the hip and correct acetabular dysplasia to prevent resubluxation and degenerative joint disease in the subluxation phase; and (4) relieve pain and enhance ambulatory status in the fixed phase, often via total hip arthroplasty [23].

Because of the recent increase in life expectancy for patients who are diagnosed with Down syndrome, it is likely that orthopaedic surgeons will see an increasing number of candidates for total hip arthroplasty (THA) [24]. However, there is currently a paucity of data on outcomes of THA among this patient population. Using the Nationwide Inpatient Sample (NIS), a large, all-payer, inpatient database, we assessed the short-term outcomes of THA in patients with Down syndrome compared to other patients. Specifically, we assessed: (1) incidence; (2) perioperative medical and surgical complications; and (3) length of stay and hospital charges.

Methods

Study Population

The NIS is the largest all-payer inpatient database in the United States and is part of the Healthcare Cost and Utilization Project (HCUP) sponsored by the Agency for Healthcare Research and Quality. The NIS data is derived from a subset of hospitals in states that make their data available to the HCUP project and that can be matched to American Hospital Association survey data. To obtain nationwide estimates, the NIS developed a weighting system using the American Hospital Association hospital "universe" as standard. Based on analysis presented in an NIS Comparison Report performed by the HCUP, the NIS was found to provide reliable national estimates when compared with other national data sources, including the National Hospital Discharge Survey and the MedPAR inpatient data, along the dimension of hospital characteristics, number of discharges, length of stay, and in-hospital mortality [25]. Each year, the NIS collects medical records of nearly eight million hospital stays across more than 1000 United States hospitals, creating a 20% representative sample of annual nationwide hospital admissions [26]. Each patient discharge record contains demographic and clinical data, including International Classification of Diseases, Ninth Revision (*ICD-9*) diagnosis and procedure codes. Since the NIS contains entirely de-identified medical record data, this study was given exempt status by the institutional review board at our institution.

Cases

Patients with a primary *ICD-9* procedure code for total hip arthroplasty (THA) (81.51, 00.74, 00.75, 00.76, 00.77) between 1998 and 2010 were included in the study cohort. Patients with diagnosis codes indicating pathological fracture, malunion of fracture, traumatic femoral neck fracture, and long-term mechanical loosening associated with revisions were excluded from this study, as these admissions are predominantly non-elective [27].

Outcomes

Perioperative complications were calculated using *ICD-9* diagnosis codes as defined previously [27], which are detailed in Table 1. Medical complications included death, acute myocardial infarction, pulmonary embolism, pneumonia, acute renal failure, deep vein thrombosis, sepsis, urinary tract infection, and stroke. Surgical complications included wound hemorrhage, wound disruption, wound infection, implant infection, irrigation and debridement, and postoperative dislocation. For each admission, data on length of stay and hospital charges were also extracted.

Table 1
ICD-9 Diagnosis Codes for Perioperative Complications.

	ICD-9 codes
Medical complication	
Death	798.1, 798.2, 798.9
Myocardial infarction	410, 410.01, 410.11, 410.2, 410.21, 410.3, 410.31, 410.4, 410.41, 410.5, 410.51, 410.6, 410.9, 410.91, 997.1
Pulmonary embolism	415.11, 415.19
Pneumonia	480-480.9, 481, 482–482.9, 483, 483.1, 483.8, 484, 484.1, 484.3, 484.5-8, 485, 486, 487, 507
Acute renal failure	584.5-9
Deep vein thrombosis	453.4, 453.41-2, 453.9
Sepsis	995.91-2
Urinary tract infection	599, 997.5
Stroke	997.02
Surgical complication	
Wound hemorrhage	719.15, 998.31-2
Wound disruption	998.3, 998.31-2
Wound infection	682.6, 686.9, 891, 891.1-2, 894, 894.1-2, 998.5, 998.51, 998.6, 998.83, 998.59
Irrigation and debridement	86.04, 86.09, 86.22, 86.28, 86.3
Implant Infection	996.66-7, 996.69
Postoperative dislocation	996.42

Covariates

Patients with Down syndrome were identified using the associated *ICD-9* diagnosis code (758.0). All patients without documented Down syndrome were treated as controls. Demographic data for each admission, including age (in years), gender (male, female), race (white, nonwhite, missing), and year of admission (1998–2010), was also extracted. Comorbidities were assessed using the Charlson and Deyo scoring method for *ICD-9* coding [28]. The 17 comorbidities and their assigned point values are detailed in Table 2. Patients with none of these comorbidities received a score of 0 points.

Analysis

A matched cohort was created to minimize the confounding effects of demographic variables on the outcome data. Using propensity score matching, controls were matched in a three to one ratio to patients with Down syndrome according to age, gender, race, Deyo comorbidity score, and year of admission.

χ^2 and independent-sample *t* tests were used to calculate the significance of differences according to demographic variables and complication rates. Risk of complication (any, medical, surgical) was assessed using

Table 2
Point Values Assigned to Each Deyo Comorbidity.

	Points
Congestive heart failure	1
Peripheral vascular disease	1
Dementia	1
Cerebrovascular disease	1
Chronic pulmonary disease	1
Rheumatologic disease	1
Peptic ulcer disease	1
Past myocardial infarct	1
Mild liver disease	1
Uncomplicated diabetes	1
Hemiplegia or paraplegia	2
Renal disease	2
Malignancy including leukemia and lymphoma	2
Diabetes with end organ damage	2
Moderate or severe liver disease	3
Metastatic solid tumor	6
Human immunodeficiency virus infection	6