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Nerve Injury in Patients Following Hip and Knee Arthroplasties and Knee Arthroscopy

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Abstract

Objective—To examine the reporting of lower limb neuropathy within 90 days of surgery for patients undergoing hip arthroplasty, knee arthroplasty or knee arthroscopy.

Design—This was a retrospective study utilizing data from the 1998 MarketScan Commercial Claims and Encounter Database (The MEDSTAT Group) to identify lower limb neuropathy following these surgeries. The sample was selected within the first nine months of 1998 using ICD-9 and CPT codes for hip and knee surgical procedures. Lower limb nerve injuries as determined by ICD-9 codes within 90 days post surgery were the main outcome measures. The influence of diabetes on the rates of nerve injuries following surgery was also examined.

Results—14,979 patients underwent these surgical procedures, 10 of whom were reported to have sustained a nerve injury post surgery (0.07%). A majority (53.1%) of the sample was male and the largest age groups consisted of those aged 45–54 years (27.0%) and those aged 55–64 years (27.7%). Nerve injury occurred at a rate of 0.03% after hip arthroplasty, 0.01% following knee arthroplasty and 0.02% within three months of arthroscopic knee surgery. Overall, nerve injuries were two times more prevalent in the diabetic vs. non-diabetic population (0.11% vs. 0.06%); however, this difference did not meet conventional levels of statistical significance. Specific to knee arthroplasty, there were ten-fold differences in nerve injury rates between diabetics and non-diabetics, 0.11% vs. 0.01% respectively ($p = 0.01$) – although the overall risks were small.

Conclusion—Nerve injuries following hip and knee arthroplasty, and knee arthroscopy were rare in a large population of patients younger than 65 years. Although the overall rates were low, there was an increased occurrence of nerve injuries in the diabetic population. This information is useful when counseling patients and benchmarking surgical complication rates.

Keywords

Nerve Injury; Hip Arthroplasty; Knee Arthroplasty; Knee Arthroscopy; Diabetes

INTRODUCTION

Despite the increasing use of hip arthroplasty, knee arthroplasty, and knee arthroscopy; there remains varying estimates of nerve injury occurrence for these patients. Arthroscopic knee surgery has become a main part of orthopaedic surgery worldwide, and is generally considered a low-risk procedure. It is reported that the rate of complications of arthroscopic knee surgery is less than 1%¹, yet there are also reports of complication rates as great as 8.2%². Complications can include cartilage damage, deep venous thrombosis, pulmonary embolism, subcutaneous emphysema, lesions of the popliteal artery, pseudoaneurysm, and tears of the gastrocnemius muscle¹. Nerve injuries are a small proportion of these total complication rates; however, their possibility should be discussed before the surgery to ensure full informed consent. Estimated frequency rates of 0.01–0.13% highlight that neurologic dysfunction is a rare complication of tourniquet application or other surgical trauma³.

Hip replacement surgeries have reported rates of nerve injuries consistent with knee arthroscopies and arthroplasties, ranging from 0.5 to a high of 8.0%⁴. Nerve injury resulting from hip replacements is often attributed to differences in surgical approach; lateral, medial, anterior or posterior. In a study conducted by Abitbol et al. thirty five out of forty five patients who had a lateral approach had an abnormal EMG in the muscles innervated by the superior or inferior gluteal nerves⁵. In a set of ten patients who had a posterior approach, nine had abnormal EMG findings in the inferior gluteal innervated muscles and eight of the ten had abnormalities in superior gluteal innervated muscles⁴. The fibrillation potentials might have been due to some level of direct muscle injury and not nerve trauma, as such direct muscle injury can lead to fibrillation potentials on needle EMG⁶. Due to the reported variations concerning nerve injury/palsy following hip and knee surgical procedures, one of the aims of this study was to delineate the differences in complication rates to provide a benchmark for post surgical neurological morbidity for these common orthopedic procedures.

Diabetic neuropathy is one of the most common disabling chronic complications of diabetes leading to poorer clinical outcomes as a result of the systemic complications of diabetes⁷. In 1996 the Mayo Clinic reported that diabetic patients undergoing TKA had no statistically significant association between diabetic nerve palsy and the matched control group⁷. However, studies such as those conducted by Meding et al. (2003), reported higher incidence rates of postoperative neuropathy in insulin-dependent diabetics compared to non-insulin dependent diabetics. Clinicians should consider the possibility of an underlying polyneuropathy in persons with joint abnormalities and diabetes as these persons can develop severe degenerative changes in lower limb joints prompting such surgical interventions⁸.

Given wide discrepancies, the objective of this study was therefore to determine, utilizing MarketScan Data, a large healthcare claims database, the occurrence of nerve injuries following hip and knee arthroplasties and knee arthroscopy. The study also examined the differences in the occurrence of nerve injuries between diabetic and non-diabetic patients.

METHODS

Database Used for Analyses

Lower limb nerve injuries were examined using the 1998 MarketScan Commercial Claims and Encounters Database (The MEDSTAT Group). The database tracks the year-long history of inpatient and outpatient claims and encounters for over 16 million individuals.

MarketScan collects data annually from over 50 large, generally self-insured individual employers, and includes the private-sector health data from over 100 different insurance companies and third party administrators. MarketScan database also includes early retirees, COBRA insured patients, and Medicare-eligible retirees with employer-provided Medicare Supplemental plans, and their dependents. Commercial claims and managed care encounters that cover employees in all 50 states, the District of Columbia and Puerto Rico are included in this database.

In addition to comprehensive utilization by provider type, service and setting, the MarketScan database contains demographic information (i.e. age, gender, census region) for all people in the sample. With over 16 million covered lives in 1998 and a geographically diverse population, this database provides a unique opportunity to examine the correlation between lower limb neuropathy and hip or knee surgeries for a large population-based sample. Medicare beneficiaries and recipients, Medicaid patients, and non-insured individuals are excluded from this database. Therefore, the data represents a relatively young cross section of the United States population.

Sample Selection

We utilized ICD-9 diagnostic and procedure codes, as well as CPT procedure codes to identify a cohort of subjects from 1998 who underwent hip arthroplasty, knee arthroplasty and arthroscopic knee surgery (Table 1). The cohort was obtained from the first nine months of the year. Our main outcome was the presence of lower limb neuropathy within 90 days post surgery. We identify neuropathy utilizing the ICD-9 and CPT codes for nerve injury/palsy listed in Table 2. With a timeframe of three months post-surgery it was assumed that the presence of a claim for nerve injury was related to the surgical procedure performed. Whether or not the patient had a nerve conduction study and/or an EMG completed post-surgery was also noted (Table 2).

The presence of Diabetes Mellitus as a comorbidity in any claim over the year utilizing IDC-9 Codes 250–250.9 was assessed. Codes under category 250 identify complications/manifestations associated with diabetes mellitus. Individuals with one of these diagnosis codes at any point during the year were considered to have diabetes.

RESULTS

Our sample consists of 14,979 individuals who have undergone hip arthroplasty, knee arthroplasty or arthroscopic knee surgery within the first 9 months of 1998. The age distributions are shown in Table 3. The largest age groups were those from 45 to 54 years and those from 55–64 years. Only 0.6% was over age 65 consistent with the nature of the data set which does not include persons insured by Medicare. A majority of the sample was

male (53.1%). The primary reason for inclusion in the sample was from patients having arthroscopic knee surgery (83%). The next most prevalent surgery was hip arthroplasty (11.5%) followed by knee arthroplasty (8.7%). The highest rates of surgical procedures were among patients aged 45–64 years. Six percent of our samples were diabetic (Table 3). Of the patients with nerve injuries post surgery, 23.8% of them underwent further investigation via electrodiagnostic testing to aid in the management of the injury.

The overall presence of any nerve injury post surgery was 0.07%, with 0.03% post-total hip surgery, 0.01% post-total knee surgery and 0.02% post arthroscopic knee surgery (Table 4). Sciatic nerve injury was found to be present only in the hip arthroplasty group. Peroneal nerve injury was found to be present post hip surgery and arthroscopic knee surgery and unspecified nerve injuries occurred following hip, knee, and arthroscopic knee surgery. There were no reported femoral, posterior tibial, cutaneous sensory nerve injuries or injury to other specified nerves of the pelvic girdle and lower limb. Overall nerve injury in the non-diabetic population was 0.06% whereas the overall nerve injury rate in the diabetic population exhibited almost a two fold increase with an incidence rate of 0.11%, however this was not statistically significant ($p=0.60$).

Interestingly, the incidence of nerve injury following knee arthroplasty was 0.01% for non-diabetics with a ten fold increase in person with diabetes (Table 4), increasing to an incidence rate of 0.11% ($p = 0.01$).

DISCUSSION

Our findings revealed that the occurrence rates for nerve injuries diagnosed within three months of hip or knee arthroplasties and knee arthroscopic surgeries were rare with an overall rate of 0.07%, or 7 per 10,000 procedures. Persons with diabetes exhibited a greater incidence rate for nerve injuries compared to persons without diabetes. A nearly two-fold increase, in any nerve injury following any procedure was observed, whereas a ten-fold (significant at $p = 0.01$) increase of nerve injuries following knee arthroplasty surgery was observed for persons with diabetes. It should be noted that the results are reported in terms of “occurrence” rather than the “incidence” of post-surgical nerve injury, as the data provided a sample population within a narrow age range. In order to report a “true” incidence of post-surgical nerve injury a broader spectrum sample selection should be utilized to calculate the weighted incidence of nerve injury by age and gender. The sample would also need to include Medicare patients as this population typically exhibits a diminished health status which could influence the post-surgical complication rates.

Total hip replacements, partial hip replacements and revision hip surgeries, place the lower extremity nerves at minimal risk for damage based upon the findings from the present study (0.03%) as well as those conducted by Butt et al (less than 0.2% in over ten years). This is in contrast to previous literature where reported incidence rates were substantially higher at 0.17%⁹, 0.3% to 3.7%⁹ and 25% (22/89)¹⁰. Possible etiologies of nerve palsy include a compressive dressing, traction or retractor placement, ischemia, laceration of the nerve, hematoma- particularly in patients less than 70 kg body weight, limb-lengthening, or a

combination of these causes^{7, 8}. Overall, these studies report incidence rates greater than the 0.03% occurrence noted in the current study following hip arthroplasty.

High rates of nerve injury in some studies may be due to the fact that nerve dysfunction and injury were specifically assessed with attention to subtle nerve damage in post operative patients as part of a focused study; thus would likely report higher rates than would be noted in administrative claims data. The use of direct data collection or chart reviews to assess nerve injury rates, rather than the database employed in the current study, could have also contributed to the variation in the rate of post-surgical nerve injury. It is important to note that while very informative, the MarketScan claims database does not include detailed physical examination or other clinical information from the encounter, only the billing and diagnosis information. Other outcomes such as pain or physical function are also not present in the database. The incidence of nerve damage due to extremity trauma is noted to be 1.64%; thus it is important to realize that the nerve injury being accessed may have occurred before surgery, rather than as a result of the surgery¹¹. Other discrepancies in the reporting of nerve injury rates may be due to the changing techniques of the surgical procedure as well as the surgeon's experience. Bal et al. notes that there is a decrease in complication rates with increased surgeon experience along with modifications in the two-incision minimally invasive primary total hip arthroplasty.

Peroneal palsy as a complication of total knee arthroplasty has been found by other investigators to occur in 0.3% – 10% of cases³. Results of knee arthroplasties showed that 1.3% of patients developed peroneal nerve palsy with most patients having a functional recovery and two patients having permanent residual peroneal nerve palsy¹². Complications of peroneal nerve palsy occur at a rate of 0.87% and were found to be associated with stretching of the nerve, local compression, and/or decreased vascular supply¹³. These high incidence rates are in contrast to the findings in the current study with only a 0.01% occurrence of any nerve injury following knee arthroplasty. Regardless of low incidence rates, appropriate surgical considerations should be used to minimize the risk of nerve injury¹⁴.

Arthroscopy has revolutionized the way knee surgery is performed, and is now the most frequently conducted orthopaedic procedure in the United States¹⁵. Studies, such as those conducted by Small, have exhibited decreased incidences of nerve injury (from 0.06 to 0.01%) which are attributed to high levels of surgeon expertise and refinement of operative techniques^{15, 16}. This is consistent with the low rates of nerve injury following arthroscopic procedures that were presented in the current study.

In contrast, there are studies which show high complication rates (infection, hemarthrosis, adhesions, cardiovascular, etc) at 8.2%¹⁷, and sensory disturbance rates at 22.2%¹⁸ associated with arthroscopic knee surgery. Isolated deficits may be avoided by clarifying the distribution of the infrapatellar nerve branch^{18, 19}. Potential mechanisms of iatrogenic nerve injury include: (1) nerve puncture (2) sutures tied over the nerve or nerve capture, and (3) tension placed on the nerve or nerve tethering²⁰.

With the consistently increasing elderly population with joint problems, neuroarthropathy should be considered in the patient with diabetes⁸. Although rare, neuroarthropathy is a well recognized complication of diabetes, and thus a pre-existing condition should be considered as it could affect the post-surgical nerve injury rate. The reports with increased neurological complication rates in diabetic patients are consistent with the results of the present study in which persons undergoing knee arthroplasties demonstrated a tenfold increase in the rates for nerve injury (Table 4). The magnitude of injury rates even for diabetics; however, were quite low at 0.11%.

This study provided important insights into the scope of a specific complication, nerve injuries, following common lower limb surgical procedures. These findings in a large population provide a large scale picture of the magnitude of this problem in a general population, without referral bias to a single institution or health system. The study however, was not without its limitations. Subtle nerve injuries may not be reflected in claims data yet might have been present with more detailed evaluations. This would be particularly true for sensory nerve dysfunction where motor strength and mobility would be well preserved, such as in the case of saphenous nerve injury. Another limitation of the study was that it consisted of a younger population and does not reflect the elderly groups over the ages of 65 years, nor does it include Medicare patients. Therefore, this may have contributed to the differences in the reporting of post-surgical nerve injuries compared to studies that were more inclusive of the elderly and Medicare populations. The younger age group of this study is also a possible contributing factor to the high (83%) rate of knee arthroscopy noted compared to the lower (11.5% and 8.7%) rates noted in those who had hip and knee arthroplasty, respectively. The elderly comprise a population with increased rates of chronic conditions such as Diabetes Mellitus and higher rates of joint arthroplasties²¹.

Surgical fees are generally global in nature and include the follow up visits post operatively. For this reason, post operative follow up visits are often not submitted as separate claims. Thus, subtle nerve injuries that resolved would be less likely to show up in administrative claims databases and may have resulted in some underestimation of the rates of injuries in these populations. Underestimation of the rates of nerve injuries may also be due to the fear of malpractice suits as it has been shown that nerve injury is the most common cause of litigation following hip and knee surgical procedures²². However, medico-legally, the identified negligence is often the faulty management of the palsy postoperatively, rather than the actual occurrence of the nerve injury²³.

CONCLUSION

A large population of relatively younger patients was examined in this study. Nerve injuries following hip and knee arthroplasties and knee arthroscopic surgeries were reassuringly infrequent complications of these hip and knee procedures. Although the overall rates were low, there were increased risks for nerve injuries in the diabetic subgroup. The most substantial differences were found following knee arthroplasties, with ten-fold increases in the occurrence rates of nerve injuries in diabetic persons compared to persons without diabetes.

Similar investigations of the elderly and Medicare populations may reveal greater complication rates than described in this investigation due to their increased rates of diabetes and more severe osteoarthritis and other joint diseases leading to greater use of these surgical interventions for pain control and to achieve increased function.

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Table 1

Surgical inclusion criteria

HIP	ICD-9 Procedure Codes
Hip replacement, revision, arthroplasty	79.35
	80.25
	81.40
	81.51–81.53
	CPT Procedure Codes
	27125
	27130
	27132
	27134
	27137–27138
	27147
	27151
	27156
	27236
	27244–27245
	27254
	27506
KNEE	ICD-9 Procedure Codes
Knee replacement, revision, arthroplasty	81.47
	81.54–81.55
Knee Arthroscopy	80.26
Knee replacement, revision, arthroplasty	CPT Procedure Codes
	27440
	27445–27446
Knee Arthroscopy	29870–29889

Table 2

Nerve injuries and electrodiagnostic testing

Injury to peripheral nerve(s) of pelvic girdle and lower limb	ICD-9 Diagnostic Codes
Sciatic nerve	956.0
Femoral nerve	956.1
Posterior tibial nerve	956.2
Peroneal nerve	956.3
Cutaneous sensory nerve, lower limb	956.4
Other specified nerve(s) of pelvic girdle and lower limb	956.5
Multiples nerves of pelvic girdle and lower Limb	956.8
Unspecified nerve of pelvic girdle and lower limb	956.9
Nerve conduction study	CPT Procedure Codes
Motor nerve conduction	95900
	95903
Sensory nerve conduction	95904
EMG testing	CPT Procedure Codes
	95860–95861
	95863–95864
	95867–95870
	95872

Table 3

Descriptive statistics

	Total (N=14,979)	Hip Arthroplasty (N= 1,727) 11.5%	Knee Arthroplasty (N=1,299) 8.7%	Arthroscopic Knee (N=12,426) 83.0%
<i>Age Group</i>				
Less than 17	7.8%	5.1%	3.2%	8.7%
17–34	18.1	8.2	5.5	20.6
35–44	18.9	12.2	8.6	20.9
45–54	27.0	24.8	24.6	27.6
55–64	27.7	47.2	57.4	22.0
65 and over	0.6	2.6	0.9	0.2
<i>Gender</i>				
Male	53.1%	51.0%	42.7%	54.2%
Female	46.9	49.0	57.3	45.8
<i>Diabetes</i>				
Yes	6.0%	8.6%	13.0%	5.0%
No	94.0	91.4	87.0	95.0

Notes: Approximately 3% of our sample had more than one of the surgical procedures

Table 4

Occurrence of nerve injury within 90 days post surgery

	Any procedure	Hip Arthroplasty	Knee Arthroplasty	Arthroscopic Knee Surgery
Any nerve injury	0.07%	0.03%	0.01%	0.02%
Sciatic nerve	0.01	0.01	0.00	0.00
Peroneal nerve	0.02	0.01	0.00	0.02
Unspecified nerve of the pelvic girdle and lower limb	0.04	0.01	0.01	0.01
<i>Any nerve injury</i>				
Sample without diabetes	0.06%	0.04%	0.01%	0.02%
Sample with diabetes	0.11	0.00	0.11 *	0.00

Notes: Rows may not add up due to rounding error, 0.1% of the sample had any nerve injury during the year:

* denotes that the difference in the incidence rates between the diabetic and non-diabetic subgroups is statistically significant at $p = 0.01$

* The percentages we report are of the TOTAL sample, not within a sub-sample. That is, the total sample of patients is 14,979. Of those 1,729 had hip arthroplasty, 1,299 had knee arthroplasty, and 12,246 had arthroscopic knee surgery. These samples are the number of people having those procedures. The "occurrence" of nerve injury was calculated as 0.07% following any of these procedures, so $0.0007 \times 14,979 = 10.4$, which is correctly reported.