Journal of Diabetes and Its Complications 30 (2016) 1473–1477

Contents lists available at ScienceDirect

Journal of Diabetes and Its Complications

journal homepage: WWW.JDCJOURNAL.COM

Diabetes mellitus increases the risk of rotator cuff tear repair surgery: A population-based cohort study

Shih-Wei Huang [a,b], Wei-Te Wang [c], Lin-Chuan Chou [a], Tsan-Hon Liou [a,b,d], Yi-Wen Chen [e], Hui-Wen Lin [f,g,*]

[a] Department of Physical Medicine and Rehabilitation, Shuang Ho Hospital, Taipei Medical University, Taipei, Taiwan
[b] Department of Physical Medicine and Rehabilitation, School of Medicine, College of Medicine, Taipei Medical University, Taiwan
[c] Department of Physical Medicine and Rehabilitation, Changhua Christian Hospital, Changhua, Taiwan
[d] Graduate Institute of Injury Prevention, Taipei Medical University, Taipei, Taiwan
[e] Department of Physical Medicine and Rehabilitation, Wan-Fang Hospital, Taipei Medical University, Taipai, Taiwan
[f] Department of Mathematics, Soochow University, Taipei, Taiwan
[g] Evidence-Based Medicine Center, Wan Fang Hospital, Taipei Medical University, Taipei, Taiwan

ARTICLE INFO

Article history:
Received 19 May 2016
Received in revised form 8 July 2016
Accepted 19 July 2016
Available online 25 July 2016

Keywords:
Diabetes
Shoulder
Rotator cuff tear
Surgical repair
Population-based study

ABSTRACT

Background: Rotator cuff tears are the most common cause of shoulder disability in people older than 50 years, and surgical intervention is usually required for restoring functioning. However, in patients undergoing rotator cuff repair surgery, patients with DM had poorer functional outcomes than those without DM, and hence, DM is one of the possible risks factor for rotator cut off tear. The aim of this population-based study was to investigate the relationship between DM and the risk of rotator cuff tear in patients receiving rotator cuff repair surgery.

Methods: In this retrospective longitudinal population-based 7-year cohort study, we investigated the risk of rotator cuff repair surgery in patients with DM. We performed a case–control matched analysis by using data from the Taiwan Longitudinal Health Insurance Database 2005. Patients were enrolled on the basis of the International Classification of Diseases, Ninth Revision, Clinical Modification diagnostic codes for DM between January 1, 2004, and December 31, 2007. The prevalence and the adjusted hazard ratios (HRs) of a rotator cuff repair surgery in patients with and without DM were estimated according to the Cox proportional hazard regression analysis using the frailty model.

Results: The DM and non-DM cohorts comprised 58,652 patients with DM and 117,304 (1:2) patients without DM after matching for age and sex. The incidence of rotator cuff repair surgery was 41 per 100,000 and 26 per 100,000 person-years in the DM and non-DM cohorts, respectively. The HR of rotator cuff repair surgery during the follow-up period was 1.56 (95% confidence interval [CI] 1.25–1.93, $p < 0.001$) for patients with DM. After adjustment for covariates, the adjusted HR of rotator cuff repair surgery was 1.33 (95% CI, 1.05–1.68, $p < 0.001$) in the DM cohort.

Conclusion: DM is an independent risk factor for rotator cuff tear repair surgery.

1. Introduction

Rotator cuff tears are the most common cause of shoulder disability in people older than 50 years, and the incidence increases with age (Tashjian, 2012). It was considered as a natural decline of the muscle tendon unit in aging with statistically significant increase in frequency after 50 years. There were 30–70% cases of painful shoulders related to disorders of the rotator cuff, and the incidence of rotator cuff tears varies between 5 and 40%. Rotator cuff tears can be asymptomatic and clinical diagnosis is uncertain (Oliva et al., 2015). Therefore, variable prevalence rates and epidemiological features of rotator cuff tears are observed among different studies. According to Tempelhof et al. and Schibany et al., the prevalence of full-thickness tears was23% and 6% in 411 and 212 subjects, respectively (Schibany et al., 2004; Tempelhof, Rupp, & Seil, 1999). Ultrasonographic examinations of 1366 shoulders in a Japanese study revealed that the prevalence of rotator cuff tears was 20.47%, and the prevalence increased with age (Yamamoto et al., 2010). In terms of medical economic burden, 4 (Oh, Wolf, Hall, Levy, & Marx, 2007) million outpatient visits and approximately 40,000 inpatient interventions for rotator cuff problems were recorded in 2002 in the United States, and the average medical expenditure was 14,000 USD per case (Colvin, Egorova, Harrison, Moskowitz, & Flatow, 2012). Rotator cuff tearing can have multifactorial etiologies and can be accompanied by age-related degeneration and trauma. The pathogenesis of rotator

Conflicts of Interest: None.

* Corresponding author at: Department of Mathematics, Soochow University, 70 Linhsi Road, Shihlin, Taipei, Taiwan. Tel.: +886228819471x6701; fax: +886288611230.
E-mail address: linhw@tmu.edu.tw (H-W. Lin).

http://dx.doi.org/10.1016/j.jdiacomp.2016.07.015
1056-8727/

cuff tears were traditionally classified as into extrinsic (overuse, chronic impingement syndrome, and multifactorial) and intrinsic (hypoperfusion, degeneration, microtrauma, apoptotic theory, and extra cellular matrix modifications) etiologies (Via, De Cupis, Spoliti, & Oliva, 2013). Repairing a torn rotator cuff provides pain relief, functional improvement, and patient satisfaction (Gartsman, Khan, & Hammerman, 1998). Arthroscopic, miniopen, and open rotator cuff repair are the general surgical methods. For patients with complete rotator cuff tear, surgical intervention i unnecessary for reattaching the tendon to the bone (Matsen, 2009). Hence, hospitalization with surgical intervention is recommended in patients with massive rotator cuff tear or significantly limited shoulder function with pain.

Diabetes mellitus (DM) remains one of the most common and debilitating medical conditions. Ultrasound examination revealed rotator cuff degeneration among asymptomatic elderly patients with DM (Abate, Schiavone, & Salini, 2010). In addition, a positive relationship was observed between glycaemia and rotator cuff tears (Longo et al., 2009). Recently, in a large-scale population-based Taiwan study, patients with DM had a 2.11-fold higher risk of rotator cuff disorders compared with participants without DM (Lin et al., 2015). With regarding to adhesive capsulitis for DM patients, the prevalence was estimated at 13.4% (Zreik, Malik, & Charalambous, 2016). Besides, a recent systemic review with meta-analysis found people with diabetes had more than three times the odds of tendinopathy compared to controls and they also had thicker tendons than controls (Ranger, Wong, Cook, & Gaida, 2015). Zakaria et al. investigated the risk of tendon rupture in patients with DM in Australia, and the adjusted odds ratio was 1.84 for overall tendon rupture requiring hospitalization in patients with DM when compared with the general population (Zakaria, Davis, & Davis, 2014). Although these studies reported the association between DM and rotator cuff tendon lesions and Zakaria et al. found the higher risk of all types tendon injury among DM patients, specific studies focused on the association between the risk of rotator cuff tear for patients with DM are lacking. Therefore, we conducted a population-based, retrospective, case-controlled cohort study with a 7-year follow up period to investigate the incidence and risk of rotator cuff tear requiring repair surgery for patients with DM.

2. Methods

2.1. Study design and study population

2.1.1. Data source

In this retrospective nationwide population-based cohort study, data were retrieved from the Taiwan Longitudinal Health Insurance Database 2005 (LHID2005). The LHID2005 comprises claims data for 1,000,000 beneficiaries randomly sampled from the Registry for Beneficiaries of the National Health Insurance Research Database (NHIRD). The NHIRD was released by the Taiwan National Health Research Institutes (NHRI) for research purposes and contains registration files and original claims data for reimbursement, which were derived from the National Health Insurance Administration and maintained by the NHRI. The National Health Insurance (NHI) program was launched in Taiwan in March 1995 and covers 99.9% of the Taiwanese population (approximately 23 million enrollees in 2012). The NHIRD claims contain information on ambulatory care; inpatient care; pharmacy use; date of service; *International Classification of Diseases, Ninth Revision, Clinical Modification* (*ICD-9-CM*) diagnostic codes; and claimed medical expenses. The NHRI manages the claims data and provides scrambled random identification numbers for insured patients to protect patient privacy. Because the NHIRD comprises deidentified secondary data that were analyzed anonymously, the need for informed consent was waived by institution of review board for this study. Besides, this study is accordance to the guideline of STROBE and the level of evidence was 3. The accuracy of the claim data has been validated previously (Cheng, Kao, Lin, Lee, & Lai, 2011).

2.1.2. Study population

Between January 1, 2004, and December 31, 2007, patients with DM in their ambulatory claims (*ICD-9-CM* 250 and 251) were identified. For an accurate diagnosis of DM, patients who received at least 5 consistent diagnoses in outpatient clinics or a primary diagnosis of OA during hospitalization within 1 year were selected. Initially, 59,348 DM patients were enrolled in this study. Then 674 patients were excluded because of missing data, and 22 DM patients with a previous history of receiving rotator cuff repair surgery were also excluded. Finally, the DM cohort comprised 58,652 patients with DM, and the non-DM cohort comprised 117,304 age- and sex-matched patients without DM (1:2). Each patient was monitored for a maximum of 4 years from the patient's entry date to the date of rotator cuff repair surgery during hospitalization or until the end of 2010.

Baseline variables of age, coronary heart disease (*ICD-9-CM* 410 and 412), hypertension (*ICD-9-CM* 401–405), hyperlipidemia (*ICD-9-CM* 272.0–272.4), renal failure, cancer, autoimmune disease (rheumatoid arthritis [RA], *ICD-9-CM* 714.0 and systemic lupus erythematosus [SLE], *ICD-9-CM* 710.0), and thyroid disorders (*ICD-9-CM* 240–246) were obtained for all patients.

Table 1
Baseline variables of demographic characteristics and comorbidities for age- and sex-matched patients in the DM and non-DM cohorts. ($N = 175,956$).

Baseline variable	DM patients, $N = 58,652$		Non-DM patients, $N = 117,304$		p value
	No	(%)	No	(%)	
Characteristics					
Age (years)					1.00
18–30	1578	2.7	3156	2.7	
31–40	3651	6.2	7302	6.2	
41–50	10,151	17.3	20,302	17.3	
51–60	15,596	26.6	31,192	26.6	
61–70	14,245	24.3	28,490	24.3	
>70	13,431	22.9	26,862	22.9	
Sex					1.00
Male	28,785	49.1	57,570	49.1	
Female	29,867	50.9	59,734	50.9	
Comorbid medical disorders					
Coronary heart disease					<0.001
Yes	12,361	21.1	15,333	13.1	
No	48,291	78.9	101,971	86.9	
Hypertension					<0.001
Yes	32,183	54.9	37,932	32.3	
No	26,469	45.1	79,372	67.7	
Chronic renal failure					<0.001
Yes	2194	3.7	2003	1.7	
No	56,458	96.3	115,301	98.3	
Cancer					<0.001
Yes	3231	5.5	5891	5.0	
No	55,421	94.5	111,413	95.0	
Hyperlipidemia					<0.001
Yes	23,434	40.0	15,761	13.4	
No	35,218	60.0	101,543	86.6	
Autoimmune disease (RA, SLE)					<0.001
Yes	1634	2.8	2826	2.4	
No	57,018	97.2	114,478	97.6	
Thyroid disorders					<0.001
Yes	2425	4.1	3363	2.9	
No	56,227	95.9	113,941	97.1	