e-ISSN:2602-2079

Volume 8
Issue 8
2024

JOURNAL of Surgery and Medicine

International Medical Journal

JOSAM

Editorial Team

Prasenjit Das, Professor, MD, DNB, MNAMS, MNASc
Department of Pathology
All India Institute of Medical Sciences
New Delhi, India
Website

Seyed Vahid Hosseini, Professor
Shiraz University of Medical Sciences, Shiraz, Iran
Website

Vol. 8 No. 8 (2024):

Published: 2024-08-30

Research Article

Effect of cardiac rehabilitation on heart rate recovery in patients with coronary artery disease

Effect of cardiac rehabilitation on heart rate recovery

Hale Yilmaz, Nazmiye Ozbilgin, Gokturk Ipek , Basak Bilir Kaya, Mehmet Yilmaz , Mehmet Baran Karatas , Osman Bolca

128-131

Is hamstring muscle shortness responsible for low back pain in healthcare professionals?

Low back pain in healthcare professionals

Javad Mirzazada, Elif Mirzazada

132-135

Case Report

A challenging case of hemobilia: Endovascular treatment of cystic artery pseudoaneursym secondary to acute cholecystitis

Cystic artery pseudoaneursym: A hemobilia case

Yasin Celal Güneş, Bilal Egemen Çifçi, Fatma Ayça Edis Özdemir

136-139

J Surg Med. 2024;8(8):128-131.
https://doi.org/10.28982/josam.7751

JOSAM

Research article
https://jsurgmed.com/

Journal of Surgery and Medicine

e-ISSN: 2602-2079

Effect of cardiac rehabilitation on heart rate recovery in patients with coronary artery disease

Hale Yilmaz [1], Nazmiye Ozbilgin [1], Gokturk Ipek [1], Basak Bilir Kaya [1,2], Mehmet Yilmaz [3], Mehmet Baran Karatas [1], Osman Bolca [1]

[1] Department of Cardiology, Siyami Ersek Thoracic and Cardiovascular Surgery Center, Istanbul, Turkey
[2] Department of Physical Medicine and Rehabilitation, Republic of Turkey Ministry of Health, Erenkoy Physical Medicine and Rehabilitation Hospital, Istanbul, Turkey
[3] Department of Cardiovascular Surgery, Siyami Ersek Thoracic and Cardiovascular Surgery Center, Istanbul, Turkey

ORCID of the author(s)

HY: https://orcid.org/0000-0002-6365-2423
NO: https://orcid.org/0000-0002-3334-8359
GI: https://orcid.org/0000-0002-0948-1010
BBK: https://orcid.org/0000-0002-9586-9547
MY: https://orcid.org/0000-0002-6243-6876
MBK: https://orcid.org/0000-0001-7578-8451
OB: https://orcid.org/0000-0003-0156-3991

Corresponding Author
Hale Yilmaz
Department of Cardiology, Siyami Ersek Thoracic and Cardiovascular Surgery Center, Istanbul, Turkey
E-mail: haleyilmazmd@gmail.com

Ethics Committee Approval
The study was approved by the ethics committee of the Haydarpasa Numune Education and Research Hospital with the reference number HNEAH-KAEK 2020/KK/138.
All procedures in this study involving human participants were performed in accordance with the 1964 Helsinki Declaration and its later amendments.

Conflict of Interest
No conflict of interest was declared by the authors.

Financial Disclosure
The authors declared that this study has received no financial support.

Previous Presentation
This study was presented as a poster, PB-082, 37th Turkish Cardiology Congress with International Participation on 18-21 November 2021, Antalya, Turkey

Published
2024 August 2

Abstract

Background/Aim: It is well-established that individuals with coronary artery disease (CAD) often exhibit autonomic dysfunction and a reduction in vagal function is associated with increased mortality and morbidity. Vagally mediated heart rate recovery (HRR) can be assessed by analyzing the post-exercise heart rate (HR) decay. It is hypothesized that effective exercise-based cardiac rehabilitation (CR) can enhance post-exercise parasympathetic function. This study aims to evaluate the impact of CR on HRR and other cardiac parameters in CAD patients.

Methods: This retrospective cohort study was conducted at a single center. It included patients with CAD who were referred to the CR unit and completed either 30 or 60 sessions. These patients were free from angina or angina-equivalent symptoms at the time of enrollment and were receiving guideline-directed medical therapy for ischemic heart disease. A customized CR program was implemented for each patient. To calculate HRR, the maximum HR during the exercise test and HR values at 1, 2, and 3 minutes after exercise cessation were recorded. The differences between the maximum HR and the HR values at the end of the 1st, 2nd, and 3rd minutes after exercise were designated as HRR1, HRR2, and HRR3, respectively.

Results: This study enrolled 104 patients with CAD. Following CR, there was a significant improvement in functional capacity, as assessed by the 6-minute walk test (from 367.83 [56.58] to 381.61 [53.76], P=0.001), and endurance, as measured by the Cycle Ergometer Test Maximum Watts (from 63.22 [22.29] to 77.38 [19.87], P<0.001). CR also led to a noteworthy increase in HRR1, HRR2, and HRR3 (P=0.036, P=0.015, P=0.002, respectively).

Conclusion: In our study, both the functional capacity and endurance of CAD patients improved significantly after CR sessions. Additionally, HRR showed a substantial increase following CR, suggesting that exercise-based CR can enhance post-exercise parasympathetic function. HRR may serve as a potential prognostic marker for predicting outcomes in CR.

Keywords: coronary artery disease, cardiac rehabilitation, heart rate recovery

How to cite: Yilmaz H, Ozbilgin N, Ipek G, Kaya BB, Yilmaz M, Karatas MB, Bolca O. Effect of cardiac rehabilitation on heart rate recovery in patients with coronary artery disease. J Surg Med. 2024;8(8):128-131.

Introduction

Cardiovascular disease stands as one of the foremost contributors to global mortality and morbidity [1]. While the precise pathophysiology remains elusive, emerging evidence underscores the significant role played by the autonomic nervous system [2]. Notably, the vagus nerve may exert an influence on cardiovascular disease through its impact on inflammatory responses [3].

Exercise-based cardiac rehabilitation (CR) programs have been shown to enhance both the quality of life [4] and cardiovascular mortality outcomes in patients with coronary artery disease (CAD) [5]. It is hypothesized that effective exercise-based cardiac rehabilitation (CR) can lead to improvements in post-exercise parasympathetic function and reductions in inflammatory markers [6,7]. Vagally mediated heart rate recovery (HRR) is characterized by the difference in heart rate (HR) between the exercise peak and one or more minutes following exercise cessation [8]. Reduced HRR has been correlated with an elevated risk of both cardiovascular and all-cause mortality [9].

In this study, we assessed the impact of CR on HRR and various cardiac parameters in patients with CAD.

Materials and methods

Study design

This was a single-center, retrospective cohort study conducted between January 2016 and January 2020. The study included patients with CAD who were referred to the CR unit and completed both 30 and 60 sessions. At the time of enrollment, all patients were free of angina or angina-equivalent symptoms and were receiving guideline-directed medical therapy for ischemic heart disease.

The ethics committee of the Haydarpasa Numune Education and Research Hospital reviewed the study and determined that there were no ethical objections to conducting it, with the study being assigned the reference number HNEAH-KAEK 2020/KK/138. Additionally, the study received approval from the Istanbul Provincial Health Directorate, Health Services Presidency Research, Printed Publication, and Announcement Content Evaluation Commission, as indicated by their decision dated 10.11.2020 and reference number 2020/42. Furthermore, informed consent was obtained from all study participants.

The study population comprised patients aged 18 years and older who had coronary artery disease (CAD) and had completed all 30 and 60 sessions of the CR program. We included patients with CAD who had experienced a myocardial infarction, received a CAD diagnosis through angiography, or underwent revascularization procedures such as percutaneous coronary intervention (PCI) or coronary artery bypass grafting (CABG).

The exclusion criteria for this study encompassed several factors, including significant cognitive disorders, acute or chronic respiratory failure, the presence of angina or angina-equivalent symptoms, non-revascularized significant coronary stenosis, recent (within a month) acute coronary syndrome, residual myocardial ischemia, uncontrolled hypertension, coexisting valvular and/or peripheral vascular diseases, any physical disabilities that could hinder ergometer bicycle training and acute or chronic heart failure. Notably, the use of medication classes that affect heart rate (HR), such as beta-blockers, was not considered an exclusion criterion. Participants were specifically instructed to continue their regular medication regimens throughout the study (Table 1).

Table 1: Medications of the patients (n=104).

Medications	n (%)
Beta-blocker	90 (87)
Calcium channel blocker	18 (17)
ACEI	49 (47)
ARB	8 (8)
Diuretics	7 (7)
Alfa blocker	3 (3)
Statin	80 (77)

Cardiac rehabilitation

All patients were invited to participate in the hospital-based CR program, which involved attending sessions three times a week for either 10 weeks (30 sessions) or 20 weeks (60 sessions) for those who wished to continue. A customized CR program was tailored to each patient based on their peak workload as determined through a cycle ergometer test. After the initial ten sessions, a physiatrist assessed and adjusted the patient's rehabilitation program using the Borg scale for exertion. Each exercise session commenced with a warm-up and concluded with a recovery period. To assess endurance, a submaximal cycle ergometer test was administered, increasing the wattage by 25 watts every 2 minutes, with patients self-reporting their exertion on the Borg scale. Throughout the exercise, continuous monitoring included electrocardiogram readings, HR, blood pressure, and oxygen saturation levels. Prior to engaging in the cycle ergometer program, patients performed supervised stretching exercises, with strengthening exercises introduced after two weeks. These strengthening sessions targeted the major muscle groups of the upper and lower extremities, involving ten repetitions at a load ranging from 60–80% of their maximum capacity.

Functional capacity was assessed using the 6-minute walk test (6MWT), during which patients were instructed to walk back and forth around cones on a 30-foot path for six minutes, allowing them to slow down or stop if necessary. Additionally, patients received dietary recommendations from nutritionists, psychosocial support from a psychologist, and educational guidance from CR nurses, along with educational materials. Smokers were referred to the tobacco cessation outpatient clinic as part of the comprehensive program.

Heart rate recovery

HRR is defined as the difference in HR between the peak of exercise and one or more minutes after exercise cessation. To calculate HRR, the maximum heart rate during the exercise test was initially recorded. Subsequently, HR measurements were taken again at 1, 2, and 3 minutes after the exercise test concluded. The disparities between the maximum HR and the HR recorded at the end of the 1st, 2nd, and 3rd minutes after exercise were designated as HRR1, HRR2, and HRR3, respectively.

Furthermore, we defined the differences in cycle ergometry watt values, HRRs, and 6-minute walk test (6MWT) results after completion of the CR program compared to their baseline values as Δwatt, ΔHRR, and Δ6MWT, respectively.

Statistical analysis

Statistical analyses were conducted using SPSS 16.0 for Windows. To assess the data obtained in this study, descriptive statistical methods such as mean (standard deviation), frequency, and ratio values were employed. In-group comparisons of quantitative variables with a normal distribution were performed using the t-test, while the Wilcoxon signed-ranks test was utilized for in-group comparisons of quantitative variables that did not exhibit a normal distribution. Mean values of continuous variables were compared between groups using either the Student t-test or the Mann-Whitney U test, as appropriate. The relationships between parameters were determined using Pearson's coefficient of correlation.

To identify differences between the CABG, PCI, and medical treatment groups, an analysis of variance (ANOVA) test was employed. Statistical significance was established at a threshold of $P<0.05$.

The study's statistical power and the minimum required patient count were calculated based on interim analysis, which evaluated the first 30 enrolled patients. To achieve 80% statistical power and account for a type 1 error rate of 0.05, a minimum of 92 patients were determined to be necessary to claim significant findings.

Results

In this study, a total of 104 patients were enrolled. Among them, 30 (29%) were female, and 74 (71%) were male. The average age of the patients was 58 years. The clinical findings of the subjects are presented in Table 2.

Table 2: Baseline characteristics of the study population.

		30 sessions (n=30)	60 sessions (n=74)	*P*-value
Age	58 (9)	58 (12)	59 (8)	0.640
Gender				
male	74 (71%)	22	52	0.755
female	30 (29%)	8	22	
Hypertension	68 (65%)	20	48	0.861
Diabetes mellitus	22 (21%)	7	15	0.729
Heart failure	15 (14%)	4	11	0.840

Data are presented as mean (SD) and n (%)

The patients' body mass index (BMI) showed a significant decrease after participating in the training program ($P=0.044$). Furthermore, functional capacity, as assessed through the 6-minute walk test, and endurance, as measured by the maximum watts achieved in a cycle ergometer test, both exhibited significant increases in patients following their participation in CR sessions (from 367.83 [56.58] to 381.61 [53.76], $P=0.001$; from 63.22 [22.29] to 77.38 [19.87], $P<0.001$, respectively).

CR also resulted in significant improvements in heart rate recovery parameters: HRR1, HRR2, and HRR3 (from 22 [11] to 24 [9], $P=0.036$; from 28 [12] to 31 [9], $P=0.015$; from 29 [11] to 33 [10], $P=0.002$, respectively). Additionally, the mean HRR showed a significant improvement (from 26.24 [10.59] to 29.49 [8.61], $P=0.006$) (Table 3).

Out of the CR patients, 20 (19%) underwent CABG, 65 (62%) received PCI, while the remaining patients were medically followed. There were no significant differences observed between the treatment groups regarding changes in HRR, endurance, and distance following CR (ΔHRR1 $P=0.404$, ΔHRR2 $P=0.174$, ΔHRR3 $P=0.640$, ΔMean HRR $P=0.349$, Δwatt $P=0.383$, Δ6MWT $P=0.882$).

Table 3: Evaluation of BMI, endurance and functional capacity, and heart rate recovery before and after cardiac rehabilitation.

	Before CR	After CR	*P*-value
BMI (kg/m²)	28.81 (4.66)	28.55 (4.37)	0.044
Cycle ergometer test max WATT	63.22 (22.29)	77.38 (19.87)	<0.001
6MWT (meters)	367.83 (56.58)	381.61 (53.76)	0.001
HRR1	22 (11)	24 (9)	0.036
HRR2	28 (12)	31 (9)	0.015
HRR3	29 (11)	33 (10)	0.002
Mean HRR	26 (11)	29 (9)	0.006

BMI: body mass index, HRR: heart rate recovery, 6MWT: 6-minute walk test. Data are presented as means (standard deviation).

In the univariate correlation analysis, there was a significant correlation observed between the increase in wattage (Δwatt) and the improvements in HRR1, HRR2, and HRR3 (r=0.229, $P=0.019$; r=0.328, $P=0.001$; r=0.330, $P=0.001$, respectively).

There were no significant differences in the baseline characteristics between the groups undergoing 30 sessions and 60 sessions (Table 1). However, it's important to note that the improvements in HRR, endurance, and the 6-minute walk test (6MWT) were not statistically different between the two groups (Table 4).

Table 4: Comparison of the results of 30 session and 60 session groups.

	30 Session	60 Session	*P*-value
ΔHRR1	0.43 (14.61)	3.60 (12 16)	0.258
ΔHRR2	0.67 (13.83)	4.12 (12.49)	0.218
ΔHRR3	0.67 (13.14)	5.26 (12.28)	0.094
Δ Mean HRR	0.59 (12.67)	4.33 (11.50)	0.148
Cycle ergometer test ΔWATT	10.00 (19.25)	15.83 (22.10)	0.209
Δ6MWT (meters)	4.00 (35.56)	17.74 (40.96)	0.111

HRR: heart rate recovery, 6MWT: 6-minute walk test. Data are presented as means (standard deviation).

Discussion

Resting HR in healthy individuals is primarily regulated by the vagus nerve [10]. Acute stress leads to vagal withdrawal, followed by sympathetic stimulation [11]. It is well-established that individuals with cardiovascular disease often exhibit autonomic dysfunction and a decrease in vagal function is correlated with increased mortality and morbidity [12,13].

Heart rate recovery (HRR), as an indicator of vagal function, is defined as the difference in HR between the peak of exercise and one or more minutes following the cessation of exercise. The elevation in HR during exercise is attributed to the interplay of parasympathetic withdrawal and sympathetic activation. The decline in HR immediately after exercise is believed to signify the reactivation of the parasympathetic system [11]. Impaired HRR has been demonstrated to be linked to an elevated risk of cardiovascular events [14,15].

In our study, we measured HRR in all patients during the initial and final sessions of the cycle ergometry exercise program. HRR showed a significant improvement following the CR program compared to its baseline measurements. Notably, there was an observed increase in HRR values at 1st, 2nd, and 3rd minutes, as well as the mean HRR. These findings align with previous studies that utilized treadmill exercise in CR programs [16,17]. Furthermore, a two-week residential CR study involving cycle ergometry exercise also reported an increase in HRR [18]. To the best of our knowledge, this is the first study to demonstrate the impact of hospital-based CR with cycle ergometry on HRR in patients with CAD.

Qiu et al. [19] reported that there was no significant difference in the predictive value of 2-minute HRR compared to 1-minute HRR concerning the risk of all-cause mortality. However, they noted that 2-minute HRR demonstrated greater sensitivity in predicting the risk of cardiovascular events. In a separate study [18], it was observed that HRR at 2 minutes significantly increased in CAD patients following a residential CR program. In our study, while all HRR measurements at 1, 2, and 3 minutes showed significant increases, the most pronounced increase was observed at the 2nd and 3rd minutes.

While there is an evident dose-response correlation between HRR and cardiorespiratory fitness [9], no significant disparity in HRR metrics has been identified between 30 and 60 workout sessions. Conversely, in another study, a 6-week program showed similar effects on HRR when compared to a 12-week program [20]. This suggests that the advantages of CR on HRR may be independent of the duration of the rehabilitation program.

We observed significant correlations between HRR and changes in cycle ergometer watts in response to the CR program. An increase in HRR was found to be significantly correlated with the magnitude of the wattage increase.

Limitations

The retrospective design of this study represents a limitation. Furthermore, the absence of a control group in the current study is another limitation. To obtain a more comprehensive understanding, future prospective studies should include a group of CAD patients who do not participate in CR as a comparison.

Conclusion

In our study, we observed improvements in the endurance and functional capacity of the patients. Furthermore, all HRR values at the 1st, 2nd, and 3rd minutes showed significant increases after the CR sessions. This increase in HRR following CR suggests an improvement in autonomic dysfunction among patients with CAD. Therefore, CR appears to be a valuable intervention for addressing autonomic dysfunction in this patient population. Additionally, HRR may serve as an effective predictor of CR outcomes.

References

1. Nowbar AN, Gitto M, Howard JP, Francis DP, Al-Lamee R. Mortality from ischemic heart disease. Circ Cardiovasc Qual Outcomes. 2019;12:e005375.
2. Olshansky B, Sabbah HN, Hauptman PJ, Colucci WS. Parasympathetic nervous system and heart failure: pathophysiology and potential implications for therapy. Circulation. 2008;118:863-71.
3. Olshansky B. Vagus nerve modulation of inflammation. Cardiovascular implications. Trends in Cardiovascular Medicine. 2016;01:1-11.
4. Conraads VM, Pattyn N, De Maeyer C, Beckers PJ, Coeckelberghs E, Cornelissen VA et al. Aerobic interval training and continuous training equally improve aerobic exercise capacity in patients with coronary artery disease: the SAINTEX-CAD study. Int J Cardiol. 2015;179:203–10.
5. Anderson L, Oldridge N, Thompson DR, Zwisler AD, Rees K, Martin N, et al. Exercise-based cardiac rehabilitation for coronary heart disease: Cochrane systematic review and metaanalysis. J Am Coll Cardiol. 2016;67:1–12.
6. Rocamora AM, Ribeiro F, Sarabia JM, Íbias J, Oliveira NL, Vera-García FJ, et al. Exercise-based cardiac rehabilitation and parasympathetic function in patients with coronary artery disease: a systematic review and meta-analysis. Clin Auton Res. 2021;31:187-203. doi: 10.1007/s10286-020-00687-0.
7. Kaya BB, Ozbilgin N. Effect of cardiac rehabilitation on mortality related inflammatory markers. J Surg Med. 2019;3(8):588-92. doi: 10.28982/josam.606487
8. Peçanha T, Silva-Júnior ND, Forjaz CL. Heart rate recovery: autonomic determinants, methods of assessment and association with mortality and cardiovascular diseases. Clin Physiol Funct Imag. 2014;34:327–39.
9. Cole CR, Blackstone EH, Pashkow FJ, Snader CE, Lauer MS. Heart-rate recovery immediately after exercise as a predictor of mortality. N Engl J Med. 1999;341:1351–7.
10. Jose AD, Collison D. The normal range and determinants of the intrinsic heart rate in man. Cardiovasc Res. 1970;4:160-7. doi: 10.1093/cvr/4.2.160.
11. Imai K, Sato H, Hori M, H Kusuoka, H Ozaki, H Yokoyama, et al. Vagally mediated heart rate recovery after exercise is accelerated in athletes but blunted in patients with chronic heart failure. J Am Coll Cardiol. 1994;15;24:1529-35. doi: 10.1016/0735-1097(94)90150-3.
12. Besnier F, Labrunee M, Pathak A, Pavy-Le Traon A, Galès C, Sénard JM, et al. Exercise training-induced modification in autonomic nervous system: an update for cardiac patients. Ann Phys Rehabil Med. 2017;60:27–35. doi: 10.1016/j.rehab.2016.07.002
13. Thayer JF, Lane RD. The role of vagal function in the risk for cardiovascular disease and mortality. Review Biol Psychol. 2007;74:224-42. doi: 10.1016/j.biopsycho.2005.11.013.
14. Vivekananthan DP, Blackstone EH, Pothier CE, Lauer MS. Heart rate recovery after exercise is a predictor of mortality, independent of the angiographic severity of coronary disease. J Am Coll Cardiol. 2003;42:831–8.
15. Nishime EO, Cole CR, Blackstone EH, Pashkow FJ, Lauer MS. Heart rate recovery and treadmill exercise score as predictors of mortality in patients referred for exercise ECG. JAMA. 2000;284:1392–8.
16. Tiukinhoy S, Beohar N, Hsie M. Improvement in heart rate recovery after cardiac rehabilitation. J Cardiopulm Rehabil. 2003;23:84-7. doi: 10.1097/00008483-200303000-00002.
17. Hao SC, Chai A, Kligfield P. Heart rate recovery response to symptom limited treadmill exercise after cardiac rehabilitation in patients with coronary artery disease with and without recent events. Am J Cardiol. 2002;90:763-5. doi: 10.1016/s0002-9149(02)02607-3.
18. Legramante JM, Iellamo F, Massaro M, Sacco S, Galante A. Effects of residential exercise training on heart rate recovery in coronary artery patients. Am J Physiol Heart Circ. Physiol 2007;292:H510-5. doi: 10.1152/ajpheart.00748.2006. Epub 2006 Sep 15.
19. Qiu S, Cai X, Sun Z, Li L, Zuegel M, Steinacker JM, et al. Heart rate recovery and risk of cardiovascular events and all-cause mortality: a meta-analysis of prospective cohort studies. J Am Heart Assoc. 2017;9;6:e005505. doi: 10.1161/JAHA.117.005505.
20. Missiri AE, Amin SA, Tawfik IR, Shabana AE. Effect of a 6-week and 12-week cardiac rehabilitation program on heart rate recovery. Egypt Heart J. 2020;72:69. doi: 10.1186/s43044-020-00107-8.

J Surg Med. 2024;8(8):132-135.
https://doi.org/10.28982/josam.7779

JOSAM

Research article
https://jsurgmed.com/

Journal of Surgery and Medicine

e-ISSN: 2602-2079

Is hamstring muscle shortness responsible for low back pain in healthcare professionals?

Javad Mirzazada, Elif Mirzazada

VM Medical Park Kocaeli Hospital, Kocaeli, Turkey

ORCID of the author(s)

JM: https://orcid.org/0000-0001-6540-9518
EM: https://orcid.org/0009-0002-1129-5126

Corresponding Author
Javad Mirzazada
VM Medical Park Hospital, Ovacık mah, D100 karayolu, Başiskele, Kocaeli, Turkey
E-mail: dr.javadmirzazada@gmail.com

Ethics Committee Approval
The study was approved by the ethics committee of Istanbul Yeni Yüzyıl University (16.12.2021/43 – December 5, 2021). All procedures in this study involving human participants were performed in accordance with the 1964 Helsinki Declaration and its later amendments.

Conflict of Interest
No conflict of interest was declared by the authors.

Financial Disclosure
The authors declared that this study has received no financial support.

Published
2024 August 9

Abstract

Background/Aim: Low back pain (LBP) is a highly prevalent pathology affecting more than half of our population. The lumbar region inherently possesses a complex structure; therefore, dozens of causes for the clinical presentation of acute/chronic pain are present. We focused on the impact of hamstring shortness on LBP in healthcare workers/professionals who need to keep medical records and perform invasive procedures while traveling overwhelming distances in relatively small workplaces.
Methods: Our research was designed as a cross-sectional study and was conducted at Beykent University Hospital from March to April 2022. Sixty-two otherwise healthy healthcare workers/professionals aged 25–45 (both male and female) volunteered. Two equal groups with and without LBP were created. Oswestry disability index, Roland–Morris score, Quebec LBP questionnaire, Visual Analog Scale (VAS), active/passive knee extension, sit and reach, and forward bending tests were performed in each group. The collected data were statistically analyzed (confidence interval [CI]=20%; $P<0.05$).
Results: Active/passive knee extension, sit and reach, and toe touch tests were significantly related to Roland–Morris, Quebec, and Oswestry Disability Index questionnaires; thus hamstring muscle shortness was significantly related to chronic low back pain ($P<0.05$). Short hamstring muscle length could accurately reflect the lower test scores obtained by the female participants.
Conclusion: Hamstring muscle shortness could explain a significant proportion of low back pain in healthcare professionals.

Keywords: low back pain, healthcare workers, hamstring shortness

Introduction

Low back pain (LBP) arises for a variety of reasons. Research suggests a 19%–39% rate for LBP in advanced countries and reported up to an 83% lifetime risk of having at least one episode of LBP [1]. Therefore, LBP could be characterized as a typical human problem. It also explains mild to moderate biomechanical disorders caused by micro-trauma and vertical imbalance, which consecutively emerge from a sedentary lifestyle or prolonged non-ergonomic mobilization. A recent meta-analysis emphasized a significant relationship between low back pain and the type of job in which the frequency escalates along with the increase in age [2].

After browsing the literature, we found that this particular situation was previously investigated several times using similar research schemes yet never in terms of a relationship with short hamstring length [3–6]. If unable to compensate via the knee joints, this hamstring shortening will revoke the adequate sagittal balance, tilting it posteriorly, and creating high pressure on posterior spinal structures. According to our hypothesis, medical recording performed while in a sitting posture and frequent paces in a relatively narrow workspace can lead to hamstring muscle shortening, consequently causing back pain.

Studies revealed an escalating pressure distribution within intervertebral discs in these body postures in a specific order: supine followed by sitting straight on a chair, by sitting in a slightly slouched posture on a chair, by erecting straightly up with knees flexed, holding an object manually while maintaining the previous posture, leaning all the way forward with knees extended, and last, taking an object from the ground while maintaining the previous posture [7,8] as shown in Figure 1. Jabbar et al. [6] investigated office workers and found a higher rate (55.5%) of hamstring muscle shortness and extended time spent in a sitting position. Individuals who spent over 6 h in a sitting position exhibited an 83% hamstring muscle tightness. Leaning forward to reach the toes seems simple; nevertheless, it is a complex mechanical synergy between the lumbar region and the hip joint. A sum of a 110-degree angle among the body and lower extremities exists of which 70 degrees originate from the hip joint and the remaining 40 degrees from the lumbosacral region [8,9] as shown in Figure 2.

Our research, on the other hand, focused only on axio-appendicular muscles, particularly on hamstring muscles. We attempted to assess any unfavorable effects caused by hamstring muscle shortness on LBP due to sitting for extended periods. Healthcare workers/professionals possess a high risk of becoming candidates for chronic LBP and are highly susceptible to this problem as they kept working in indoor conditions even throughout the coronavirus 2019 (COVID-19) pandemic.

Figure 1: Intradiscal pressures in various postures [19].

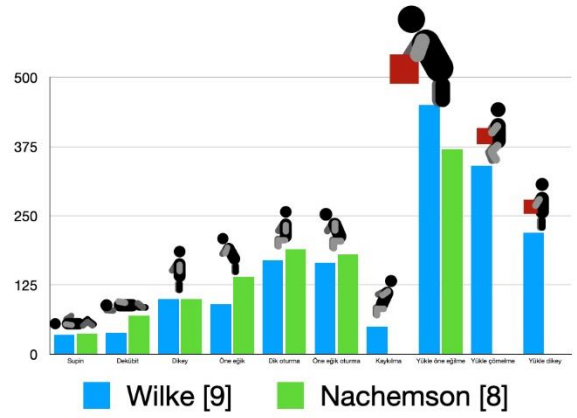
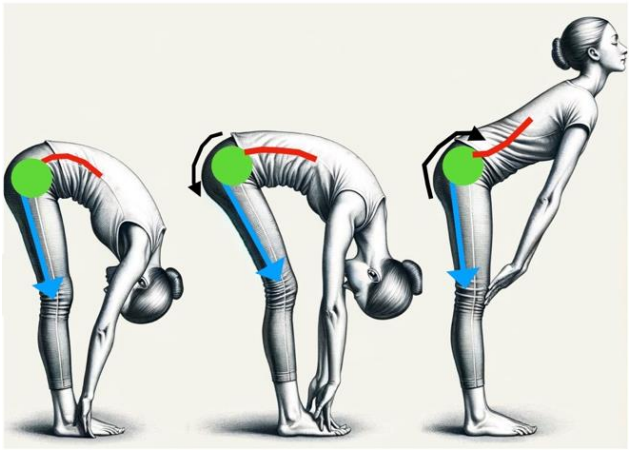


Figure 2: Importance of lumbopelvic rhythm during forward bending. Blue arrow – hamstrings, black arrow – pelvic tilt direction.



Materials and methods

The Yeni Yuzyil University Ethical Committee approval was granted before the commencement of our study (file no: 16.12.2021/43).

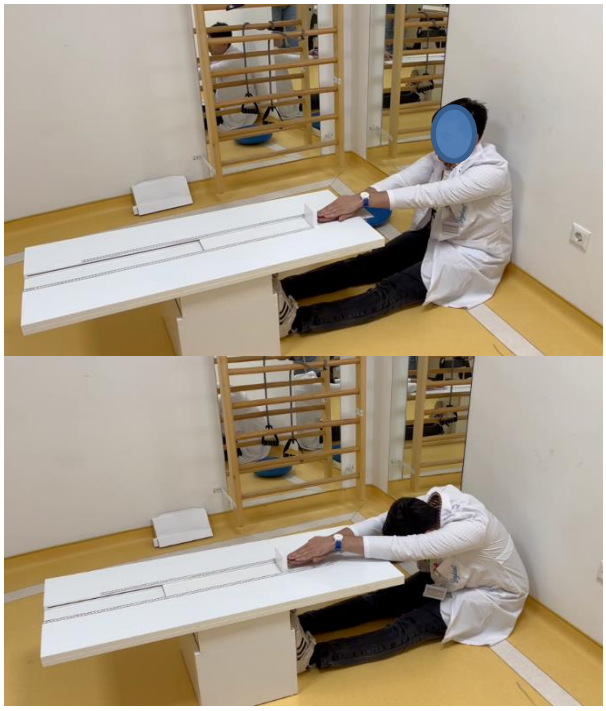
This cross-sectional research was conducted between March and April 2022 at Beykent University, and the study population consisted of 62 healthcare workers of both sexes between 25- and 45-year-olds working at Beykent University Hospital. Volunteers were randomly selected. Two groups were formed. The group with chronic LBP was compared to those with no pain in hamstring shortness. Chronic LBP was accepted as the pain lasted for not less than three days a week and was more protracted than at least three months.

Statistical analysis

Several tests were used to collect data: (1) Visual Analogue Score (VAS), (2) Quebec, Roland–Morris and Oswestry Disability Index (ODI) questionnaires, (3) Active Knee Extension (AKE), (4) Passive Knee Extension (PKE), (5) Sit and Reach (SR), and (6) Toe Reach (TR) tests.

We designed a custom-made modifiable mechanical device, particularly for the SR test (Figure 3). SPSS 25.0 was used for statistical analysis (confidence interval [CI]=20%, $P<0.05$). Levene, Shapiro–Wilk, Kolmogorov–Smirnoff, Mann–Whitney-U, Kruskal–Wallis, and Chi-squared tests were applied.

Figure 3: Sit and reach test.



Results

A total of 62 individuals participated in the study, including 24 males and 38 females. Twenty-eight participants met the chronic LBP criteria and 34 were considered control participants (groups 1 and 2, respectively). Roland–Morris (P=0.032), ODI (P=0.017), SR (P=0.012), and TR (P=0.005) results presented significant differences between sexes in favor of females indicating a decreased rate of LBP; henceforth, this finding was interpreted as more flexible hamstrings and thus a lower rate of LBP.

A significant distinction between the two main groups (LBP versus normal) in terms of Roland-Morris (P<0.001), Quebec (P<0.001), ODI (P<0.001), AKE (P<0.001), PKE (P<0.001), TR (P=0.005), and SR (P=0.005) tests was found; therefore, the results were found to support our hypothesis.

We also compared anthropometric parameters, such as weight, height, leg, foot, and torso length, their proportional varieties, lower extremity circumferences, and other parameters. Several statistical tests were applied, and only one significant relationship could be built concerning LBP or hamstring shortness. A significant (P=0.008) positive correlation between PKE and AKE regarding advancing age was noted. Since this was a specific ratio, we concluded that not only did the passive range of motion improve with age, but active motion also deteriorated due to the degraded muscle power. Also, a wide range of people near the upper age limit of our study reported doing yoga, Pilates, and other stretching exercises, which might have contributed to the finding.

Also, the population was divided into three occupation groups: (1) doctors, (2) nurses, and (3) other data managers. No significant differences between these groups were found, indicating that all occupations presented the same weighted risk in terms of LBP.

Discussion

This study originated from an idea of at least 40 years of popularity [10]. Hamstring muscles possess a broad range of functionality over the knee joint and create a posterior tilt on the pelvis due to its origin and insertion [11]. Nevertheless, it has been only a couple of decades that hamstrings were felt to directly correlate to chronic LBP [12]. Similar study designs have already been published [13–15]. However, an adequate investigation of healthcare facility workers in terms of LBP has not been done to date, thus giving added value to our research.

Various epidemiological papers claim a higher rate of chronic LBP than predecessors [1,16]. There is a diversity of culprits such as a sedentary lifestyle, easy access to unhealthy food pumped with high carbohydrates that lacks fibers, low level of exercise and low demand of bipedal movement, consecutively bloating body mass index, which leads to inappropriate and rather non-ergonomic usage of muscles, accordingly, triggering an ache in the vertebral column and paravertebral structures. Although we did not find any relationship between BMI and chronic LBP, we must point out that we didn't have any attendees suffering from obesity. We wouldn't acknowledge the threshold of body mass index (BMI) to trigger the LBP, which is, in fact, out of context.

We included the 18–45 age range to rule out hyper- and hypo-elastic individuals. On the other hand, age 45 is also the upper age limit for ruling out degenerative musculoskeletal diseases that occur in older people. Reference studies used similar ranges for similar physiological features [1,3,5,6].

Figure 2 depicts forward bending through lumbopelvic rhythm during which the hip joint collaborates with the lumbar vertebrae to improve the reaching angle and expedite the movement. Pelvic posterior sagittal tilt eventually leads to vertebral misalignment, called flatback, which appears to be responsible for the exacerbated pressure on the front of the vertebral body and endplates. Considering that intervertebral discs are nourished through these zones, gradual degeneration occurs if flatback is left untreated. A meta-analysis proved this process was prevented by strengthening antagonistic quadriceps muscles [17]. On the other hand, we excluded all patients with severe spondyloarthritis and/or lumbar hernia, which abolished the possibility of our research to investigate these issues as causes of LBP.

Various choices are commercially available for the SR test, yet many of them need to pay attention to the aforementioned anthropometric measures that could induce slightly erroneous results. Therefore, we recruited two specific intertwined rulers and also marked initial and final points in each attendee to obtain the arm's length. We also adjusted the table height, exactly matching their xiphoid processes with −5, 0, +5, +10, and +15 cm stakes.

Hamstring muscles are the most susceptible muscles for shortening. Shortening aggravates the flatback, which leads to increased thoracic kyphosis because all motor nerves are attached to the spinal cord after which hamstring shortening causes a flare-up of the shortening in the whole posterior chain of muscles [18].

Some study limitations need to be discussed. Our study was conducted in a private clinic setup, which could differ from

other types of healthcare settings in many aspects, such as working conditions, hours, shifts, work environment, and other parameters. Therefore, these conditions might elicit some or even entirely different outcomes. Several centers with many participants are needed to strengthen the results of our research. Participant numbers might seem ample according to power analysis, but they are not diverse enough to create a pool with various symptoms that could be classified as metadata.

We relied on merely subjective forms and physical examinations in this study. A diagnostic tool, such as magnetic resonance imaging, would aid us in obtaining a more precise evaluation. Since it is a cross-sectional study, it would be satisfactory to include MRI results that could correlate with lumbago.

Conclusion

This study describes a relationship between hamstring muscle shortness and chronic LBP in otherwise healthy healthcare workers. We investigate gender, age, occupation, height, leg length, and weight in terms of hamstring muscle shortness for any relationship with LBP. Perpetual data recording and patient care due to an overwhelming workload and long work hours force healthcare facility workers to sit for prolonged hours in addition to inevitably sedentary leisure time, both of which cause hamstring muscle tightness. Therefore, an action as simple as addressing this issue in these workers would prevent chronic LBP for many healthcare workers and increase their overall welfare.

References

1. Shemory ST, Pfefferle KJ, and Gradisar IM. Modifiable risk factors in patients with low back pain. Orthopedics. 2016 May;39(3):413–6. doi: 10.3928/01477447-20160404-02.
2. Hoy D, Bain C, Williams G, March L, Brooks P, Blyth F, et al. A systematic review of the global prevalence of low back pain. Arthritis and Rheumatism. 2012 June;64(6):2028–37. doi: 10.1002/art.34347.
3. Fatima G, Qamar M, Ul Hassan J, and Basharat A. Extended sitting can cause hamstring tightness. Saudi Journal of Sports Medicine. 2017;17(2):110. doi: 10.4103/sjsm.sjsm_5_17.
4. Kanishka GK, Sandamali H, Weerasinghe I, Binduhewa L, Dilshara C, De Silva C, et al. Prevalence of hamstring tightness and associated factors among sewing machine operators. Ceylon Journal of Medical Science. 2020 Feb;56(1):24. doi: 10.4038/cjms.v56i1.4957.
5. Cejudo A, Centenera-Centenera JM, and Santonja-Medina F. The potential role of hamstring extensibility on sagittal pelvic tilt, sagittal spinal curves and recurrent low back pain in team sports players: A gender perspective analysis. Int J Environ Res Public Health. 2021 Aug;18(16). doi: 10.3390/ijerph18168654.
6. Jabbar M, Mustansar A, Zulfiqar F, Ayub T, Latif W, Laique T. Prevalence Of Hamstring Tightness Due To Prolonged Sitting Among Administrative Staff : Cross Sectional Study. P J M H S. 2021 March;15(3):1115-7.
7. Davis DS, Quinn RO, Whiteman CT, Williams JD, and Young CR. Concurrent validity of four clinical tests used to measure hamstring flexibility. J Strength Cond Res. 2008 March;22(2):583–8. doi: 10.1519/JSC.0b013e31816359f2.
8. Nachemson A. Lumbar intradiscal pressure. Experimental studies on post-mortem material. Acta Orthop Scand Suppl. 1960;43:1–104. doi: 10.3109/ort.1960.31.suppl-43.01.
9. Wilke HJ, Neef P, Hinz B, Seidel H, Claes L. Intradiscal pressure together with anthropometric data - a data set for the validation of models. Clinical Biomechanics. 2001;16. doi: 10.1016/S0268-0033(00)00103-0.
10. Jackson AW and Baker AA. The relationship of the sit and reach test to criterion measures of hamstring and back flexibility in young females. Res Q Exerc Sport. 1986;57(3):183–6. doi: 10.1080/02701367.1986.10605395.
11. Mellin G. Correlations of hip mobility with degree of back pain and lumbar spinal mobility in chronic low-back pain patients. Spine. 1988 June;13(6):668–70.
12. Kuukkanen T and Mälkiä E, Effects of a three-month therapeutic exercise programme on flexibility in subjects with low back pain. Physiotherapy Research International. 2000;5(1).
13. Moreira RFC, Moriguchi CS, Carnaz L, Foltran FA, Silva LCCB, Coury HJCG. Effects of a workplace exercise program on physical capacity and lower back symptoms in hospital nursing assistants: a randomized controlled trial. Int Arch Occup Environ Health. 2021 Feb;94(2):275–84. doi: 10.1007/s00420-020-01572-z.
14. Denis A, Zelmar A, Le Pogam MA, Chaleat-Valayer E, Bergeret A, Colin C. The PRESLO study: Evaluation of a global secondary low back pain prevention program for health care personnel in a hospital setting. Multicenter, randomized intervention trial. BMC Musculoskelet Disord. 2012 Nov;13:234. doi: 10.1186/1471-2474-13-234.
15. Barene S, Holtermann A, Oseland H, Brekke OL, Krustrup P. Effects on muscle strength, maximal jump height, flexibility and postural sway after soccer and Zumba exercise among female hospital employees: a 9-month randomised controlled trial. J Sports Sci. 2016 Oct;34(19):1849–58. doi: 10.1080/02640414.2016.1140906.
16. Meucci RD, Fassa AG, and Xavier Faria NM. Prevalence of chronic low back pain: Systematic review. Revista de Saude Publica (Universidade de Sao Paulo). 2015 Oct;49(1). doi: 10.1590/S0034-8910.2015049005874.
17. de Sousa CS, de Jesus FLA, Machado MB, Ferreira G, Ayres IGT, de Aquino LM, et al. Lower limb muscle strength in patients with low back pain: a systematic review and meta-analysis. J Musculoskelet Neuronal Interact. 2019 March;19(1):69–78.
18. Medeiros DM, Cini A, Sbruzzi AG, Lima CS, Influence of static stretching on hamstring flexibility in healthy young adults: Systematic review and meta-analysis. Physiother Theory Pract. 2016 Aug;32(6):438–45. doi: 10.1080/09593985.2016.1204401.
19. Neumann DA. A comparison between data from two intradiscal pressure studies. Kinesiology of the Musculoskeletal System. Mosby Elsevier. 2010;2(9):331.

J Surg Med. 2024;8(8):136-139.
https://doi.org/10.28982/josam.7395

JOSAM

Journal of Surgery and Medicine

e-ISSN: 2602-2079

Case report
https://jsurgmed.com/

A challenging case of hemobilia: Endovascular treatment of cystic artery pseudoaneursym secondary to acute cholecystitis

Yasin Celal Güneş, Bilal Egemen Çifçi, Fatma Ayça Edis Özdemir

Ankara City Hospital, Department of Radiology, Ankara, Turkey

ORCID of the author(s)

YCG: https://orcid.org/0000-0001-7631-854X
BEÇ: https://orcid.org/0000-0002-1664-3241
FAEÖ: https://orcid.org/0000-0002-0172-6837

Abstract

Acute cholecystitis is a leading cause of individuals seeking medical attention in the emergency department due to right upper quadrant pain. Common complications associated with this clinical condition, which is frequently encountered in daily practice, include gangrenous cholecystitis, pericholecystic abscess, cholangitis, and gallbladder perforation. It is important to also consider the rare but potentially severe complication of cystic artery pseudoaneurysm. This case report details the development of a cystic artery pseudoaneurysm secondary to acute cholecystitis and its subsequent endovascular treatment in a 59-year-old male patient with no known underlying medical conditions, in accordance with existing literature.

Keywords: cystic artery, pseudoaneurysm, hemobilia

Introduction

Cystic artery pseudoaneurysm is an exceedingly uncommon complication, typically arising as a consequence of biliary system interventions but occasionally observed, albeit rarely, following acute cholecystitis [1]. In instances of complicated cases, inflammatory alterations within the pericholecystic region and potential concomitant hemorrhage may pose challenges for accurate detection through imaging modalities. Failure to promptly diagnose and treat this condition can result in significant morbidity and mortality.

Corresponding Author
Yasin Celal Güneş
Ankara City Hospital, Department of Radiology, Ankara, Turkey
E-mail: gunesyasincelal@gmail.com

Informed Consent
The authors stated that the written consent was obtained from the patient presented with images in the study.

Conflict of Interest
No conflict of interest was declared by the authors.

Financial Disclosure
The authors declared that this study has received no financial support.

Published
2024 August 17

How to cite: Güneş YC, Çifçi BE, Edis Özdemir FA. A challenging case of hemobilia: Endovascular treatment of cystic artery pseudoaneursym secondary to acute cholecystitis. J Surg Med. 2024;8(8):136-139.

Case presentation

A 59-year-old male patient, previously free of known medical conditions, presented to our hospital's emergency department with complaints of progressively worsening right upper quadrant pain, accompanied by nausea and vomiting over the past two weeks. Upon physical examination, positive findings included defense and rebound tenderness, while the patient exhibited a body temperature of 38°C. Laboratory tests revealed elevated hepato-pancreaticobiliary enzyme levels, specifically: aspartate aminotransferase at 123 IU/L (normal range: <35), alanine aminotransferase at 197 IU/L (normal range: <50), alkaline phosphatase at 651 IU/L (normal range: < 119), γ-glutamyltransferase at 1275 IU/L (normal range: <73), total bilirubin at 2.7 mg/dL (normal range: <1.2 mg/dL), and direct bilirubin at 2.2 mg/dL (normal range: <0.3 mg/dL). The patient's leukocyte count was elevated at 14.58×10^3 cells/mL, while other laboratory parameters remained within normal limits.

An ultrasound examination was conducted to assess the patient, given the preliminary diagnosis of acute cholecystitis, revealing an enlarged gallbladder (transverse diameter: 4 cm). The gallbladder contained concentrated bile sludge and a few stones with a diameter of 1.5 cm. These findings were consistent with acute cholecystitis. Subsequently, a contrast-enhanced upper abdomen computed tomography (CT) scan was performed to provide a comprehensive evaluation and identify potential additional pathologies. The CT scan revealed hydropic changes in the gallbladder, marked thickening and irregularity in the gallbladder wall, and stranding in the pericholecystic area. Furthermore, dilation of the intrahepatic bile ducts and a common bile duct diameter of 16 mm were observed. Density increments suggestive of possible stones or biliary sludge were identified in the lumen distal to the common bile duct. The pancreas appeared normal in the imaging (Figures 1 and 2).

The patient, who was admitted with acute cholecystitis, was initiated on treatment protocols involving Ceftriaxone (2 × 1 gr) and IV Metronidazole (4 × 500 mg) upon hospitalization. Subsequently, the patient underwent endoscopic retrograde cholangiopancreatography for choledocholithiasis, during which a biliary tract stone was successfully removed, and a 10F stent was placed due to the blunt distal end of the common bile duct. Additionally, brush cytology was performed from the distal common bile duct at the conclusion of the procedure, revealing findings consistent with hemorrhage.

A follow-up hepatobiliary ultrasound examination of the patient detected an echogenic fluid collection extending up to 6 cm in the gallbladder fossa, primarily suggestive of hemobilia. To further elucidate the etiology, a subsequent dynamic upper abdomen CT scan was performed. The gallbladder walls displayed irregularity, making it challenging to assess wall integrity. Within the gallbladder lumen, a prominently opacified 9 mm diameter pseudoaneurysm was observed, particularly during the arterial phase. Furthermore, heterogeneous density increases were noted in the surrounding adipose tissue in the subhepatic area and the paracolic area adjacent to the gallbladder. The CT examination confirmed the large-sized hemobilia previously identified in the ultrasound (Figure 3).

Figure 1: Upper abdomen CT revealed hydropic and heterogeneous gallbladder and mucosal hyperenhancement which resembled acute cholecystitis (arrow), pancreas head was normal (star)

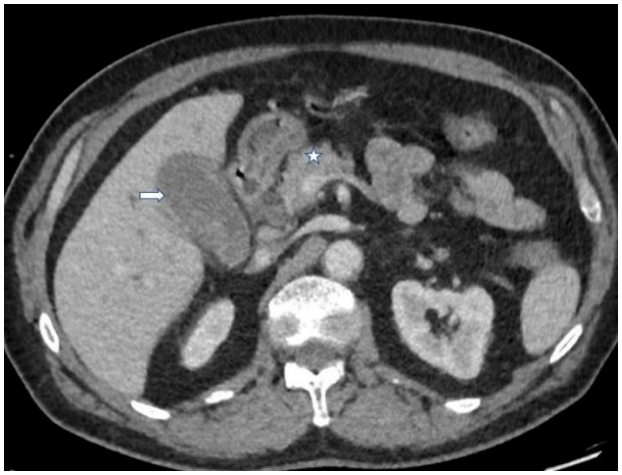
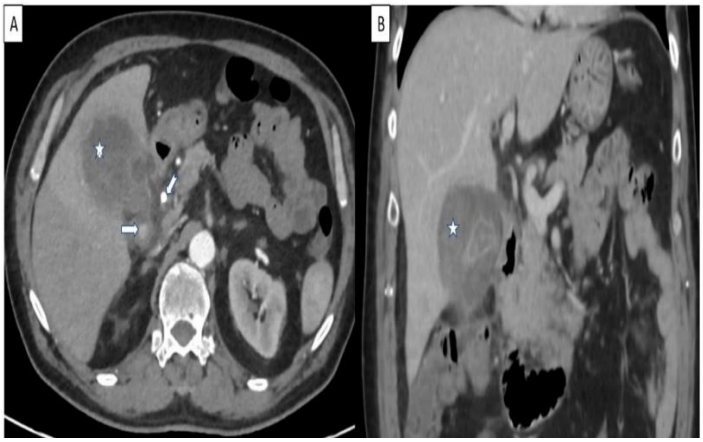


Figure 2: Upper abdomen CT showed a nodular lesion in the portal venous phase. The lesion was thought to be a gallbladder stone. The following imaging modalities revealed that was a pseudoaneursym (arrow)

Figure 3: A.B Dynamic upper abdomen CT revealed cystic artery pseudoaneurysm in the arterial phase (arrow) and giant hemobilia at the gallbladder fossa (star), biliary stent (notched arrow)



Following these findings, the patient was referred to the interventional radiology department. Superselective angiography revealed the origin of the pseudoaneurysm from a branch of the cystic artery. The cystic artery was successfully embolized using coils, resulting in the disappearance of the aneurysm during follow-up (Figures 4 and 5). No complications were observed throughout the monitoring period, and the patient was discharged with appropriate recommendations.

Figure 4: A.B Super selective angiography revealed cystic artery pseudoaneurysm (arrow), the pseudoaneursym was embolized with coils and the aneurysm disappeared in the control (notched arrow)

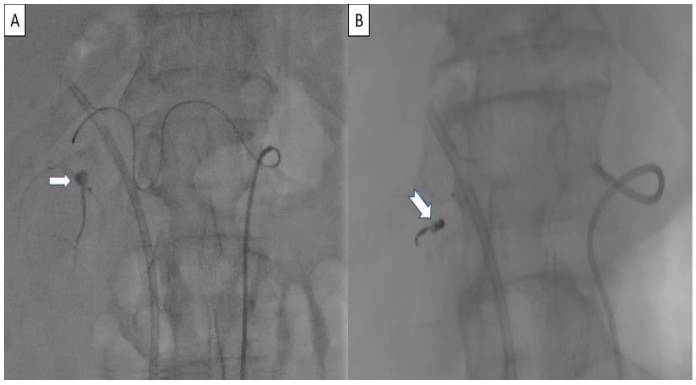
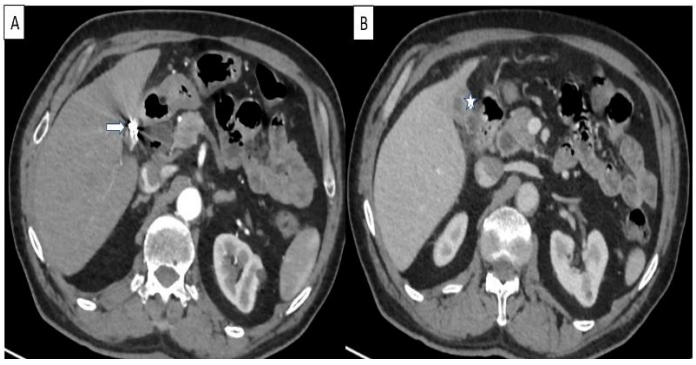


Figure 5: A.B After the six months of embolization, control upper abdomen CT revealed embolization material in the gallbladder fossa (arrow), post-operative changes in the gallbladder (star)



Discussion

Acute cholecystitis stands out as one of the most prevalent causes of right upper quadrant pain encountered in daily medical practice. Patients typically present with symptoms such as fever, nausea, vomiting, and right upper quadrant pain. If acute cholecystitis is inadequately treated, it can lead to severe complications, including pericholecystic abscess, cholangitis, necrosis in the gallbladder, gallbladder perforation, and peritonitis [2,3]. Another noteworthy complication in untreated cholecystitis cases in the chronic phase is the development of a cholecystoduodenal fistula [4].

While acute cholecystitis is relatively common, the occurrence of a pseudoaneurysm in the context of acute cholecystitis is exceedingly rare and is mainly documented in isolated case reports in the literature [5,6]. The most prevalent predisposing factor for the development of cystic artery pseudoaneurysms is a history of previous cholecystectomy surgery [7]. It has been suggested that inflammation secondary to acute cholecystitis may weaken the arterial wall, serving as the underlying etiology for this condition [8]. Patients with cystic artery pseudoaneurysms typically present with symptoms like hemobilia, hemoperitoneum, and occasionally upper gastrointestinal bleeding. Clinical manifestations, often referred to as Quincke's triad, include upper abdominal pain, obstructive jaundice, and gastrointestinal hemorrhage [9].

Although a characteristic yin-yang pattern is described in Doppler ultrasound for detecting cystic artery pseudoaneurysms, ultrasound alone may present challenges in diagnosis. In cases where rupture occurs, hyperechoic fluid may be observed in the gallbladder lumen on ultrasound, warranting consideration of an underlying pseudoaneurysm. CT angiography is deemed the most effective diagnostic tool for evaluating major arteries in the context of intra-abdominal inflammatory conditions. It can reveal anatomical variations and detect pseudoaneurysms. In our specific case, the initial CT scan lacked precontrast images, leading to a misinterpretation of the cystic artery pseudoaneurysm as a stone. However, upon reevaluation with a dynamic CT scan that included precontrast and arterial phase images, the true nature of the lesion as a cystic artery pseudoaneurysm became evident. In certain instances, the diagnosis of small-sized pseudoaneurysms may necessitate standard catheter angiography [10].

The management of cystic artery pseudoaneurysms remains a subject of debate in the medical community. While there have been reports of successful non-operative management of hemobilia, the majority of recommendations lean towards interventional approaches, such as selective visceral angiography with embolization or surgical intervention [11]. Furthermore, percutaneous selective cystic artery embolization has emerged as an effective treatment strategy, boasting lower mortality and morbidity rates, improved identification of the bleeding vessel, and enhanced hemorrhage control compared to surgical options. A significant advantage of this approach is its ability to combine both diagnosis and treatment within the same procedure session [12].

Moreover, some publications advocate for performing an elective cholecystectomy following embolization in patients with cystic artery pseudoaneurysm [13]. However, it is worth noting that in the case of our patient, they declined the cholecystectomy procedure, making it impossible to proceed with that aspect of the treatment.

The embolization process can employ various materials such as coils, N-Butyl cyanoacrylate (glue injection), or Gelfoam. Coil embolization stands as the most commonly employed method, with different coil sizes were chosen based on the vessel's diameter during the procedure [14]. It is important to note that some other embolizing agents carry the risk of potentially elevating pressure within the vascular lesion, which may lead to rebleeding after endovascular embolization [15].

Conclusion

While the occurrence of a cystic artery pseudoaneurysm in the context of acute cholecystitis is rare, it should remain a noteworthy consideration as a significant cause of hemobilia when formulating a differential diagnosis.

References

1. Taghavi SMJ, Jaya Kumar M, Damodaran Prabha R, Puhalla H, Sommerville C. Cystic Artery Pseudoaneurysm: Current Review of Aetiology, Presentation, and Management. Surg Res Pract. 2021 Nov 24;2021:4492206. doi: 10.1155/2021/4492206. PMID: 34869829; PMCID: PMC8635945
2. Praveen Kumar Sunkara PRV, Shah PK, Rakshit K, Choudhary SR, Bohidar NP, Dubey SK. Rupture of Cystic Artery Pseudoaneurysm: a Rare Complication of Acute Cholecystitis. Indian J Surg. 2018 Feb;80(1):87-9. doi: 10.1007/s12262-017-1667-2. Epub 2017 Jun 28. PMID: 29581692; PMCID: PMC5866805.
3. Bedirli A, Sakrak O, Sözüer EM, Kerek M, Güler I. Factors effecting the complications in the natural history of acute cholecystitis. Hepatogastroenterology. 2001 Sep-Oct;48(41):1275-8. PMID: 11677945
4. Chong VH, Lim KS, Mathew VV. Spontaneous gallbladder perforation, pericholecystic abscess and cholecystoduodenal fistula as the first manifestations of gallstone disease. Hepatobiliary Pancreat Dis Int. 2009 Apr;8(2):212-4. PMID: 19357038.
5. Hague J, Brennand D, Raja J, Amin Z. Cystic artery pseudoaneurysms in hemorrhagic acute cholecystitis. Cardiovasc Intervent Radiol. 2010 Dec;33(6):1287-90. doi: 10.1007/s00270-010-9861-7. PMID: 20458590.
6. Alis D, Ferahman S, Demiryas S, Samanci C, Ustabasioglu FE. Laparoscopic Management of a Very Rare Case: Cystic Artery Pseudoaneurysm Secondary to Acute

Cholecystitis. Case Rep Surg. 2016;2016:1489013. doi: 10.1155/2016/1489013. Epub 2016 Aug 22. PMID: 27635274; PMCID: PMC5011207.
7. Petrou A, Brennan N, Soonawalla Z, Silva MA. Hemobilia due to cystic artery stump pseudoaneurysm following laparoscopic cholecystectomy: case presentation and literature review. Int Surg. 2012 Apr-Jun;97(2):140-4. doi: 10.9738/CC52.1. PMID: 23102080; PMCID: PMC3723213
8. Hall TC, Sprenger De Rover W, Habib S, Kumaran M. Cystic artery pseudoaneurysm secondary to acute cholecystitis: an unusual cause for haemobilia. BJR Case Rep. 2016 May 24;2(2):20150423. doi: 10.1259/bjrcr.20150423. PMID: 30363671; PMCID: PMC6180884.
9. Zhornitskiy A, Berry R, Han JY, Tabibian JH. Hemobilia: Historical overview, clinical update, and current practices. Liver Int. 2019 Aug;39(8):1378-88. doi: 10.1111/liv.14111. Epub 2019 May 3. PMID: 30932305.
10. Machado NO, Al-Zadjali A, Kakaria AK, Younus S, Rahim MA, Al-Sukaiti R. Hepatic or Cystic Artery Pseudoaneurysms Following a Laparoscopic Cholecystectomy: Literature review of aetiopathogenesis, presentation, diagnosis and management. Sultan Qaboos Univ Med J. 2017 May;17(2):e135-46. doi: 10.18295/squmj.2016.17.02.002. Epub 2017 Jun 20. PMID: 28690884; PMCID: PMC5488813.
11. Mokrane FZ, Alba CG, Lebbadi M, Mejdoubi M, Moulabbi M, Lombard F, Lengellé F, Aveillan M. Pseudoaneurism of the cystic artery treated with hyperselective embolisation alone. Diagn Interv Imaging. 2013 Jun;94(6):641-3. doi: 10.1016/j.diii.2012.07.002. Epub 2013 Feb 13. PMID: 23415465.
12. Proença AL, Veloso Gomes F, Costa N, Bilhim T, Luz JH, Coimbra É. Transarterial Embolization of Iatrogenic Cystic Artery Pseudoaneurysm. GE Port J Gastroenterol. 2020 Feb;27(2):115-8. doi: 10.1159/000501400. Epub 2019 Aug 7. PMID: 32266308; PMCID: PMC7113591.
13. Maeda A, Kunou T, Saeki S, Aono K, Murata T, Niinomi N, Yokoi S. Pseudoaneurysm of the cystic artery with hemobilia treated by arterial embolization and elective cholecystectomy. J Hepatobiliary Pancreat Surg. 2002;9(6):755-8. doi: 10.1007/s005340200105. PMID: 12658412.
14. Carey F, Rault M, Crawford M, Lewis M, Tan K. Case report: cystic artery pseudoaneurysm presenting as a massive per rectum bleed treated with percutaneous coil embolization. CVIR Endovasc. 2020 Jan 15;3(1):8. doi: 10.1186/s42155-019-0090-0. PMID: 32027010; PMCID: PMC6966396.
15. Keeling AN, McGrath FP, Lee MJ. Interventional radiology in the diagnosis, management, and follow-up of pseudoaneurysms. Cardiovasc Intervent Radiol. 2009 Jan;32(1):2-18. doi: 10.1007/s00270-008-9440-3. Epub 2008 Oct 16. PMID: 18923864.