Perioperative cardiac investigations for chest pain after parathyroidectomy rarely yield a cardiac diagnosis

Michael Guo, MD1*
Daniel Ben Lustig, MSc, MD*
Karina Chornenka, MD
Adrienne L Melck, MD, MPH

*Both authors contributed equally to this study.

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Correspondence to:
A.L. Melck
Faculty of Medicine
Division of General Surgery Active Staff
St. Paul's Hospital
Department of Surgery
Room C303-1081 Burrard St
Vancouver BC V6Z 1Y6
amelck@providencehealth.bc.ca

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Background: The incidence of adverse perioperative cardiac complications after parathyroidectomy has not been well described. This study aimed to evaluate the incidence of perioperative chest pain and cardiac complications after parathyroidectomy and to evaluate risk factors that may identify patients who are more likely to benefit from a cardiac workup.

Methods: We performed a retrospective study of all patients undergoing parathyroidectomy for primary hyperparathyroidism by a single endocrine surgeon at a tertiary endocrine centre between 2011 and 2018. Patient demographics, clinicopathologic variables, operative and postoperative details (reported chest pain, performance of a cardiac workup and new postoperative cardiac diagnosis) were reviewed. Patients with chest pain were compared to those without chest pain using the Fisher exact test and Student *t* test.

Results: Fourteen of 295 patients (4.7%) reported chest pain in the immediate postoperative period. Most patients were investigated with a 12-lead electrocardiogram and troponin (n = 12/14), yet none were diagnosed with a cardiac event. When comparing patients with and without chest pain, there was no significant difference in age, gender, body mass index, presence of cardiovascular risk factors, American Society of Anesthesiologists score or length of surgery.

Conclusion: Postoperative chest pain after parathyroidectomy is not an uncommon event and leads to a cardiac workup in most cases; however, the risk of significant postoperative cardiac events is minimal. In the "choosing wisely" era, one should evaluate each patient's pretest probability of such events and avoid extensive workup in low-risk patients to avoid unnecessary costs to the health care system.

Contexte : L'incidence des complications cardiaques périopératoires après la parathyroïdectomie n'a pas été bien décrite. Cette étude visait à évaluer l'incidence des douleurs rétrosternales (DRS) et des complications cardiaques périopératoires après la parathyroïdectomie et à analyser les facteurs de risque qui permettraient d'identifier les patients les plus susceptibles de bénéficier d'une batterie d'examens cardiaques.

Méthodes : Nous avons procédé à une étude rétrospective sur tous les patients ayant subi une parathyroïdectomie pour hyperparathyroïdie primaire effectuée par un seul spécialiste en chirurgie endocrinienne d'un centre de soins tertiaires d'endocrinologie entre 2011 et 2018. Nous avons passé en revue les caractéristiques démographiques et clinico-pathologiques des patients et certaines données per- et postopératoires (DRS, résultats des examens cardiaques et diagnostic postopératoire nouveau de cardiopathie). À l'aide du test exact de Fisher et du test *t* de Student, nous avons comparé les patients selon qu'ils avaient ou non présenté des DRS.

Résultats : Quatorze patients sur 295 (4,7 %) se sont plaints de DRS durant la période postopératoire immédiate. La plupart (n = 12/14) ont alors subi un électrocardiogramme à 12 dérivations et un dosage de la troponine, et aucun n'a reçu de diagnostic de cardiopathie. La comparaison entre les patients ayant ou non présenté des DRS n'a fait ressortir aucune différence quant à l'âge, au sexe, à l'indice de masse corporelle, aux facteurs de risque cardiovasculaires, au score de l'American Society of Anesthesiologists et à la durée de la chirurgie.

Conclusion : Les DRS postopératoires ne sont pas rares après la parathyroïdectomie et dans la plupart des cas, elles donnent lieu à des batteries d'examens pour le cœur, alors que le risque de graves complications cardiaques postopératoires est minime. En cette époque où il faut « choisir avec soin », on doit évaluer la probabilité de survenue de tels événements chez chaque patient et s'abstenir de demander des examens trop poussées chez ceux qui ont un risque faible afin de réduire les coûts superflus pour le système de santé.

Chest pain is a common nonspecific symptom that patients may endorse in the postoperative setting, with potential causes ranging from benign to medical emergencies. Acute myocardial injury is the most common urgent consideration in the context of isolated chest pain.[1] However, numerous studies have indicated that chest pain, even with the presence of suggestive features of ischemia, is a poor predictor of acute coronary syndrome. Chest pain in isolation has not been proven specific enough to prompt further cardiac investigations.[2–4] A study of experienced cardiologists' abilities to detect coronary artery disease showed that even with decades of experience, a clinician's gestalt has a low level of accuracy, with "typical chest pain" yielding negligible positive and negative likelihood ratios. The study further reported poor interclinician agreement in the definition of "typical chest pain."[4]

Most postoperative myocardial infarctions (MIs) do not present with the "typical" features, such as chest pressure or pain, dyspnea, diaphoresis, nausea or vomiting, which makes the symptomatology even less valuable as a trigger for further investigations. A prospective study following patients undergoing noncardiac surgery, who were considered to be at increased cardiovascular risk, found that only 6% of patients who experienced a postoperative MI presented with typical features, and only 18% had any ischemic symptoms.[5]

Routine investigations for vague complaints of chest pain in the inpatient setting often result in negative findings, becoming a reflexive and unhelpful practice for clinicians to rule out cardiac events. In light of increasing vigilance for perioperative cardiac events,[6] this practice has become more substantiated in the past decade. However, ordering potentially unnecessary investigations is not without consequence and has been shown to prolong hospital stay and incur unnecessary health care costs.[7] This has been demonstrated by campaigns like "Choosing Wisely Canada," which encourage ongoing discussion and leadership to provide high-quality care through smart and effective choices.[8]

The gold standard treatment for primary hyperparathyroidism is a minimally invasive parathyroidectomy guided by intraoperative parathyroid hormone (ioPTH) monitoring. This can be done safely as day surgery and is a very low-risk operation in the hands of high-volume surgeons.[9] There is a paucity of evidence reporting the incidence of cardiac events related to low-risk procedures specific to parathyroidectomy.[10] We hypothesize that the incidence is low, and therefore ordering perioperative cardiac investigations in patients with a low risk of cardiac events may benefit from a more tailored approach.

We conducted a retrospective study of patients undergoing parathyroid surgery to evaluate the incidence of chest pain and cardiac complications in the immediate perioperative period and within 30 days after parathyroidectomy, to evaluate risk factors that may assist surgeons to identify patients more likely to benefit from a cardiac workup.

Methods

We performed a retrospective study of all patients who underwent a minimally invasive (focused single gland excision) parathyroidectomy for primary hyperparathyroidism by a single endocrine surgeon at a tertiary referral centre for endocrine surgery between January 2011 and December 2018. At our centre, most patients with primary hyperparathyroidism undergo a minimally invasive parathyroidectomy with ioPTH monitoring. Bilateral explorations are undertaken in cases where multigland disease is suspected (i.e., lithium-induced primary hyperparathyroidism, familial disease or suggestion of more than 1 enlarged gland on preoperative imaging) or in cases of a less than 50% drop in the ioPTH from baseline after unilateral exploration.[10] Patients are followed for a minimum of 6 months postoperatively, and calcium levels are checked at 2 weeks and 6 or more months postoperatively in addition to clinical visits, which we have found adequately approximates recurrence rates. Most patients have their final set of blood work done past the 6-month mark. No other extended electrolytes are measured routinely.

We excluded patients with secondary and tertiary hyperparathyroidism (i.e., renal hyperparathyroidism) as they often have multiple comorbidities, including coronary artery disease. In addition, these patients often get postoperative 12-lead electrocardiograms (ECGs) for hypocalcemia that results from postoperative hungry bone syndrome and so it may be difficult to ascertain the indication for the postoperative ECGs. Patient demographics, clinicopathologic variables, cardiac risk factors (hypertension, dyslipidemia, diabetes, smoking and obesity), operative and postoperative details including complaints of chest pain, performance of a cardiac workup, and new postoperative cardiac diagnosis, which included angina and MI, were reviewed from the immediate postoperative period, defined as within 30 days from the initial surgery. We compared patients with chest pain to those without chest pain using a Fisher exact test and Student t test for categorical and continuous variables, respectively. A p value < 0.05 was considered statistically significant. The study was approved by the University of British Columbia institutional research ethics board.

Results

A total of 295 patients with primary hyperparathyroidism were included in our study. The mean age was 61.1 ± 13.7 years (range 16–89 yr). The patient population

was 19.7% male (n = 58) and 80.3% women (n = 237). Of the 295 patients, 38 (19.5%) required bilateral neck exploration for suspicion of multigland disease, and 286 (97%) remained normocalcemic after the 6-month postoperative period, with only 8 patients having persistent or recurrent disease indicated by postoperative calcium levels. Of the 295 patients, 14 (4.7%) reported chest pain in the immediate postoperative period. All 14 were investigated with 12-lead ECGs and 12 of 14 (85.7%) with troponins. None received a diagnosis of a cardiac event. When we compared patients with and without chest pain, we found no significant difference in age, body mass index, presence of cardiovascular risk factors, American Society of Anesthesiologists (ASA) score, or length of surgery (Table 1). There was a trend toward more female patients (93% v. 70%, p = 0.08) and a longer hospital length of stay (1.2 v. 0.74 d, p = 0.07) in the group with chest pain.

Patients with chest pain more commonly had a history of an anxiety disorder than patients without chest pain (21% v. 4%, p = 0.02).

Table 1. Comparison of baseline characteristics in patients undergoing parathyroidectomies between those who reported chest pain postoperatively and those who did not

Patient characteristics	Patients with chest pain (n = 14/295)	Patients without chest pain (n = 281/295)	p value*
Age, yr	64.2	66.4	0.68
Female sex	93%	70%	0.08
BMI	26.8	24.4	0.15
Cardiovascular risk factors	6.1%	4.6%	0.56
ASA classification	2.46	2.38	0.86
Length of OR stay, hr	1.25	1.12	0.54
Length of hospital stay, d	1.20	0.74	0.07
History of anxiety disorder	21%	4%	0.02

ASA = American Society of Anesthesiologists; BMI = body mass index; OR = operating room.

*Calculated using Fisher exact test and Student t test for categorical and continuous variables, respectively.

Discussion

To our knowledge, this study is the first to review the incidence and yield of routine cardiac investigations in patients undergoing parathyroidectomy for primary hyperparathyroidism. Our results showed a low incidence (4.7%) of documented chest pain in the immediate postoperative period. There were no significant differences between patients with and without cardiovascular risk factors who experienced chest pain. Most patients with chest pain received investigations (n = 12/14), of which none yielded a cardiac diagnosis.

Such data put into question the utility of frequent postoperative cardiac testing in patients with chest pain after a low-risk surgery.

Parathyroidectomy is widely regarded as a safe and well-tolerated procedure in experienced hands, in part owing to advancements in preoperative gland localization, leading to a more focused neck exploration and, ultimately, shorter operating times. Most postoperative complications after parathyroidectomy are usually temporary and treatable. Cardiovascular complications remain an uncommon postoperative complication and are scarcely reported. In a retrospective review of 21 267 patients undergoing parathyroidectomy in the United States, cardiovascular complications ranged from 0.2% to 1.8%, depending on the indication for surgery, with most patients with events having previous cardiac event risk factors.[9]

There are theoretical links between hyperparathyroidism and impaired cardiovascular function owing to the molecular actions of parathyroid hormone and hypercalcemia on the cardiovascular system.[10] However, whether this translates to a significant clinical impact has yet to be established, especially in the immediate postoperative period. A smaller prospective study found no differences in systolic and diastolic functioning, nor cardiac morphology, in patients with primary hyperparathyroidism compared with age-matched controls with no cardiovascular risk factors.[11] Risk factors for chest pain after parathyroid surgery have yet to be reported in the literature. Our results did not show a difference in the presence of cardiovascular risk factors between the subgroup experiencing chest pain compared with the rest of the cohort. However, our results do suggest that female sex and the presence of anxiety disorder on initial consultation are associated with higher rates of postoperative chest pain. Interestingly, similar results have been shown in the perioperative setting for patients with lung cancer.[12] These findings support our hypothesis that anxiety may be a significant driver of postoperative pain in patients undergoing minimally invasive parathyroidectomy.

Another possible explanation for noncardiac postoperative chest pain is that patients feel the after-effects of physical pressure on the chest during the operation, which may arise from the surgical team or from instruments inadvertently placed on the chest, such as a magnetic pad. However, the standard of practice at our centre is not to use a magnetic pad on the patient's chest for parathyroid surgery and to make every effort during the procedure to avoid direct pressure on any part of the patient's body. The unknown psychological burden of awaiting investigations for cardiac events in an already stressful postoperative environment warrants further study. Patient-reported experience measures have improved our understanding of value-based care, and may be a beneficial addition to investigate the impact of unnecessary medical investigations.

Much of the evidence on early postoperative cardiac testing in noncardiac surgery is based on large studies in patients undergoing major surgeries who have a high baseline cardiac risk.[13,14] The Vascular Events In

Noncardiac Surgery Patients Cohort Evaluation (VISION) trial is the largest study, which evaluated an international cohort of 15 133 patients undergoing noncardiac surgery.[14] The study reported a 30-day mortality rate of 1.9% and demonstrated significant association between 30-day mortality and peak postoperative troponin T levels.[14] A large prospective study conducted by Rinfret and colleagues showed immediate postoperative ECGs to be a significant independent predictor of major cardiac complications (odds ratio 2.2, 95% confidence interval 1.2–3.9).[13] The data from these trials suggest a high yield for troponin and ECG as investigations for postoperative chest pain. However, it is difficult to extrapolate these data to low-risk surgeries, especially in patients without cardiac risk factors before surgery. The VISION trial included patients undergoing emergent and high-risk surgeries, most of whom had cardiovascular risk factors (24.2% older than 75 yr, 50.9% with hypertension, 19.5% with diabetes, 12.1% with history of coronary artery disease).[14] In the study by Rinfret and colleagues, a large proportion of the patient cohort had cardiovascular risk factors (40.9% with ASA classification ≥ 3, 65.6% past or present smokers, 44.3% hypertension) and underwent high-risk procedures (32.1%).[13] However, in both studies there were no data that exclusively examined low-risk procedures or patients with no or minimal cardiovascular risk factors. We acknowledge the importance of considering routine use of cardiac investigations in older patients and those with significant cardiovascular risk factors undergoing major operations, as these have proven beneficial in a variety of clinical settings in detecting potentially devastating coronary events. However, these benefits may not be generalizable to low-risk surgeries for patients without cardiovascular risk factors.

Patients and health care systems may benefit from more judicious cardiac workup plans for low-risk procedures, which requires more diligent use of preoperative risk stratification. In the context of elective noncardiac surgery, the Canadian Cardiovascular Society recommends preoperative cardiac risk assessment in patients who are older than 45 years, or younger patients with known significant cardiovascular disease.[6] Patient selection for further workup using biomarkers such as N-terminal pro b-type natriuretic peptide (NT-proBNP) can then be based on individual risk factors such as history of ischemic heart disease, congestive heart disease, cerebrovascular disease or insulin-dependent diabetes.[15] The use of risk factor information and NT-proBNP can be helpful in guiding necessity for postoperative investigations and avoiding unnecessary workup of lower-risk individuals.[6] One may consider balancing the low cost of conducting an ECG and troponin with the high cost of a missed acute coronary event. However, in patients with low cardiovascular risk undergoing minimally invasive parathyroid surgeries with short-duration exposure to anesthetics, the costs of routine cardiac investigations may be unnecessary. At our institution, the practice of routine preoperative pro-BNP testing was implemented midway through the study and so we are not able to report on pro-BNP levels. Information on preoperative BNP levels would be of great interest in future studies with similar objectives.

Limitations

There are limitations of our study that must be acknowledged. First, the design is a single-institution, unblinded, retrospective review and is therefore subject to information bias. The results may not be reflective of practices at other institutions, and may be affected by under-reporting of routine chest-pain in the immediate postoperative setting. The small proportion of patients with documented reports of chest pain may be an underestimation of true clinical experience. Because no major cardiac events were observed in our study cohort, the population size may have been too small for such a rare occurrence to be detected. Moreover, our data reflect our institution exclusively. It is possible that missed cardiac events within the 30-day postoperative period would not have been captured if the patient had presented to a facility other than our hospital. Lastly, we were unable to detail the specific characteristics of the chest pain (e.g., intensity of pain, radiation and associated symptoms such as diaphoresis, nausea). This may be useful in the future to better delineate the true nature of the symptoms that may warrant further investigation.

Conclusion

Currently, there is a paucity of data regarding the incidence of chest pain and morbidity outcomes related to postoperative cardiac events after parathyroid surgery. This may be reflective of the low frequency of cardiac events, as demonstrated in our study, or possibly a result of the unknown etiology of chest pain that is not related to a cardiac cause. In light of future directions, we encourage surgeons to report on perioperative cardiac symptoms, their evaluation and workup, and morbidity to better delineate the association between parathyroid surgery and reported chest pain.

Postoperative chest pain after parathyroid surgery is a common complaint that often leads to reflexive cardiac workup in most cases. However, the incidence of significant postoperative cardiac events is minimal. Endocrine surgeons caring for patients after parathyroid surgery should utilize validated metrics and scoring systems to evaluate a patient's pretest probability of a true cardiac event before ordering an extensive workup — particularly in patients who are at low risk. Exercising a degree of vigilance in low-risk patients will avoid unnecessary health care costs and potential psychological burden to the patient. We acknowledge the

significance and potential consequences of a missed cardiac event, and surgeons must err on the side of caution if there is a clinical suspicion of potential perioperative acute coronary syndrome. This is particularly important in older patients, those deemed high risk by validated tools and those with cardiovascular risk factors in which investigation with ECG and troponin is completely warranted.

Affiliations: From the Department of Surgery, University of British Columbia, Vancouver, BC (Guo, Lustig, Melck); the Faculty of Medicine, University of British Columbia, Vancouver, BC (Chornenka); and the Department of Surgery, St. Paul's Hospital, Vancouver, BC (Melck).

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References

1. Galanis T, Merli GJ. Postoperative chest pain and shortness of breath. In: Lubin MF, Dodson TF, Winawer NH, editors. *Medical Management of the Surgical Patient. 5th ed.* Cambridge: Cambridge University Press; 2013. p. 113–8. Available: https://www.cambridge.org/core/product/identifier/CBO9780511920660A022/type/book_part (accessed 2019 Sept. 20)
2. Swap CJ, Nagurney J. Value and limitations of chest pain history in the evaluation of patients with suspected acute coronary syndromes. *JAMA* 2005;294:2623-9.
3. Goodacre S, Locker T, Morris F, et al. How useful are clinical features in the diagnosis of acute, undifferentiated chest pain? *Acad Emerg Med* 2002;9:203-8.
4. Bittencourt das Virgens C. Lemos L, Noya-Rabelo M. Accuracy of gestalt perception of acute chest pain in predicting coronary artery disease. *World J Cardiol* 2017;9:241-7.
5. Puelacher C, Buse G, Seeberger D, et al. Perioperative myocardial injury after noncardiac surgery: incidence, mortality, and characterization. *Circulation* 2017;137:1221-32.
6. Duceppe E, Parlow J, MacDonald P, et al. Canadian Cardiovascular Society guidelines on perioperative cardiac risk assessment and management for patients who undergo noncardiac surgery. *Can J Cardiol* 2017;33:17-32.
7. McMullan R, Silke B, Bennett K, et al. Resource utilisation, length of hospital stay, and pattern of investigation during acute medical hospital admission. *Postgrad Med J* 2004;80:23-6.
8. Levinson W, Huynh T. Engaging physicians and patients in conversations about unnecessary tests and procedures: Choosing Wisely Canada. *CMAJ* 2014;186:325-6.
9. Tang J, Salapatas A, Bonzelaar L, et al. Parathyroidectomy for the treatment of hyperparathyroidism: thirty-day morbidity and mortality. *Laryngoscope* 2018;128:528-33.
10. Brown S, Ruppe M, Tabatabai L. The parathyroid gland and heart disease. *Methodist Debakey Cardiovasc J* 2017;13:49-54.
11. Farahnak P, Ring M, Caidahi K, et al. Cardiac function in mild primary hyperparathyroidism and the outcome after parathyroidectomy. *Eur J Endocrinol* 2010;163:461-7.
12. Malinowska K. The relationship between chest pain and level of perioperative anxiety in patients with lung cancer. *Pol Przegl Chir* 2018;90:23-7.
13. Rinfret S, Goldman L, Polanczyk CA, et al. Value of immediate postoperative electrocardiogram to update risk stratification after major noncardiac surgery. *Am J Cardiol* 2004;94:1017-22.
14. Devereaux PJ, Chan M, Alonso-Coello P, et al. Association Between postoperative troponin levels and 30-day mortality among patients undergoing noncardiac surgery. *JAMA* 2012;307:2295-304.
15. Davis C, Tait G, Carroll J, et al. The Revised Cardiac Risk Index in the new millennium: a single-centre prospective cohort re-evaluation of the original variables in 9,519 consecutive elective surgical patients. *Can J Anaesth* 2013;60:855-63.