# **The value of pre and postoperative Quality of life after parathyroid glands Resection in patients with hyperparathyroid.**

1. **Dr. Mohammed Tareq Mohammed**

M.B.Ch.B. \ C.A.B.M.S. **\ (General Surgeon)**

Ministry of Higher Education and Scientific Research, College of Medicine, University of Anbar, Anbar, Iraq.

**dr.mohammed82@uoanbar.edu.iq**

1. **Dr. Ali Mohammed Ali Ridha**

**Consultant Surgeon**

Ministry of Higher Education and Scientific Research, Jabir Ibn Hayyan Medical University, College of Medicine, Al-Najaf, Iraq.

**aliandaleeb@yahoo.cim**

**aliandaleeb70@gmail.com**

1. **Dr. Tareq Jawad kadem Al-Rubayee**

M.B.Ch.B. \ M.R.C.S. \ **Ireland**

**Diploma General Surgery**

Ministry of Higher Education and Scientific Research, AL-Rasheed University College, Department of Pharmacy, Baghdad, Iraq.

**dr.tariq.jawad@alrasheedcol.edu.iq**

1. **Dr. Ali Tariq Thanoon Yahya**

M.B.Ch.B., CABP, MRCPCH **(UK)**

Senior Lecturer/ Specialist pediatrician

Department of Pediatrics at COMHS/National University of Science and Technology/Rustaq general hospital, Oman

**alitariq@nu.edu.om**

1. **Dr. Ali Qais Abdulkafi**

M.B.Ch.B. \ D.C.H. \ (**Pediatrics**)

Iraqi Ministry of Health, Kirkuk Health Department, Kirkuk General Hospital, Kirkuk, Iraq.

**Newiraqhospital@yahoo.co.uk**

1. **Abbas AbdulWahhab Jumaah**

Department of Applied Embryology, High Institute for Infertility Diagnosis and Assisted Reproductive Technologies, Nahrain University, Kadhimiya, Baghdad, Iraq.

**Abbasabdalwahab@ierit.nahrainuniv.edu.iq**

# ***Abstract***

**Background.** Hyperparathyroidism is a disease that develops with increased production of parathyroid hormone and is manifested by a violation of calcium-phosphorus metabolism

**Objective.** This study aims to assess the value of quality of life before and after surgery in patients with hyperparathyroidism.

**Methods.** In this study, the data were analyzed statistically according to the IBM SOFT SPSS 22 program Where demographic information and data for this study were collected from several different hospitals in Iraq with a study period of 2020-2021.

The results were recorded in this study according to the SWAL QOL questionnaire before surgery and 6 months after it to know the quality of life for patients.

**Results**

 in this study, 40 patients were collected, the ages of the patients ranged between 40-70 years, and they were distributed according to gender (male 25 with patient (62.5%), female were 15 patients with (37.5%),the patients were distributed according to concentration of calcium in the blood where found a statistically significant relationship was found between calcium level and quality of life before parathyroidectomy

**Conclusion**

We conclude from this study on the improvement of the patient's condition according to the quality of life scale, where parathyroid glands Resection leads to an improvement in the patient's health in physical function, mental health and vital activity

**Keywords:** hyperparathyroid; QoL, SWAL-QOL; Depression; and Dysphagia.

# ***Introduction***

Dysphagia is difficulty swallowing or swallowing liquids due to involvement of one or more stages of swallowing. The effect can be seen in the oral preparation of the bolus or in the displacement of food from the mouth into the stomach **[1,2]**. It must be differentiated from swallowing, which is the pain caused by eating certain foods, especially hot or cold liquids. As a result of dysphagia, food items may penetrate other than the digestive tract, sometimes causing frank episodes of tracheostomy, bronchial aspiration (due to passage of water or food into the trachea and bronchi) or silent aspiration (permeation of saliva or food under the vocal cords not accompanied by a cough or other signs of difficulty swallowing). **[3]**

The normal chewing and swallowing activity are a rapid and complex process of voluntary and involuntary movements involving no fewer than six cranial nerves, the first three parts of the cervical nerves, and 26 muscles of the mouth, pharynx, and esophagus. Dysphagia is a clinical complication that continues to significantly affect people's lives and health. Dysphagia is the most influential factor that causes swallowing disorder. Dysphagia is usually described by the patient as difficulty initiating swallowing or, more commonly, a feeling that the bolus has stopped or a realization that it is difficult to pass it somewhere in the neck or sternum as a result of thyroid disorders. **[4,5]**

The parathyroid gland is one of the best examples of how surgery can solve the problem. Untreated parathyroid adenomas cause an increase in blood calcium levels. Too much calcium can cause an irregular heartbeat **[6].** Parathyroid crisis (a clinical event in which a person experiences mental changes that can lead to nervous system failure and coma). Primary hyperparathyroidism is caused by an overactivity of one or more parathyroid glands, resulting in an inappropriate rise of parathyroid hormone (PTH) and impaired bone and mineral metabolism **[7].** The prevalence of hyperthyroidism in the United States is estimated at 1%, accounting for approximately 100,000 new cases of the disease each year. **[8,9]**

It is believed that about 10% is passed down from the parents (inherited). Hypocalcemia may develop at a rate greater than 40% and this rate may increase further after surgery in patients with primary and secondary hyperparathyroidism with bone lesions. Parathyroidectomy is the most common surgical procedure worldwide for primary hyperparathyroidism from the first surgery in patients without skeletal injury although hypocalcaemia is rare thereafter and may increase by up to 30% after secondary hyperparathyroidism surgeries. Persistent parathyroidism **[10,11].**

The low level of calcium in the diet in the long term increases the risk of infection, as the benign tumor of the parathyroid glands represents 85% of the pathological cases of hyperparathyroidism **[12].**

Hypercalcemia causes the patient to experience many symptoms, such as confusion, fatigue, depression, memory loss, weakness, mental confusion, vomiting, frequent urination, constipation, and high blood pressure. **[13-15].** Hypocalcemia may develop at a rate greater than 40% and this rate may increase further after surgery in patients with primary and secondary hyperparathyroidism with bone lesions **[16].** This study aims to assess the value of pre and postoperative quality of life after parathyroid glands resection in patients with hyperparathyroid.

***Method and collection sample***

This study is represented an observational study that included 40 Iraqi patients with symptoms of hyperthyroidism, which included both males and females. The study was carried out at Al Furat Hospital in Baghdad, Iraq, in 2020-2021. Diagnosed with PHPT for levels of calcium in the blood for ages 40 and over and some of them suffer from thyroid tumors. Symptoms of this study were allocated to feeling tired and weak, depression, memory loss, increased urination, and sleep deprivation as shown in Table 1. Institutional ethics committee approval was obtained.

The group of patients in this study was classified as normal, mild hypercalcemia, moderate hypercalcemia, and severe hypercalcemia as can be seen in Figure 1. The distribution of calcium classes which included Serum calcium, Serum PTH for pre- and post-parathyroidectomy surgery is shown in Figure 2 and Figure 3. The patient's quality of life was assessed through the use of QoL under the SF-36 questionnaire score where includes Physical function, body pain, general health, mental health-vitality, and general mental health in Table 2.

A preoperative and postoperative life outcome assessment was conducted. Swallowing Quality Tool outcomes include fear of swallowing, sleep, burden, food selection, and fatigue and are specialized for all Domains SWAL-QOL cases.

# ***Results***

***Table 1-*** *Demographic results of parathyroid glands Resection for Iraqi patients.*

|  |  |
| --- | --- |
| Variables | Patients(40) |
| Age |  |
| 40-49 | 8(20%) |
| 50-59 | 14(35%) |
| 60-70 | 18(45%) |
| sex |  |
| male | 25(62.5%) |
| female | 15(37.5%) |
| BMI, kg/m2 | 31±4.4 |
| Marital status |  |
| single | 8(20%) |
| married | 32(80%) |
| Symptoms |  |
| Feeling tired and weak | 5(12.5%) |
| Depression | 12(30%) |
| memory loss | 9(22.5%) |
| increased urination | 7(17.5%) |
| sleep deprivation | 7(17.5%) |

This study was conducted on patients between the ages of 40-70 years. This study presented 40 sick cases of thyroid gland, the majority of patients were males, reaching 25 cases, amounting to 62.5% of the patients’ group, while females were 15, representing 37.5% of the patients group. In this study, the demographic profile of symptoms is shown in Table 1, symptoms included these parameters, feeling tired and weak 5 (12.5%), depressed 12 (30%), memory loss 9 (22.5%), increased urination 7 (17.5%), and sleep deprivation 7 (17.5%). Depression was the most affecting symptom on patients, covering 30% of the patient group.

**Fig 1-** Mean ± SD of patients according to concentration of calcium in the blood.

In Figure 1 is shown Mean ± SD of patients according to concentration of calcium in the blood, which included Normocalcemia mean (8.7) SD (0.7), Mild hypercalcemia mean (11) SD (0.5), Moderate hypercalcemia mean (13) SD (0.7) , Severe hypercalcemia mean 16 and SD (0.9).

**Fig 2-**Serum calcium pre-operation and six months after parathyroidectomy.

**Fig 3-** Serum PTH pre-operative and post-operative after six months after parathyroidectomy.

The patients’ group were assessment based on the presence the calcium in the blood where the patients group divided into two group that normalized in the Figures 2 and 3. The (Figure 2), (Figure 3) are shown Mean ± SD of Serum calcium and Serum PTH of pre-operation and six months after the parathyroidectomy according to pre-operative and post-operative stages. To Serum calcium, mean of Serum calcium (12.6) and SD (1.67) in the pre-operative and mean of Serum calcium (9.4) and SD (0.87) for post-operative. in (Figure 2). To follow that, (Figure 3) is presented mean of Serum PTH (402) and SD (635.55) in the pre-operative and mean of PTH calcium (45) and SD (38.44) in the post-operative where the degree of hypercalcemia was not correlated with serum PTH levels.

**Table 2-** Evaluation the quality-life during pre-operative and post-operative according to QoL.

|  |  |  |  |
| --- | --- | --- | --- |
| Domains | Quality of life during pre-operation | Quality of life during post-operation | P-value |
| **Physical function**  | *63±9* | *87.9±8* | *0.0025* |
| **Bodily pain**  | *53±14* | *77±5* | *0.0045* |
| **general health**  | *47±13* | *81.6±5.5* | *0.0066* |
| **mental health-vitality**  | *36±14.5* | *76±9* | *0.0024* |
| **general mental health**  | *57.6±12* | *81±11* | *0.0036* |

(Table 2) Explains evaluation the quality life during the pre-operative and post-operative according to QoL, as this evaluation was represented based on physical function, bodily pain, general health, mental health - vitality, and general mental health. There was a general improvement in the QoL of the patient groups for all cases, as this development was significantly six months after curative parathyroidectomy with p-value less than 0.001. The enhancement was very significant for bodily pain before operation 53±14 and postoperative 77±5, general health before operation 47±13 and postoperative 81.6±5.5, and mental health-vitality before operation 36±14.5 and postoperatively 76±9.

**Table 3-** Outcomes evaluation tool scores for Quality - Life preoperative and postoperative of swallowing.

|  |  |  |  |
| --- | --- | --- | --- |
| **Domains**  | **Preoperative Score** | **Postoperative Score** | **P-value** |
| Fear of swallowing | *92.7* | *97.43* | *0.00012* |
| Sleep | *89.6* | *95.88* | *0.0002* |
| Burden | *65.44* | *87.9* | *0.00023* |
| Food selection | *85.6* | *96.2* | *0.00025* |
| Fatigue  | *60.3* | *93.8* | *0.00032* |

(Table 3) displays preoperative and postoperative swallowing quality of life outcomes assessment tool scores. The mean preoperative SWAL-QOL score was 78.73 for 5 domains, which indicates a perception of oral dysphagia as well as a decrease in swallowing-related to its quality life. To follow that, domains associated with the assessment of oral dysphagia were fear of swallowing, sleep, burden, food selection, and fatigue. It was noted in the evaluation that the lowest scores for domains before surgery were in burden (65.44) and fatigue (60.3), and the highest scores evaluated before surgery were fear of swallowing (92.7), sleep (89.6) and food selection (85.6). This study showed a good enhancement in burden, which was before surgery (65.44) and after surgery 87.9, as well as fatigue before surgery (60.3) and after surgery 93.8. In addition, in all Domains SWAL-QOL showed that all ratios were p-value < 0.0001.

# ***Discussion***

In this study, all patients with hyperthyroidism (PHPT) suffer from neurological and psychiatric diseases, especially those over 50 years of age due to a low QoL. This study is based on the SF-36 questionnaire to assess thyroidectomy by QoL of patients with hyperthyroidism. Based on the results, this study determined that depression was the most affecting symptom on patients, as this study showed a significant improvement in patients' assessment of postoperative QoL for various pathological conditions of hyperthyroidism. This study showed significant and significant improvement in body pain, general health, and mental health-vitality. American studies confirmed that patients with hyperthyroidism are exposed to painful physical pain, a nervous attack, and a very bad psychological state, which is accompanied by a clear effect on the patient's activity in terms of desire to eat, sleep, and swallow food. **[17-19]**

Alper et al. conducted a study on PHPT patients, recruiting 150 patients who underwent a QoL assessment using the SF-36 questionnaire **[20]**. The scores for depression and poor mental state were very high **[20]**. The SF-36 score of PHP patients before surgery was significantly lower than after surgery, as there was an increase in the assessment of QoL post-operative thyroidectomy six months later. **[20]**

QoL was assessed for the quality of life of 40 patients after thyroidectomy (PHPT) using the SF-36 scale. To show an improvement in all Domains, where it was noted that there was a significant weakness in the quality of life of patients before surgery, especially in Domains related to general health, mental health-vitality before surgery. The assessment of QoL showed a significant improvement for patients after thyroidectomy (PHPT). Although improvements in patients with depressive symptoms, memory loss, increased urination, and sleep deprivation were significantly more pronounced, even those with poor mental and physical health before surgery saw improvement after thyroidectomy. **[21,22]**

In this study, it was discovered that while PH scores improved independently of preoperative calcium levels, improvement in PHPT scores did not. In addition, patients with normal hypocalcaemia reported a worse quality of life, which was significantly increased after thyroid surgery. Shows how thyroid hormone directly affects quality of life. Building on Robert's study, the SF-36 questionnaire was used to measure quality of life, and it was discovered that the physical and mental components of QoL were affected similarly in patients with normal or hyperglycemic PHPT. After thyroidectomy, physical quality of life and non-specific symptoms (fatigue and anxiety) improved, although PHPT patients with hyperglycemia experienced the greatest improvement. **[23-25]**

Eelsen demonstrated that thyroidectomy reduced these risk variables in the patient group and that patients with normal PHPT, dyscalcemia, and hypercalcaemia had comparable risks for risk factors as difficulties swallowing, metabolic syndrome, and poor glucose tolerance. Additionally, according to German research, 20% of normotensive PHPT eventually becomes hypercalcemic PHPT, usually within 2-4 years of diagnosis. **[26,27]**

# ***Conclusion***

This study presented a significant improvement in the evaluation of patients after parathyroidectomy based on the assessment of QoL score of SF-36. Before surgery, QoL showed a significant decrease in physical function, mental health, and vital activity. Despite the high decrease in patients' quality of life in terms of symptoms and health status, the QoL assessment provided that the patients' quality of life increased significantly after thyroidectomy. The QoL index showed a significant improvement in the pre- and postoperative assessment of PHPT patients. However, this study believes that QoL is not a sufficient indicator of thyroid resorption. This study suggests that the evaluation criteria for thyroidectomy should be developed and the evaluation of PHPT patients reconsidered.

# ***References***

1. Howden CW. Management of acid-related disorders in patients with dysphagia. Am J Med. 2004;117(Suppl 5A):44S–48S. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/15478852)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Am+J+Med&title=Management+of+acid-related+disorders+in+patients+with+dysphagia&author=CW+Howden&volume=117&issue=Suppl+5A&publication_year=2004&pages=44S-48S&pmid=15478852&)]
2. Palmer JB, Drennan JC, Baba M. Evaluation and treatment of swallowing impairments. Am Fam Physician. 2000;61:2453–2462. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/10794585)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Am+Fam+Physician&title=Evaluation+and+treatment+of+swallowing+impairments&author=JB+Palmer&author=JC+Drennan&author=M+Baba&volume=61&publication_year=2000&pages=2453-2462&pmid=10794585&)]
3. Lovell SJ, Wong HB, Loh KS, et al. Impact of dysphagia on quality-of-life in nasopharyngeal carcinoma. Head Neck. 2005;27:864–872. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/16114007)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Head+Neck&title=Impact+of+dysphagia+on+quality-of-life+in+nasopharyngeal+carcinoma&author=SJ+Lovell&author=HB+Wong&author=KS+Loh&volume=27&publication_year=2005&pages=864-872&pmid=16114007&)]
4. Greenblatt DY, Sippel R, Leverson G, et al. Thyroid resection improves perception of swallowing function in patients with thyroid disease. World J Surg. 2009;33:255–260. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2903838/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/19034567)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=World+J+Surg&title=Thyroid+resection+improves+perception+of+swallowing+function+in+patients+with+thyroid+disease&author=DY+Greenblatt&author=R+Sippel&author=G+Leverson&volume=33&publication_year=2009&pages=255-260&pmid=19034567&)]
5. Fraser WD. Hyperparathyroidism. Lancet. 2009;374:145–158. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/19595349)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Lancet&title=Hyperparathyroidism&author=WD+Fraser&volume=374&publication_year=2009&pages=145-158&pmid=19595349&)]
6. Chen H, Wang TS, Yen TW, et al. Operative failures after parathyroidectomy for hyperparathyroidism: The influence of surgical volume. Ann Surg. 2010;252:691–695. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/20881776)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Ann+Surg&title=Operative+failures+after+parathyroidectomy+for+hyperparathyroidism:+The+influence+of+surgical+volume&author=H+Chen&author=TS+Wang&author=TW+Yen&volume=252&publication_year=2010&pages=691-695&pmid=20881776&)]
7. Korkis AM, Miskovitz PF. Acute pharyngoesophageal dysphagia secondary to spontaneous hemorrhage of a parathyroid adenoma. Dysphagia. 1993;8:7–10. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/8436023)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Dysphagia&title=Acute+pharyngoesophageal+dysphagia+secondary+to+spontaneous+hemorrhage+of+a+parathyroid+adenoma&author=AM+Korkis&author=PF+Miskovitz&volume=8&publication_year=1993&pages=7-10&pmid=8436023&)]
8. Shundo Y, Nogimura H, Kita Y, et al. Spontaneous parathyroid adenoma hemorrhage. Jpn J Thorac Cardiovasc Surg. 2002;50:391–394. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/12382409)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Jpn+J+Thorac+Cardiovasc+Surg&title=Spontaneous+parathyroid+adenoma+hemorrhage&author=Y+Shundo&author=H+Nogimura&author=Y+Kita&volume=50&publication_year=2002&pages=391-394&pmid=12382409&)]
9. Maweja S, Sebag F, Hubbard J, et al. Spontaneous cervical haematoma due to extracapsular haemorrhage of a parathyroid adenoma: a report of 2 cases. Ann Chir. 2003;128:561–562. [[PubMed](https://pubmed.ncbi.nlm.nih.gov/14559311)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Ann+Chir&title=Spontaneous+cervical+haematoma+due+to+extracapsular+haemorrhage+of+a+parathyroid+adenoma:+a+report+of+2+cases&author=S+Maweja&author=F+Sebag&author=J+Hubbard&volume=128&publication_year=2003&pages=561-562&pmid=14559311&)]
10. Grieve RJ, Dixon PF. Dysphagia: A further symptom of hypercalcaemia? Br Med J (Clin Res Ed) 1983;286:1935–1936. [[PMC free article](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1548315/)] [[PubMed](https://pubmed.ncbi.nlm.nih.gov/6407643)] [[Google Scholar](https://scholar.google.com/scholar_lookup?journal=Br+Med+J+(Clin+Res+Ed)&title=Dysphagia:+A+further+symptom+of+hypercalcaemia?&author=RJ+Grieve&author=PF+Dixon&volume=286&publication_year=1983&pages=1935-1936&)]
11. Lila AR, Sarathi V, Jagtap V, Bandgar T, Menon PS, Shah NS. Renal manifestations of primary hyperparathyroidism. Indian J Endocrinol Metab. 2012;16(2):258–258. [PMC free article] [PubMed] [Google Scholar]
12. Shah VN, Bhadada SK, Bhansali A, Behera A, Bhattacharya A, Nahar U, et al. Effect of gender, biochemical parameters & parathyroid surgery on gastrointestinal manifestations of symptomatic primary hyperparathyroidism. Indian J Med Res. 2014;139(2):279–279. [PMC free article] [PubMed] [Google Scholar]
13. Weber T, Eberle J, Messelhäuser U, Schiffmann L, Nies C, Schabram J, et al. Parathyroidectomy, elevated depression scores, and suicidal ideation in patients with primary hyperparathyroidism: results of a prospective multicenter study. JAMA Surg. 2013;148(2):109–115. [PubMed] [Google Scholar]
14. Brito K, Edirimanne S, Eslick GD. The extent of improvement of health-related quality of life as assessed by the SF36 and Pasieka scales after parathyroidectomy in patients with primary hyperparathyroidism–a systematic review and meta-analysis. Int J Surg. 2015;13:245–249. [PubMed] [Google Scholar]
15. Roman SA, Sosa JA, Mayes L, Desmond E, Boudourakis L, Lin R, et al. Parathyroidectomy improves neurocognitive deficits in patients with primary hyperparathyroidism. Surgery. 2005;138(6):1121–1129. [PubMed] [Google Scholar]
16. Bannani S, Christou N, Guerin C, Hamy A, Sebag F, Mathonnet M, et al. Effect of parathyroidectomy on quality of life and non-specific symptoms in normocalcaemic primary hyperparathyroidism. Br J Surg. 2018;105(3):223–229. [PubMed] [Google Scholar]
17. Beysel S, Caliskan M, Kizilgul M, Apaydin M, Kan S, Ozbek M, et al. Parathyroidectomy improves cardiovascular risk factors in normocalcemic and hypercalcemic primary hyperparathyroidism. BMC Cardiovasc Disor. 2019;19(1):106–106. [PMC free article] [PubMed] [Google Scholar].
18. Bollerslev J, Schalin-Jäntti C, Rejnmark L, et al. Management of endocrine disease: unmet therapeutic, educational and scientific needs in parathyroid disorders. *Eur J Endocrinol*. 2019; **181**(3): P1– 19.
19. Khan AA, Hanley DA, Rizzoli R, et al. Primary hyperparathyroidism: review and recommendations on evaluation, diagnosis, and management. A Canadian and international consensus. *Osteoporos Int*. 2017; **28**(1): 1– 19.
20. Shah VN, Bhadada S, Bhansali A, Behera A, Mittal BR. Changes in clinical & biochemical presentations of primary hyperparathyroidism in India over a period of 20 years. *Indian J Med Res*. 2014; **139**(5): 694– 9.
21. Bannani S, Christou N, Guerin C, et al. Effect of parathyroidectomy on quality of life and non-specific symptoms in normocalcaemic primary hyperparathyroidism. *Br J Surg*. 2018; **105**(3): 223– 9.
22. Storvall S, Ryhänen EM, Heiskanen I, Sintonen H, Roine RP, Schalin-Jäntti C. Surgery significantly improves neurocognition, sleep, and blood pressure in primary hyperparathyroidism: a 3-year prospective follow-up study. *Hormone Metab Res*. 2017; **49**(10): 772– 7.
23. Ejlsmark-Svensson H, Sikjaer T, Webb SM, Rejnmark L, Rolighed L. Health-related quality of life improves 1 year after parathyroidectomy in primary hyperparathyroidism: a prospective cohort study. *Clin Endocrinol*. 2019; **90**(1): 184– 91.
24. Machado NN, Wilhelm S. Diagnosis and evaluation of primary hyperparathyroidism. Surg Clin N Am 2019;;99:649-66. [[Crossref](http://dx.doi.org/10.1016/j.suc.2019.04.006)] [[PubMed](http://www.ncbi.nlm.nih.gov/pubmed/31255197)]
25. Zhu CY, Nguyen D, Yeh M. Who benefits from treatment of primary hyperparathyroidism? Surg Clin N Am 2019;;99:667-79.
26. Pepe J, Cipriani C, Sonato C, et al. Cardiovascular manifestations of primary hyperparathyroidism: A Narrative Review. Eur J Endocrinol 2017;177:R297-308. [[Crossref](http://dx.doi.org/10.1530/EJE-17-0485)] [[PubMed](http://www.ncbi.nlm.nih.gov/pubmed/28864535)]
27. Ejlsmark-Svensson H, Rolighed L, Rejnmark L. Effect of parathyroidectomy on cardiovascular risk factors in primary hyperparathyroidism: A randomized clinical trial. J Clin Endocrinol Metab 2019;104:3223-32. [[Crossref](http://dx.doi.org/10.1210/jc.2018-02456)] [[PubMed](http://www.ncbi.nlm.nih.gov/pubmed/30860588)]