Published in final edited form as:

Surgery. 2009 November ; 146(5): . doi:10.1016/j.surg.2009.05.004.

Thyroid surgery in octogenarians is associated with higher complication rates

Michal Mekel, MD¹, Antonia E. Stephen, MD¹, Randall D. Gaz, MD¹, Alona Muzikansky, MA², Richard A. Hodin, MD¹, and Sareh Parangi, MD¹

¹Department of Surgery and Endocrine Surgery Unit, Massachusetts General Hospital and Harvard Medical School, Boston, MA

²Department of Biostatistics, Massachusetts General Hospital and Harvard Medical School, Boston, MA

Abstract

Objectives—To determine whether thyroid surgery in patients ≥ 80 is associated with higher complication rates.

Background—The incidence of thyroid nodules increases with age and little information is available regarding the risks of thyroid surgery in elderly patients.

Methods—Out of 3568 patients undergoing thyroid surgery between July 2001 and October 2007 at a single institution, the records of 90 consecutive patients ≥ 80 years were retrospectively reviewed and compared to a cohort of 242 randomly selected patients aged 18–79, who underwent thyroid surgery during the same time period, using SAS statistical software. Clinical variables included age group, sex, medical co-morbidities, pre-operative diagnosis, substernal component, previous surgery, final pathology, length of stay (LOS), postoperative complications and mortality.

Results—Preoperative indications for surgery included benign disease in 51.1% vs. 40.9%, suspected malignancy in 18.9% vs. 26% and suspected follicular neoplasms including indeterminate/microfollicular cytology in 30% vs. 33.1% in the octogenarian patient group (≥ 80 yrs old) vs. the younger patient cohort (p=NS). Octogenarians had a 21.1% rate of significant malignancy on final pathology vs. 28.1% in the younger cohort (p=NS). The overall complication rate in the octogenarian group was 23.3% vs. 9.1% in the younger cohort (p=.0006). Male sex and lung disease were independent risk factors for perioperative complications. Complications unique to octogenarians included heart failure, atrial fibrillation, pneumonia, tracheotomy, urosepsis, blood transfusion, wound infection and ischemic colitis. There was no mortality in either group.

Conclusions—Patients ≥ 80 years of age can undergo successful thyroid surgery but with significantly higher morbidity. Earlier surgical intervention may be advised in those who are at high risk for disease progression whereas follow-up strategies without surgery may be advised for others.

INTRODUCTION

The occurrence of nodular disease of the thyroid is very frequent in the elderly. It has been estimated that 90% of thyroid glands in women over the age of 70 will contain nodules and

Corresponding author and reprints: Sareh Parangi, Massachusetts General Hospital, 15 Parkman Street, Wang ACC 460, Boston, MA 02114, Phone: 617-643-4806, Fax: 617- 643-4802.

FINANCIAL DISCLOSURE

We have no financial disclosure for this study.

80% of the glands of men over the age of 80 will be nodular ¹. In 2000, 3.3% of all North Americans were over the age of 79. This is projected to increase to 5.4% in 2030 ². With the increase in the number of older patients in the population, it is expected that thyroid problems requiring surgery will be seen more frequently in the elderly. Population-based studies have shown higher mortality in octogenarians undergoing major cancer operations ^{3,4}. In view of these studies, we wanted to evaluate whether thyroid surgery in the elderly is also associated with increased risk.

Specialization in thyroid surgery has led to increasingly safe surgical management, to the extent that some dismiss age alone as a contraindication to surgery ⁵. Thyroidectomy at an old age seems to confer a better morbidity and mortality rate when compared with other elective general surgical procedures. However, the literature on thyroid surgery in the elderly is limited. Single institution series have shown no difference in morbidity or mortality between patients aged 75 years and older and younger patients ^{5,6}. On the other hand, recent population-based studies have shown higher rate of complication rates in elderly patients undergoing thyroid surgery ⁷. To our knowledge, this study is the largest single institution series looking at complications and risk factors in patients aged 80 years and older undergoing thyroid surgery.

PATIENTS AND METHODS

An IRB approved retrospective review was used to obtain data on patients aged 80 years old and older, who underwent thyroid surgery at Massachusetts General Hospital between July of 2001 and October of 2007. CPT4 codes specifying for 10 thyroid surgical procedures (60200, 60210, 60212, 60220, 60225, 60240, 60252, 60260, 60270, and 60271) were used to retrieve a total of 3,568 patients that underwent thyroid surgery by the high volume thyroid surgeons who are co-authors on this manuscript (AS, RG, RH, SP) at that time period in our institution. Procedures included in our data search were excision of thyroid nodule, lobectomy, sub-total or near-total thyroidectomy, total thyroidectomy and any other partial thyroidectomy. Patients were then stratified by age, and ninety patients aged 80 years and older (referred to as the octogenarians group) were identified and included in our study group. For the control cohort, 250 patients aged 18–79 years were randomly selected from the 3,568 patients who underwent thyroid surgery during the same time period using a computerized program. In 8 of the 250 patients, major components of the data were missing and therefore they were excluded. Two hundred and forty two patients therefore comprised our control group. As practiced at our institution, preadmission testing is available for all patients depending on surgeon preference. All the octogenarians and those younger patients with significant co-morbid conditions were screened in the pre-admission testing area and pre-existing conditions were optimized prior to surgery. Our primary outcomes of interest were 30 day post-operative complications, including cardiovascular, respiratory, gastrointestinal, urologic, central nervous system, metabolic, wound or any other occurrence within 30 days after the operation. Thyroid specific complications including hypoparathyroidism and vocal cord dysfunction were documented based upon readmission for symptomatic hypoparathyroidism or laryngoscopically documented immobility of a vocal cord during the 30 day period, respectively. Retrospective data analysis included review of pre- and postoperative office records, electronic medical records and anesthesia records. Clinical variables analyzed as risk factors for development of complications included age group, sex, preoperative diagnosis, presence of substernal component, occurrence of previous surgery, medical comorbidities, extent of surgery and final pathologic diagnosis. Comorbidities at the time of surgery were extracted from the patients' medical record. Lung disease was defined as documented chronic obstructive pulmonary disease (COPD), asthma, pulmonary hypertension or any other chronic respiratory disorder. Cardiac comorbidity was defined as documented coronary artery disease, congestive heart failure or significant

valvular heart disease. Arrhythmia was defined as any significant arrhythmia such as atrial fibrillation or any other ventricular arrhythmia excluding premature ventricular contractions. Renal disease was defined as any chronic renal insufficiency documented in the medical records. Neurologic comorbidity was defined as a history of transient ischemic attack or stroke. Also recorded were diabetes mellitus, hypertension and coumadin use.

Statistics

Clinical variables were converted into categorical variables, and a univariate analysis was performed using chi-square statistical analysis to identify risk factors for the development of complications in octogenarian patients undergoing thyroid surgery. A multivariate logistical regression analysis was then used to determine a model of risk for developing complications. Variables that were statistically significant in the univariate analysis were included and a stepwise selection process was applied to select the significant explanatory variables for the model. Continuous variables were evaluated using Wilcoxon rank sum test. Data analysis was performed using SAS statistical software (SAS Institute Inc., Cary, NC, USA).

RESULTS

We identified ninety octogenarians, who underwent thyroid surgery between July of 2001 and October of 2007 with a mean age of 83.2 (range 80–94) (Figure 1). Patients included in this group comprised 2.5% of all thyroid operations performed during that time period. When divided by years of study, in spite of an observed increase in the total number of thyroidectomies per year, the percentage of elderly patients remained fairly constant, ranging from 2.2%–3.1% (Figure 2). There were 72 (80%) women and 18 (20%) men in the octogenarian group. Two hundred and forty two patients comprised our control group with a mean age of 50.1 (range 18–79) (Figure 2). There were 193 (79.7%) females and 49 (20.3%) males in the control cohort ($p=NS$). Indication for surgery was divided into 3 major groups: (1) presumed benign disease - included patients who had a benign or non-diagnostic FNA result, Graves' disease, toxic goiter, or any nodule or goiter without preoperative cytology; (2) malignant disease or suspected malignancy – patients with malignant or suspicious cytology; (3) microfollicular neoplasms – included atypical, microfollicular or mixed micro and macrofollicular cytology with predominance of microfollicles, or an indeterminate cytology report. There was no significant difference between the two groups in terms of gender distribution, preoperative diagnosis, extent of procedure or final histopathology (Table 1). Octogenarians had a significantly higher occurrence of substernal goiter when compared to the control group, 10% vs. 3.3%, respectively ($P=0.014$). The occurrence of previous thyroid surgery was also significantly higher in the octogenarians compared to the control group, 7.8% vs. 1.6%, respectively ($P=0.0056$).

ASA (American Society of Anesthesiologists) scores were available for 84 patients of our octogenarian group and for 224 patients from the control group (Figure 3). Most of the octogenarians had an ASA score of 2 or 3, i.e., patients with mild systemic disease or with severe systemic disease, respectively, while most of the patients in the control group had an ASA of 2 with only a few ASA 3 patients in this group. No patients were operated on emergently. Most of the octogenarians had one or two comorbidities, with hypertension being the most common, present in 80% of the octogenarians. In the control group, most of the patients had no comorbidities (Figures 4–5).

Mean length of stay was 1.67 ± 2.19 days in the octogenarian group (range 1–18) and 1.23 ± 2.84 days (range 1–43) in the control group. The median length of stay was one day for both groups. Seventy eight percent of the octogenarians were discharged within 1 day of surgery, whereas in the control group 94% were discharged by that time. Using a Wilcoxon rank sum

test, length of stay for the octogenarians was significantly longer than for the control group ($P<0.0001$). Final histopathology was divided into three groups: (1) benign – included any benign pathology; (2) clinically significant malignancy – including papillary carcinoma > 1 cm (i.e., excluding micropapillary carcinoma), follicular, medullary or anaplastic cancer; (3) micropapillary carcinoma (papillary carcinoma < 1 cm). The rate of clinically significant cancer was 21.1% in the octogenarians and 28.1% in the control group ($P=NS$). Eight octogenarians (8.9%) had an incidental micropapillary carcinoma with an average size of 0.26cm (range 0.05 – 0.6cm). The rate of incidental micropapillary cancer in the control group was 7% with an average size of 0.18cm (range 0.1– 0.7cm) ($P=NS$).

Twenty one of the ninety octogenarians had complications, with an overall complication rate of 23.3% vs. 9.1% in the younger cohort ($p=0.0006$). As some patients had more than one complication (range 1–3), the total number of complications in octogenarians was 28. There was no mortality in either group (Table 2). Many complications were unique to octogenarians (Table 3). One patient required a tracheostomy. This was an 80 year old female who developed respiratory distress on post operative day 4 after a total thyroidectomy with median sternotomy for a symptomatic large toxic substernal goiter with compressive symptoms. The patient was admitted 6 days prior to elective surgery for correction of electrolyte abnormalities and cardiac evaluation. She had a total thyroidectomy with an upper median sternotomy with no intraoperative complications. She was extubated post operatively but re-intubated after several hours due to respiratory distress with worsening pulmonary edema. She was extubated on post operative day 2 but required reintubation and a tracheostomy on post operative day 4. Respiratory insufficiency was thought to be mainly caused by a restrictive pulmonary component due to severe kyphoscoliosis. The patient was gradually weaned of ventilation and transferred to rehabilitation with a tracheostomy tube on post operative day 18. She was then readmitted with a sternal wound infection necessitating drainage.

Univariate Analysis

A univariate risk factor analysis was done for selected variables to identify risk factors for the development of complications in patients undergoing thyroid surgery. Analysis was done for each of the groups separately and for both groups together (Tables 4–6). In the octogenarian group, male gender, cardiac comorbidity, lung disease, and the total number of comorbidities were found to be significant risk factors for the development of complications. In the control group, significant risk factors included male gender, cardiac comorbidity, diabetes, hypertension, neurologic comorbidity, renal disease and the total number of comorbidities. When the univariate analysis was done for both patient groups combined, being part of the octogenarian group was a significant risk factor for complications.

Multivariate Analysis

All variables that were significant on the univariate analysis were included in the multivariate logistic regression model, to identify independent risk factors for complications (Table 7). Male gender and lung disease were identified as independent risk factors for the development of complications in the octogenarian group. Analysis for the control group, revealed the total number of comorbidities to be an independent risk factor in that group. The octogenarian group was not an independent risk factor when all patients were included. Given the small number of events, the multivariate model is suggestive in nature and not indicative.

DISCUSSION

It has previously been suggested that thyroid surgery in the elderly should be restricted to those elderly whose lesions are at high risk for being malignant, whereas low risk lesions may be followed ⁸. Since then, the management of thyroid disorders has become increasingly specialized, and techniques of safe anesthesia and operative skills have led to an increase in the proportion of these patients being managed in specialized endocrine surgical units ⁵. Passler et al⁶ compared the outcomes of 55 patients aged 75 years and older (mean age 79.9±4.1) to 683 younger patients. Similar to our findings, the most common comorbidity was hypertension followed by cardiac disease and arrhythmia, with most patients having one or two comorbidities (30.9% and 32.7%, respectively). Eighteen percent of their elderly patients had 3 or more comorbidities (24.4% in our series). They found a rate of 25.5% early post-operative complications in the elderly compared with 21.8% in the younger group. Although there was a trend toward higher morbidity in the elderly, this was not statistically significant. Most of these complications involved early post-operative recurrent laryngeal nerve palsy and early postoperative hypocalcemia, with rates of 6.3% and 13.6%, respectively. Other post-operative complications occurred in 6 of the 55 elderly patients (10.9%) and included 5.5% hematomas requiring surgery, 3.6% respiratory distress with transfer to the intensive care unit, and 1.8% wound infection. Although a risk factor analysis for complications was not done in this study, they suggested 2 possible explanations for this trend which included the significantly higher rate of recurrent thyroid surgery and the higher frequency of large and retrosternal goiters in the elderly. Although we also found a significant higher rate of retrosternal goiters as well as previous thyroid surgery in our octogenarians, the presence of these variables was not a risk factor for complications in our univariate analysis.

Bliss et al also looked at complication rates in 221 patients aged 75 years and older (68 of whom were over the age of 80) and compared them to younger patient cohorts (age 50–74) ⁵. Complications in patients older than 75 years of age included vocal cord dysfunction (1.8%), temporary hypoparathyroidism (3.9%), evacuation of hematoma (0.9%), wound infection (0.4%) and tracheostomy (0.4%). A significant difference was found between the elderly group and the 61 to 74-year group in the incidence of hematoma formation. There were 2 deaths within 30 days of operation in the group of patients above 75 years of age (0.87%) which were due to advanced anaplastic carcinoma with no significant difference in mortality between the age groups.

More recently, a population based study looking at outcomes from thyroidectomy in elderly patients was published by Sosa et al. ⁷. The study used discharge information obtained from the Healthcare Utilization Project National Inpatient Sample (HCUP-NIS), which is a stratified 20% sample of inpatient admissions to acute care hospitals nationwide, for the years 2003–2004. Of a total of 22,848 patients that underwent thyroid procedure at that time, there were 744 (3%) patients aged 80 years and older that they referred to as superelderly. Nearly 36% of the superelderly had 3 or more comorbid conditions in addition to their thyroid diagnosis. Perioperative complication rates increased significantly with age - from 2.6% in patients age 18–44 years to 10.2% in the superelderly. A significant increase was also seen with the thyroid specific complications with a rate of 1.1% in those aged 18–44 years to 3.6% in the superelderly. Less than 16% of patients over the age of 80 were operated by experienced high volume surgeons (>30 thyroidectomies/year). When the data was adjusted for high volume surgeons vs. low volume surgeons, length of stay for the superelderly was 2.3 and 4.8 days, and complication rate was 4.5% and 13%, respectively. Although previous institution series looking at the morbidity of thyroidectomies in elderly patients have used age limit as low as 60 years old and above ⁸⁹, with more recent studies looking at patients over the age of 75 ^{5, 6}, we have chosen the age of 80 years as our cutoff

due to the major improvement in anesthesia and surgical specialization that would make the age of 80 a more up-to-date age, above which one would consider it to be justified to change common practice. In our study, overall complication rate in the octogenarian group was 23.3% vs. 9.1% in the younger cohort ($P=.0006$). When we carefully investigated the complications in octogenarians, some unique, potentially life threatening complications were revealed. These included, congestive heart failure, atrial fibrillation, hypotension necessitating pressors, tracheostomy, urosepsis and blood transfusion. On the other hand it was also noted that in the octogenarian group thyroid surgery specific complications were less frequent: 1.1% vocal cord dysfunction and 1.1% readmission for hypocalcemia during the 30-day post operative period. All of the operations were performed by highly skilled thyroid surgeons and there was no significant difference in complication rate when the surgeons were compared.

In agreement with Sosa et al.⁷, we have shown in a single high volume institution that patients over the age of 80 have higher morbidity with thyroid surgery. However, as opposed to their findings, our multivariate analysis did not find the age group itself to be an independent risk factor for complications. It should then be emphasized that the chronologic age of the patient should not be the sole decision factor, and rather other physiologic conditions and comorbidities, especially male gender and lung disease, need to be considered before making the final decision to proceed to surgery.

It has been previously shown that high volume thyroid surgeons have the lowest complication rates¹⁰. This observation also holds true in the superelderly group analyzed by Sosa et al. as previously mentioned⁷. It is important to note that the high complication rate in our study in patients over the age of 80 (23.1%), all operated by high-volume surgeons, was not due to the usually observed post thyroidectomy complications, such as nerve injury, hypoparathyroidism or post-operative bleeding. In fact, our thyroid specific complication rates were on par with those published by high volume surgeons^{11, 12}. Rather, most of the complications were cardiovascular, respiratory or urinary in nature. This could have three explanations: 1. our age limit of 80 years old compared with 75 years in the previous published single institution series may potentially increase the patients' comorbid status; 2. other studies using national database data may miss some important complications, especially those requiring readmission or careful chart review. In our study, we thoroughly reviewed all patients records and included all readmission and outpatient complications that were reported to the surgeon or by the surgeon within 30 days of surgery; 3. our institution is a major referral and tertiary/quaternary care center that receives patients presenting with more challenging operative problems, as well as those with higher numbers of comorbidities, thus at higher risk for complications. This may be further supported by the finding that most thyroid surgery in octogenarians in the United States is being done by low volume surgeons^{7, 13} which may bias the database for less difficult cases or patients, and thereby lower the rate of reported complications. We compared our results with national data from the ACS-NSQIP PUF (American College of Surgeons - National Surgical Quality Improvement Program, Participant Use File) for the years 2005–2006. This database contains surgical complication data from 121 hospitals in the United States. We looked at patient data for 126 patients aged 80 years and older that underwent thyroid surgery using the same CPT4 codes as used in our study. The report delineates the complication rate for each individualized complication and included 0.79% wound infection, 0.79% pneumonia, 2.38% unplanned intubation, 0.79% peripheral nerve injury and 0.79% acute myocardial infarction. Because we could not tell from the report whether some patients suffered more than one complication, an overall complication rate could not be provided. Interestingly, many complications that we had captured in our study were not being looked at in the NSQIP data, e.g., congestive heart failure, arrhythmias, severe hypotension, laryngeal edema with respiratory symptoms, urinary retention, milder neurologic complications such as

confusion and general deterioration, ER referrals and readmissions, difficulty swallowing and RLN injury. This further supports the observation that general complication rate as reflected in national databases may be an underestimate of true complication rates, and more validation and auditing of these databases may be required.

Thyroid surgery may be more challenging in the elderly. The aged patient has often neglected a slow growing goiter that ultimately begins to produce obstructive symptoms¹⁴. Our octogenarians had significantly higher rate of substernal goiter. In fact, the most common indication for surgery in the octogenarian group was goiter (28 patients, 31.1%). Of these, 15 patients had non-toxic multinodular goiter (MNG), 4 had toxic nodular goiter and 9 had nodular goiter with substernal component. Eighteen octogenarians had clinical compressive symptoms or very significant radiographic evidence of tracheal compression. Of these, 16 patients had goiters and 2 had large compressing thyroid nodules. For those patients with underlying pulmonary disease, it is sometimes difficult to determine to what extent their symptoms are due to the goiter. Patients with thyroid masses referred to surgery for shortness of breath may have underlying cardiac or respiratory disease as the cause of their respiratory symptoms¹⁵. Lung disease was found to be an independent risk factor for the development of complications in our octogenarian group and cardiac comorbidity was also significantly correlated with the risk for complications. It is therefore important to identify these underlying comorbidities before surgery. Pulmonary function testing with flow-volume loops and neck and chest CT may provide more information as to the degree of obstruction and contribution of the thyroid mass to the clinical presentation.

Based on our results, male gender is an independent risk factor for complications in octogenarians undergoing thyroid surgery. Male gender has also been associated with increased risk for complications in living donor nephrectomies, gastric bypass operations, and Hickman catheter insertions^{16–18}. Recently, male gender has been shown to be a predicting factor for complications in elderly patients undergoing oncologic neck surgery (excluding thyroid surgery)¹⁹. In fact, gender is increasingly recognized as a major factor in the outcome of patients with infectious conditions, as well as in patients under stress conditions such as trauma, with females being more tolerant to major injuries than males. This appears to be related to sex hormone influence on modulation of the immune and cardiovascular response, as well as influence on various metabolic processes²⁰.

When dealing with elderly patients with surgical thyroid diseases, careful patient selection is mandatory. Physicians caring for elderly patients with thyroid problems that may require surgery need to be aware of the higher surgical risk and consider all medical problems and comorbidities of the patient, and also take into consideration anticipated longevity of the patient. Prior to performing a biopsy, which may yield an indeterminate result, clinicians must think through whether surgical options are appropriate for any given patient, considering age and specific comorbidities. Honest and forthright discussions about increased surgical risk in some elderly needs to be undertaken. For some diseases, definitive surgical management may prevent complications that may further interfere with the well being of the patient, e.g., a cancerous nodule or an enlarging goiter. Biopsying all clinically suspicious thyroid nodules and nodules >1–1.5cm is becoming a common practice, especially after some national organizations, such as the American Thyroid Association, have released algorithms suggesting this practice²¹. This would naturally lead to an increase in surgery for benign disease which may sometimes be avoided. Bliss et al. noticed a change in their practice over the last decade with more elderly patients being referred for benign thyroid disease. When they compared indications for surgery in their department, the incidence of total thyroidectomy for cancer fell from 59% in patients aged 60 years and older between 1970 and 1985 to 37% in patients over the age of 75 and to just 19% in those aged 61–74 years in the years 1986–1996⁵. Looking at the risk-benefit ratio, maximal

efforts should be made to avoid unnecessary surgery in the elderly. We, therefore, suggest that more individualized decision making algorithms be applied to elderly patients found to have thyroid nodules, and more strict criteria be applied prior to needle biopsy. Fine needle aspiration of nodules that have a non-suspicious ultrasound appearance may be delayed in those older than 80 years of age, if the nodules are very small and of little clinical significance. These nodules may need to be followed by serial ultrasounds. Some patients may benefit from earlier identification of the need for surgical intervention. Differentiated thyroid carcinoma may be more aggressive in the elderly^{14, 22} and appropriate surgical treatment should be provided in these cases. Efforts should be made to identify surgical patients earlier than the 8th decade of life and surgery should not be delayed, since delay may lead to the risk of added comorbidities at a more advanced age. It is important to discuss the purpose and anticipated outcome of the surgery, as well as the risks, with the patient and the family members. Surgical therapy should then be accompanied by careful preoperative preparation, meticulous operative procedure, and appropriate postoperative management.

Our study is one of the few in the literature looking at the complication rate and risk factors in elderly patients undergoing thyroid surgery. The study is limited because of its retrospective nature and the relatively low number of events. There is definitely a need for larger prospective studies that will also include overall outcomes, benefits, long term survival and quality of life for elderly patients with surgical thyroid disease. For now, it is clear that for those octogenarians who clearly require surgery, surgeons need to have better preoperative evaluation and risk stratification, and we further need to improve our postoperative care, perhaps with better monitoring and involvement of a geriatric team. Patient selection by both endocrinologists and surgeons may lead to earlier surgical intervention in those who are at high risk for disease progression, while others may be recommended for follow-up strategies without surgery, especially those at lowest risk for cancer or disease progression but with the highest risk for complications.

Acknowledgments

Funding support: Dr. Parangi is partially supported by the ATA/ThyCa Grant Award for Thyroid Cancer Research.

Dr. Mekel is a recipient of fellowship grant from the American Physicians Fellowship for Medicine in Israel. Dr. Mekel is also supported in part by the American Friends of Rambam, Israel Medical Association and The Israel Cancer Association.

We would like to acknowledge the contribution of Matthew Hutter, MD for providing the NSQIP data.

References

1. Beahrs, OH. Surgery of thyroid and parathyroid disorders in the aged. In: Adkins, RB.; Scott, HW., editors. Surgical care for the elderly. Baltimore: Williams & Wilkins; 1988. p. 128-137.
2. Kevin, K.; VAV. An Aging world: 2001. Vol. 2001. U.S. Census Bureau; Washington, DC: 2001.
3. Finlayson E, Fan Z, Birkmeyer JD. Outcomes in octogenarians undergoing high-risk cancer operation: a national study. J Am Coll Surg. 2007; 205(6):729–34. [PubMed: 18035254]
4. Finlayson EV, Birkmeyer JD. Operative mortality with elective surgery in older adults. Eff Clin Pract. 2001; 4(4):172–7. [PubMed: 11525104]
5. Bliss R, Patel N, Guinea A, et al. Age is no contraindication to thyroid surgery. Age Ageing. 1999; 28(4):363–6. [PubMed: 10459789]
6. Passler C, Avanessian R, Kaczirek K, et al. Thyroid surgery in the geriatric patient. Arch Surg. 2002; 137(11):1243–8. [PubMed: 12413310]
7. Sosa JA, Mehta PJ, Wang TS, et al. A population-based study of outcomes from thyroidectomy in aging Americans: at what cost? J Am Coll Surg. 2008; 206(3):1097–105. [PubMed: 18501806]

8. Clark OH, Demling R. Management of thyroid nodules in the elderly. *Am J Surg.* 1976; 132(5): 615–9. [PubMed: 984306]
9. Reeve TS, Delbridge L, Crummer P. Thyroid surgery in the elderly. *Ann Acad Med Singapore.* 1987; 16(1):54–7. [PubMed: 3592595]
10. Sosa JA, Bowman HM, Tielsch JM, et al. The importance of surgeon experience for clinical and economic outcomes from thyroidectomy. *Ann Surg.* 1998; 228(3):320–30. [PubMed: 9742915]
11. Kikuchi S, Perrier ND, Cheah WK, et al. Complication of thyroidectomy in patients with radiation-induced thyroid neoplasms. *Arch Surg.* 2004; 139(11):1185–8. [PubMed: 15545564]
12. Liu Q, Djuricin G, Prinz RA. Total thyroidectomy for benign thyroid disease. *Surgery.* 1998; 123(1):2–7. [PubMed: 9457216]
13. Saunders BD, Wainess RM, Dimick JB, et al. Who performs endocrine operations in the United States? *Surgery.* 2003; 134(6):924–31. discussion 931. [PubMed: 14668724]
14. Gaz, RD. Endocrine surgery in the elderly. In: Katlic, MR., editor. *Geriatric Surgery.* Baltimore: Urban & Schwarzenberg; 1990. p. 393-409.
15. Whitman ED, Norton JA. Endocrine surgical diseases of elderly patients. *Surg Clin North Am.* 1994; 74(1):127–44. [PubMed: 8108764]
16. Johnson EM, Remucal MJ, Gillingham KJ, et al. Complications and risks of living donor nephrectomy. *Transplantation.* 1997; 64(8):1124–8. [PubMed: 9355827]
17. Livingston EH, Huerta S, Arthur D, et al. Male gender is a predictor of morbidity and age a predictor of mortality for patients undergoing gastric bypass surgery. *Ann Surg.* 2002; 236(5):576–82. [PubMed: 12409663]
18. Craft PS, May J, Dorigo A, et al. Hickman catheters: left-sided insertion, male gender, and obesity are associated with an increased risk of complications. *Aust N Z J Med.* 1996; 26(1):33–9. [PubMed: 8775526]
19. Sanabria A, Carvalho AL, Melo RL, et al. Predictive factors for complications in elderly patients who underwent head and neck oncologic surgery. *Head Neck.* 2008; 30(2):170–7. [PubMed: 17694555]
20. Hsieh YC, Frink M, Choudhry MA, et al. Metabolic modulators following trauma sepsis: sex hormones. *Crit Care Med.* 2007; 35(9 Suppl):S621–9. [PubMed: 17713419]
21. Cooper DS, Doherty GM, Haugen BR, et al. Management guidelines for patients with thyroid nodules and differentiated thyroid cancer. *Thyroid.* 2006; 16(2):109–42. [PubMed: 16420177]
22. Vini L, Hyer SL, Marshall J, et al. Long-term results in elderly patients with differentiated thyroid carcinoma. *Cancer.* 2003; 97(11):2736–42. [PubMed: 12767085]

Figure 1.
Age distribution in octogenarians

Number of thyroidectomies by year

Figure 2.
Number of thyroidectomies, by year

Figure 3.
Age distribution in the control group

Figure 4.
Patients' ASA score distribution, by age group; ASA indicates American Society of Anesthesiologists

Figure 5.
Frequency of comorbidities, by age group

Figure 6.
Number of comorbidities, by age group

Table 1

Thyroidectomy Patient characteristics, by age group

Characteristics	OCTOGENARIANS (n=90)		CONTROL (n=242)		P
	n	%	n	%	
Gender					
Female	72	80	193	79.7	0.9601
Male	18	20	49	20.2	
Preoperative diagnosis					
Benign	46	51.1	99	40.9	0.2077
Malignant	17	18.9	63	26	
Microfollicular	27	30	80	33.1	
Substernal goiter	9	10	8	3.3	0.014
Previous thyroid surgery	7	7.8	4	1.6	0.0056
Extent of current procedure					
Lobectomy/partial thyroidectomy	36	40	124	51.2	0.068
Total/subtotal thyroidectomy	54	60	118	48.8	
Final histopathology					
Benign	63	70	157	64.9	0.410
Malignant	19	21.1	68	28.1	
Micropapillary	8	8.9	17	7	

Table 2

clinical outcome after thyroidectomy, by age group

Outcome	OCTOGENARIANS (n=90)		CONTROL (n=242)		P
	n	%	n	%	
Patients with complications	21	23.3	22	9.1	0.0006
Cardiovascular	6	6.7	3	1.2	
Respiratory	3	3.3	4	1.6	
Urinary	4	4.4	3	1.2	
Electrolyte	2	2.2	1	0.4	
Neurologic	1	1.1	5	2	
Bleeding/transfusion	1	1.1	1	0.4	
Other	6	6.7	3	1.2	
Thyroid surgery specific complications	5	5.5	6	2.5	
Total number of complications	28		26		
Mortality	0		0		

Table 3

Detailed analysis of complications in octogenarians

Complication	Number of patients (%)
cardio-vascular complications	6 (6.7)
* congestive heart failure	1 (1.1)
* atrial fibrillation	2 (2.2)
* other arrhythmia	2 (2.2)
* Hypotension necessitating pressors	1 (1.1)
Respiratory complications	3 (3.3)
* Pneumonia	1 (1.1)
reintubation with * tracheostomy	1 (1.1)
laryngeal edema	1 (1.1)
Urinary complications	4 (4.4)
urinary retention	3 (3.3)
* urosepsis	1 (1.1)
Electrolyte complications	2 (2.2)
* hypokalemia	1 (1.1)
* readmission with hypercalcemia	1 (1.1)
Neurologic	1 (1.1)
* confusion	1 (1.1)
Bleeding/* transfusion requirement	1 (1.1)
Other	6 (6.7)
* general deterioration/unsteadiness	3 (3.3)
* GERD	1 (1.1)
* Biliary colic	1 (1.1)
* ischemic colitis	1 (1.1)
Specific thyroid surgery complications	5 (5.5)
readmission for hypocalcemia	1 (1.1)
Vocal cord dysfunction	1 (1.1)
* difficulty swallowing	2 (2.2)
* sternotomy wound infection	1 (1.1)

* Complications unique to octogenarians

Univariate analysis of selected risk factors for the development of complications after thyroid surgery in the octogenarian group

Table 4

Variable	Patients with complications (n=21)		Patients without complications (n=69)		P
	n	%	n	%	
Gender					
Female	9	42.9	63	91.3	<0.0001
Male	12	57.1	6	8.7	
Preoperative diagnosis					
Benign	11	52.4	35	50.7	0.3909
Malignant	2	9.5	15	21.7	
Follicular	8	38.1	19	27.5	
Substernal goiter	1	4.8	8	11.6	0.3608
Previous thyroid surgery	2	9.5	5	7.2	0.733
Arrhythmia	5	23.8	12	17.4	0.532
Cardiac comorbidity	9	42.9	12	17.4	0.0157
Coumadin use	1	4.8	8	11.6	0.3608
Diabetes	4	19	8	11.6	0.379
Hypertension	18	85.7	54	78.3	0.4547
Neurologic comorbidity	4	19	5	7.2	0.1145
Renal disease	4	19	5	7.2	0.1145
Lung disease	4	19	2	2.9	0.0094
Number of comorbidities					0.0027
Extent of surgery					
Lobectomy/partial Thyroidectomy	9	42.9	27	39.1	0.760
Total/subtotal	12	57.1	42	60.9	
Cancer > 1cm	2	9.5	17	24.6	0.1373

Univariate analysis of selected risk factors for the development of complications after thyroid surgery in the control group

Table 5

Variable	Patients with complications (n=22)		Patients without complications (n=220)		P
	n	%	n	%	
Gender					
Female	14	63.6	179	81.4	0.0485
Male	8	36.4	41	18.6	
Preoperative diagnosis					
Benign	8	36.4	91	41.4	0.7135
Malignant	5	22.7	58	26.4	
Follicular	9	40.9	71	32.3	
Substernal goiter	1	4.5	7	3.2	0.733
Previous thyroid surgery	1	4.5	3	1.4	0.2644
Arrhythmia	1	4.5	12	5.4	1
Cardiac comorbidity	4	18.2	8	3.6	0.0027
Coumadin use	2	9.1	9	4.1	0.2831
Diabetes	4	18.2	14	6.4	0.044
Hypertension	11	50	54	24.5	0.0102
Neurologic comorbidity	2	9.1	1	0.4	0.0005
Renal disease	2	9.1	1	0.4	0.0005
Lung disease	4	18.2	23	10.4	0.2724
Number of comorbidities					0.0188
Extent of surgery					
Lobectomy/partial Thyroidectomy	9	40.9	115	52.3	0.309
Total/subtotal	13	59.1	105	47.7	
Cancer > 1cm	8	36.4	63	28.6	0.4479

Univariate analysis of selected risk factors for the development of complications after thyroid surgery in octogenarians and controls combined

Table 6

Variable	Patients with complications (n=43)		Patients without complications (n=289)		P
	n	%	n	%	
Group					
Octogenarians	21	48.8	69	23.9	0.0006
Control	22	51.2	220	76.1	
Gender					
Female	23	53.5	242	83.7	<0.0001
Male	20	46.5	47	16.3	
Preoperative diagnosis					
Benign	19	44.2	126	43.6	0.3545
Malignant	7	16.3	73	25.3	
Follicular	17	39.5	90	31.1	
Substernal goiter	2	4.7	15	5.2	0.881
Previous thyroid surgery	3	7	8	2.8	0.1503
Arrhythmia	6	13.9	24	8.3	0.251
Cardiac comorbidity	13	30.2	20	6.9	<0.0001
Coumadin use	3	7	17	5.9	0.7784
Diabetes	8	18.6	22	7.6	0.019
Hypertension	29	67.4	108	37.4	0.0002
Neurologic comorbidity	6	13.9	6	2.1	<0.0001
Renal disease	6	13.9	6	2.1	<0.0001
Lung disease	8	18.6	25	8.6	0.0418
Number of comorbidities					
Extent of surgery					
Lobectomy/partial Thyroidectomy	18	41.9	142	49.1	0.373
Total/subtotal	25	58.1	147	50.9	
Cancer > 1cm	10	23.3	80	27.7	0.5424

Table 7

Multivariate risk factors analysis for the development of complications after thyroid surgery (A) in the octogenarian group (B) in the control group and (C) in octogenarians and controls combined

A			
Variable	OR	95% CI	P
Male gender	15.2	4.3 – 53.7	<0.0001
Respiratory comorbidity	9.9	1.3 – 73.2	0.02

B			
Variable	OR	95% CI	P
Number of comorbidities	1.9	1.3 – 2.7	0.0006

C			
Variable	OR	95% CI	P
Male gender	3.3	1.6 – 6.7	0.0012
Number of comorbidities	1.8	1.4 – 2.4	<0.0001