



Original Research

Impact of the Coronavirus Disease Pandemic on the Annual Thyroid, Parathyroid, and Adrenal Surgery Volume in a Tertiary Referral Endocrine Surgery Center in 2020

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Abstract

Objective: The purpose of the study was to evaluate the impact of the coronavirus disease (COVID-19) pandemic on endocrine surgical volumes.

Methods: There were periodic surgical restriction sin our country in 2020 due to the pandemic. Endocrine surgery volumes at the Division of Endocrine Surgery, Istanbul Medical Faculty were compared between 2019 and 2020.

Results: The surgical volume reduction in 2020 compared to 2019 was 20%, 54.5%, and 40% for thyroid, parathyroid, and adrenal surgery, respectively. Surgical volume for thyroidectomy for benign nodular goiter and parathyroidectomy significantly decreased, whereas adrenal surgery showed no significant difference in 2020 compared to 2019. No significant difference was found in the rates of thyroid cancer and adrenocortical cancer surgery in 2020 compared to 2019.

Conclusion: The COVID-19 outbreak led to a significant reduction in the annual rates of parathyroidectomy and thyroidectomy for benign goiter, whereas the volume of thyroid cancer and adrenal surgeries were similar to the previous year.

Keywords: Coronavirus disease pandemic; endocrine surgery; endocrine surgical volume.

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Introduction

The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) virus was first reported in Wuhan City, China in December 2019, and it rapidly spread worldwide in 2020. The World Health Organization (WHO) declared the SARS-CoV-2 disease (coronavirus disease [COVID-19]) outbreak a pandemic on March 11, 2020.^[1] Globally, health-care authorities have reacted by restricting medical care to urgent and emergency cases to route most of the hospital

and intensive care resources toward the care of the massive number of COVID-19 patients. Thus, surgical societies have published guidelines for triage and prioritization criteria to define the emergent and urgent surgical procedures that should not be postponed and elective procedures that could be deferred during the pandemic.^[2–5] In Turkey, the first COVID-19 patient was reported on March 11, 2020. By then, the Ministry of Health had announced that all elective surgical procedures should be postponed

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and restricted surgery only to urgent or emergent cases. Our institution has served as a COVID-19 hub hospital during the pandemic, and the department of surgery, surgical intensive care unit, and most of the operative rooms were reserved for the care of COVID-19 patients during peak outbreaks. In our country, there were two peak outbreak periods in 2020 when elective surgery was restricted. Following the first outbreak, elective procedures were progressively reopened when the incidence of COVID-19 infection decreased in June 2020, but restrictions were re-imposed during the second peak outbreak, which occurred by the end of September 2020. The restrictions led to a significant decrease in overall surgical volumes including endocrine surgery. The objective of this study was to compare the surgical indications, surgical approaches, surgical volumes of endocrine surgery, and the rate of histopathologically proven malignancy between 2019 and 2020, including a comparison of the four periods that were defined for the pandemic in 2020 and same the same periods in 2019.

Materials and Methods

Study Design and Setting

This retrospective analysis was conducted at the Istanbul Medical Faculty, which is a tertiary referral endocrine surgery center. The medical records of patients who were surgically treated in 2020 and 2019 were evaluated retrospectively. Retrospective analysis included thyroid, parathyroid, adrenal, and neuroendocrine tumor (NET) surgery. No ethical license was required as the study included retrospective archive analysis of surgical indications and surgical volumes. Written informed consent was waived. The study complies with the Declaration of Helsinki.

Definition of Study Periods

In our country, there were no restrictions for elective surgery from January 1 to March 15, 2020. During the 2020 pandemic, there were two peak outbreak periods in Turkey when elective surgery was restricted: March 16 to June 15 and October 1 to December 31. Elective procedures were progressively reopened between June 16 and September 30, 2020, due to a significant decrease in new COVID-19 cases. The year 2020 was divided into four periods according to the local intensity of the pandemic and the associated restrictions: Period I (January 1–March 15), period II (March 16–June 15), period III (June 16–September 30), and period IV (October 1–December 31). Periods II and IV correspond to the periods when our institution's resources were mainly routed toward COVID-19 patients due to the rapid escalation of the disease course. Under such

circumstances, emergent, urgent, and semi-urgent surgeries were performed in a surgery unit, which was isolated from the patients who were being treated for SARS-CoV-2 infection.

Endocrine Surgical Decision-making during the COVID-19 Pandemic

During the pandemic, the Division of Endocrine Surgery, Istanbul Faculty of Medicine continued multidisciplinary meetings through online facilities and decided on the surgical indications according to the International and Institutional guidelines and recommendations for surgery during the COVID-19 pandemic.^[6–11] The surgical restriction regulations were more rigid during the first peak (period II) due to the sudden presentation of the pandemic and the need for urgent adaptation of hospital resources to pandemic conditions compared to the second peak (period IV). Endocrine surgery was restricted to patients with clinically aggressive thyroid cancer with local invasion, thyroid diseases leading to life-threatening airway obstruction, medically uncontrolled hormone-secreting endocrine tumors, and rapidly progressive adrenocortical cancer during period II.^[6,7,11] During period IV, re-organization of hospital resources had been well established for the pandemic conditions, and isolated buildings were reserved for COVID-19 patients at our institution. Therefore, the indications for endocrine surgery were relatively more flexible (including large thyroid nodules with Bethesda V–VI cytology) in period IV compared to period II. During the 2020 pandemic, a swab test was performed for all patients 24 h before surgery.

Pre-operative Management

In periods II and IV, chest computerized tomography was also performed preoperatively in addition to the swab test for COVID-19 screening. The surgery was postponed if the screening test results were positive. During the pandemic, a pre-operative vocal cord examination was performed in selected cases with voice symptoms and was scheduled after the COVID-19 screening test. In our endocrine surgery unit, routine neck ultrasonography (USG) is performed in all patients who have nodules with Bethesda III–VI cytology within 1 week before surgery. If surgery was deferred due to the pandemic, re-evaluation with a repeat neck USG was performed in these patients before the re-scheduled surgery. Sonographic follow-up could not be performed in these patients during the surgical delay period due to pandemic-related restrictions and patients' reluctance to visit a hospital.

Intraoperative Approach

Intraoperative precautions were undertaken during all surgical procedures to maintain the safety of health-care personnel and patients. All endocrine surgeries were performed by the same team in the endocrine surgery unit. Routine use of intraoperative nerve monitoring was continued in thyroid and parathyroid surgeries during the pandemic.

Post-operative Management

Postoperatively, a laryngeal examination was performed on patients with recurrent laryngeal nerve injury or loss of signal during intraoperative neuromonitoring. A multidisciplinary approach was used for safe and early discharge of the patient after surgery. Routine COVID-19 screening tests were not performed postoperatively except for patients with suspected COVID-19 infection symptoms.

Study Outcomes

The indications for surgery, surgical approaches, surgical volumes, and the rate of his to pathologically proven malignancy were compared between 2019 and 2020, including a comparison of the four periods that were defined for the pandemic in 2020 and same the same periods in 2019.

Statistical Analysis

Categorical variables were expressed as a percentage and were analyzed using the χ^2 test or the F exact test. $p < 0.05$ was considered to be statistically significant. Statistical analysis was performed using IBM SPSS Statistics for Windows, Version 20.0 (IBM Corp., Armonk, NY, USA).

Results

The overall surgical volumes in 2019 and 2020 are summarized in Table 1. The total volume reduction in endocrine surgery was 25% in 2020 compared to 2019 (291 vs. 388 surgeries, respectively). The volume reduction in 2020

compared to 2019 was 20%, 54.5%, and 40% for thyroid, parathyroid, and adrenal surgery, respectively. Although the volume of thyroid surgery decreased in 2020 compared to 2019, the ratio of thyroid surgery-to-total endocrine surgery increased in 2020 (86% vs. 80.6%; $p=0.07$). There was a significant reduction in the ratio of parathyroid surgery-to-total endocrine surgery in 2020 compared to 2019 (8.6% vs. 14%, respectively; $p=0.017$). The ratio of adrenal surgery-to-total endocrine surgery was similar in 2019 and 2020 (4% vs. 5%, respectively; $p=0.8$). There was no NET surgery in 2019. Four patients underwent surgery for NETs (insulinoma, three patients; gastrointestinal NET, one patient) in 2020. When the indications for thyroid surgery were compared, the rate of thyroidectomy for presumed benign nodular goiter with mild to moderate compressive symptoms was significantly reduced in 2020 compared to 2019 (18.8% vs. 26%, respectively; $p=0.04$; Table 2). Other indications including nodules with Bethesda III–VI cytology, recurrent thyroid cancer or hyperthyroidism showed no significant differences between the 2 years. The overall rates of lobectomy, total thyroidectomy, and lymph node dissection were not significantly different in 2019 and 2020 (Table 3). The rate of his to pathologically diagnosed thyroid cancer was similar in 2020 and 2019 (52% and 53%, respectively; $p=0.6$; Table 3). No patient was diagnosed with parathyroid carcinoma in 2019 or 2020. The rates of adrenocortical cancer in 2019 and 2020 were 10% and 8.3%, respectively ($p=0.8$).

Thyroid Surgery

Comparison of indications and surgical volume in periods I–IV in 2019 and 2020

There were 313 and 250 thyroid operations in 2019 and 2020, respectively. The distribution of surgical indications, surgical volume, surgery type, and the rate of thyroid malignancy in periods I–IV in 2019 and 2020 is summarized in Tables 2 and 3. The total rate of lymph node dissection, including prophylactic and/or therapeutic central neck

Table 1. The ratio of thyroid, parathyroid, and adrenal surgery to total endocrine surgery and endocrine surgical volume reduction and in 2019 and 2020

Surgical indication	2019/2020 n(%) –to total surgery	P value	Reduction rate 2020 versus 2019%
Thyroid	313(81)/250 (86)	0.07	20%
Parathyroid	55(14)/25 (8.6)	0.017	54.5%
Adrenal	20(5)/12 (4)	0.8	40%
NET*	0(0)/4 (1.4)	0.04	—
Total endocrine surgery	388/291		25%

*NET: Neuroendocrine tumor.

Table 2. Surgical indications and surgical volume of thyroid surgery in 2019 and 2020

Surgical indication	Period I 2019/2020 n (%)	Period II 2019/2020 n (%)	Period III 2019/2020 n (%)	Period IV 2019/2020 n (%)	Total 2019/2020 n (%)
Nodular goiter*	20 (25)/19 (40) <i>p</i> =0.06	16 (20)/0 (0) <i>p</i> =0.001	30 (37)/27 (58) <i>p</i> =0.02	15 (18)/ 1(2) <i>p</i> =0.007	81 (25.9)/47 (18.8) <i>p</i> =0.04
Bethesda 3–4 Cytology	20 (29)/16 (30) <i>p</i> =0.8	10 (14)/0 (0) <i>p</i> =0.004	24 (34)/ 35(66) <i>p</i> =0.004	16 (23)/2 (4) <i>p</i> =0.003	70 (22.4)/53 (21.2) <i>p</i> =0.7
Bethesda 5-6 cytology	25 (26.6)/21 (23) <i>p</i> =0.6	26 (27.6)/3 (3) <i>p</i> =0.0001	30(32) / 51(57) <i>p</i> =0.007	13 (14)/15 (17) <i>p</i> =0.5	94 (30)/90 (36) <i>p</i> =0.1
Recurrent thyroid cancer	2 (9)/2 (10.5) <i>p</i> =0.8	6 (27)/0 (0) <i>p</i> =0.01	11 (50)/15 (79) <i>p</i> =0.05	3 (14)/2 (10.5) <i>p</i> =0.8	22 (7)/19 (7.6) <i>p</i> =0.7
Hyperthyroidism	10 (22)/18 (44) <i>p</i> =0.03	14 (30)/0 (0) <i>p</i> =0.0001	11 (24)/20 (49) <i>p</i> =0.01	11 (24)/3 (7) <i>p</i> =0.03	46 (14.7)/41 (16.4) <i>p</i> =0.5
Total thyroid surgery	77 (25)/76 (30.4) <i>p</i> =0.1	72(23)/3(1.2) <i>p</i> =0.0001	106 (34)/148 (59.2) <i>p</i> =0.0001	58 (18)/23 (9.2) <i>p</i> =0.002	313/250

*Bilateral or unilateral nodular goiter leading to compressive symptoms with no clinical evidence of malignancy.

Table 3. The types of thyroid surgery and the rate of thyroid cancer in 2019 and 2020

	Period I 2019/20210 n (%)	Period II 2019/2020 n (%)	Period III 2019/2020 n (%)	Period IV 2019/2020 n (%)	Total 2019/2020 n (%)
Lobectomy	18 (26)/18 (31) <i>p</i> =0.5	12 (17)/0 (0) <i>p</i> =0.0008	18 (26)/37 (64) <i>p</i> =0.0001	21 (31)/3 (5) <i>p</i> =0.0002	69 (22)/58 (23) <i>p</i> =0.7
Total tiroidectomy	57 (26)/56 (32) <i>p</i> =0.1	54 (24)/3 (2) <i>p</i> =0.0001	77 (35)/96 (56) <i>p</i> =0.0001	34 (15)/18 (10) <i>p</i> =0.1	222 (71)/173 (69) <i>p</i> =0.1
Surgery for recurrent cancer*	2 (9)/2 (10.5) <i>p</i> =0.8	6 (27)/0 (0) <i>p</i> =0.01	11 (50)/15 (79) <i>p</i> =0.05	3 (14)/2 (10.5) <i>p</i> =0.7	22 (7)/19 (8) <i>p</i> =0.7
Total surgery	77 (25)/76 (30.4) <i>p</i> =0.1	72 (23)/3 (1.2) <i>p</i> =0.0001	106 (34)/148 (59.2) <i>p</i> =0.0001	58 (18)/23 (9.2) <i>p</i> =0.002	313/250
LND **	18 (30.5)/16 (29) <i>p</i> =0.8	19 (32)/2 (4) <i>p</i> =0.0001	14 (24)/27 (49) <i>p</i> =0.004	8 (13.5)/10 (18) <i>p</i> =0.4	59 (18.8)/55 (22) [†] <i>p</i> =0.3
Malignant histopathology	38 (23)/35 (27) <i>p</i> =0.5	46 (28)/3 (2) <i>p</i> =0.0001	54 (32)/76 (58) <i>p</i> =0.0001	54 (32)/76 (58) <i>p</i> =0.0001	167 (53)/130 (52) [‡] <i>p</i> =0.6

*Surgery for locoregional recurrence of thyroid cancer; **LND: Prophylactic or therapeutic central neck dissection, or lateral neck dissection performed additional to thyroidectomy or for recurrent thyroid cancer; [†]The overall rate of lymph node dissection in 313 and 250 thyroid surgeries performed in 2019 and 2020; respectively; [‡]The overall rate of malignant histopathology in 313 and 250 thyroid surgeries performed in 2019 and 2020; respectively.

dissection or lateral neck dissection in addition to thyroidectomy, was used to evaluate the statistical differences between the four periods in 2019 and 2020.

Period I

The volume of thyroid surgery was not significantly different between 2019 and 2020 (25% vs. 30.4%, respectively; *p*=0.1). The surgery rates were similar in 2019 and

2020, except for a higher rate of hyperthyroidism in 2020 (Table 1). The extent of thyroidectomy and the rate of total lymph node dissection and malignancy showed no significant difference between 2019 and 2020 (Tables 2 and 3).

Period II

Among 250 thyroid surgeries, 1.2% (*n*=3) were performed in period II in 2020, whereas 23% of all thyroid

surgeries were performed during the same period in 2019 ($p=0.0001$). The three patients who underwent total thyroidectomy in 2020 had thyroid carcinoma that led to significant airway obstruction. Additional central lymph node dissection was performed in two of these three patients. All other patients with presumed benign goiter, nodules with Bethesda III–VI, and medically controlled hyperthyroidism were postponed.

Period III

The volume of thyroid surgery was significantly higher in 2020 compared to 2019 (59.2% vs. 34%, respectively; $p=0.0001$). There was a significant increase in the rate of surgery for presumed benign nodular goiter, nodules with Bethesda III–VI cytology, and hyperthyroidism in 2020 compared to 2019 (Table 2). The rates of lobectomy, total thyroidectomy, and lymph node dissection significantly increased in 2020 compared to 2019 (Table 3). The rate of histopathologically diagnosed thyroid malignancy significantly increased in 2020 compared to 2019 (32% vs. 58%, respectively; $p=0.0001$). The increase in the rate of surgery and malignancy in period III was attributed to re-scheduling surgery for the patients who had their surgery postponed in the previous restriction period.

Period IV

There was a significant reduction in thyroid surgery volume in 2020 compared to 2019 (9.2% vs. 18%, respectively; $p=0.002$). When surgical indications in 2020 and 2019 were compared, there was a significant reduction in the rates of surgery for presumed benign nodular goiter, nodules with Bethesda III–IV cytology, and hyperthyroidism, whereas the rate of surgery for nodules with Bethesda V–VI cytology was similar (Table 2). Most surgeries for patients with presumed benign nodular goiter, Bethesda III–IV cytology, and hyperthyroidism were postponed in period IV in 2020. The rate of lobectomy decreased in 2020 compared to 2019, whereas the rates of total thyroidectomy and lymph node dissection were similar. The rate of thyroid malignancy was higher in 2020 compared to 2019 ($p=0.0001$).

Comparison of parathyroid, adrenal, and NET surgeries in 2019 compared to 2020 according to periods I–IV

Parathyroid surgery in periods I–IV

The volumes of parathyroid surgery in the four periods in 2019 and 2020 are summarized in Table 4. The volume of parathyroid surgery showed no significant difference in period I between 2019 and 2020 ($p=0.9$). All patients with hyperparathyroidism were managed medically in period II in 2020, and there were no parathyroid surgeries performed, whereas 31% (17/55) of all parathyroid surgeries in 2019 were performed during this period ($p=0.001$). The rate of parathyroidectomy was significantly higher in period III in 2020 compared to 2019 (80% vs. 32.7%, respectively; $p=0.0001$). In period IV in 2020, the volume of parathyroid surgery was markedly reduced compared to 2019, but the difference was not statistically significant (8% vs. 23%, respectively; $p=0.09$).

Adrenal surgery in periods I–IV

The volumes of adrenal surgery in the four periods in 2019 and 2020 are summarized in Table 5. The adrenal surgery volume showed no significant differences between the four periods in 2019 and 2020 (Table 5). Functional adrenal tumors constituted the major indication for adrenalectomy in both years. In period II, the ratio of adrenalectomy was 40% in 2019, whereas only one (8.3%) patient with medically uncontrolled pheochromocytoma underwent adrenalectomy in period II in 2020. All other functional adrenal tumors or suspicious adrenal lesions that could be managed medically were postponed during period II in 2020. In period III in 2020, the rate of adrenalectomy increased compared to the same period in 2019 (50% vs. 30%, respectively; $p=0.2$). In period IV in 2019, there was no adrenal surgery, whereas two patients with medically uncontrolled bilateral pheochromocytoma underwent bilateral adrenalectomy in period IV in 2020. The rates of adrenocortical cancer in 2019 and 2020 were 10% (2/20) and 8.3% (1/12), respectively ($p=0.8$). Adrenal metastatic tumors were found in one (5%) patient in 2019 and one (8.3%) patient in 2020 ($p=0.7$).

Table 4. The volume of parathyroid surgery in 2019 and 2020

	Period I 2019/2020 n (%)	Period II 2019/2020 n (%)	Period III 2019/2020 n (%)	Period IV 2019/2020 n (%)	Total 2019/2020
Parathyroid surgery	7/ (13)/3 (12) $p=0.9$	17 (31)/0 (0) $p=0.001$	18 (33)/20 (80) $p=0.0001$	13 (23)/2 (8) $p=0.09$	55/25

Table 5. Surgical indications, surgical volume and the rate of adrenocortical cancer in adrenal surgery in 2019 and 2020

Surgical indication	Period I 2019/2020 n (%)	Period II 2019/2020 n (%)	Period III 2019/2020 n (%)	Period IV 2019/2020 n (%)	Total 2019/2020 n (%)
Functional adrenal tumor	6/ (40)/2 (22)	5 (33)/1 (11)	4 (26)/4 (45)	0 (0)/2 (22)	15 (75)/9 (75) <i>p</i> =1
Adrenal mass (SM)*	0 (0)/1 (50)	3 (75)/0 (0)	1 (25)/1 (50)	-/-	4 (20)/2 (17) <i>p</i> =0.8
Adrenal metastasis	-/-	-/-	1 (100)/1 (100)	-/-	1 (5)/1 (8) <i>p</i> =0.7
Total adrenal surgery	6 (30)/3 (25) <i>p</i> =0.7	8 (40)/1 (8) <i>p</i> =0.05	6 (30)/6 (50) <i>p</i> =0.2	0 (0)/2 (17) <i>p</i> =0.06	20/12
Histopathology: ACC**	0/1	1/0	1/0	-/-	2 (10)/1 (8.3) <i>p</i> =0.8

*SM: suspicious for malignancy; **ACC: Adrenocortical cancer.

NET surgery in periods I–IV

There was no NET surgery in 2019. Four patients underwent surgery for NET in 2020. Three patients with insulinoma underwent distal pancreatectomy and splenectomy. Among these three patients with insulinoma, one underwent surgery in period II due to medically uncontrollable disease. This patient developed symptoms that were consistent with COVID-19 on the second post-operative day, and the swab test result was positive. There were no complications associated with the surgery and COVID-19 infection, and the patient was discharged on post-operative day 10. The remaining two patients with insulinoma underwent surgery in periods I and III. The patient with gastrointestinal NET underwent segmental small intestine resection in phase IV.

Discussion

In this study, we showed that there was a 25% reduction in the volume of endocrine surgery during the pandemic. The most prominent reduction was recorded for parathyroid surgery. The rate of thyroidectomy for presumed benign nodular goiter significantly decreased during the pandemic compared to 2019, whereas the rate of surgery for thyroid cancer showed was not significantly different between the 2 years.

Health institutions and surgical societies published triage and prioritization statements and guidelines after a pandemic was declared to adjust the surgical practice.^[2-5] The main goal of these recommendations was to guide the correct timing for surgery while balancing the risk between the adverse results of surgical delay and viral

spread. Elective surgeries, including most of the oncologic procedures, were recommended to be postponed 4 weeks to 3 months during the escalation and peak phases of the pandemic, which was mainly based on decisions made by a multidisciplinary team.^[2]

In a pandemic state, most surgeries for benign or malignant endocrine disorders can be postponed due to the low probability that these diseases will be life threatening. However, thyroid malignancy with aggressive behavior and local invasion, thyroid disease leading to life-threatening airway obstruction, medically uncontrolled hormone-secreting endocrine tumors, and rapidly enlarging adrenocortical cancer necessitate urgent surgical intervention.^[6-11] Lombardi *et al.* evaluated the impact of the pandemic on the volume of endocrine surgery during a period of 4 weeks at their institution, which also served as a COVID-19 hub hospital.^[11] The authors reported about a two-thirds decrease in the surgical volume during the pandemic compared to the institution's usual surgical volume over a similar time period. They noted that, among the 97 previously planned surgeries, only 18 (18.5%) were performed because of the institution's surgical prioritization criteria and 79 non-urgent surgeries were postponed. Most of the 18 patients who underwent surgery had thyroid cancer with lymph node metastasis. The authors mentioned that the post-operative course was uneventful in these 18 patients.

During the first outbreak of the pandemic (period II), only five patients underwent endocrine surgery, which corresponded to 2% of all endocrine surgery during 2020. Three of these patients had thyroid cancer leading to significant airway obstruction, among whom one had medically

uncontrolled pheochromocytoma and one had medically uncontrolled insulinoma. Of these five patients, the patient who underwent surgery for insulinoma developed COVID-19 postoperatively. This was the only patient who was diagnosed with post-operative COVID-19 among all the patients who underwent surgery during the 2020 pandemic.

Elective surgeries were progressively restarted by mid-June 2020 due to the decreased nationwide incidence of COVID-19; this continued until October 2020 when the pandemic accelerated again. During the re-opened period, we rapidly re-scheduled surgery for patients, whose surgery had been postponed during the previous period, giving high-priority to patients with thyroid cancer, suspected thyroid cancer, and adrenal tumors. A significant increase in the volume of all endocrine surgeries was noted during the re-opening period (period III) compared to the same period in 2019. Among the 130 patients who underwent surgery for thyroid cancer in 2020, 58% underwent surgery during period III. Fifty percent of all adrenal surgery and 80% of all parathyroid surgery in 2020 were performed during period III.

The rate of cervical lymph node dissection was higher in period III in 2020 compared with 2019, but the overall rate showed no significant difference between the 2 years. There are no current recommendations about the follow-up strategy for patients who have nodules with Bethesda III–VI cytology in case surgery is postponed due to the pandemic. There are no data on the prognostic impact of delaying surgical treatment in such patients, especially in patients with differentiated thyroid cancer. We could not follow-up such patients using serial neck USG when we postponed surgery due to the pandemic. However, we performed a repeat neck USG in these patients before their re-scheduled surgery, and we observed no disease progression when we compared the initial and subsequent sonographic findings. Therefore, the increased rate of cervical lymph node dissection in period III probably resulted from surgical prioritization of thyroid cancer patients during this period so that most of these patients who were postponed during period II underwent surgery.

Zhang *et al.* investigated the impact of pandemic conditions on thyroid surgery patient volumes during the initial 3 months of the pandemic at the Division of Thyroid Surgery in a high-volume university hospital.^[12] The authors noted a reduction in thyroid cancer surgery, which occurred mainly in patients with advanced-stage thyroid cancer. In our study, the overall rate of the patients who were treated for thyroid cancer was similar in 2019 and 2020. The strategy of prioritizing thyroid cancer surgery during period III avoided an annual reduction in the rate of thyroid cancer surgery during the pandemic, but it significantly

reduced the rate of surgery for benign nodular goiter and hyperparathyroidism.

There are some limitations in the study. We did not perform routine postoperative screening for COVID-19, and therefore, it was impossible to provide an exact rate related to the risk of postoperative COVID-19 in our patients who underwent surgery during the pandemic. We could not record the surgical time in all patients, and the impact of pandemic conditions on surgical time could not be assessed.

In conclusion, the start of the pandemic at the beginning of 2020 resulted in a 25% reduction in the endocrine surgery volume compared to the previous year. The most prominent reduction occurred in parathyroid surgery and surgery for presumed benign nodular goiter. When elective surgery restrictions eased, a strategy for rapidly re-scheduling surgery with the priority placed on the formerly postponed thyroid cancer and adrenal tumor surgeries avoided an annual reduction in surgical volume for thyroid cancer, NETs, and adrenal diseases during the pandemic.

Disclosures

Ethics Committee Approval: No ethical license was required as the study included retrospective archive analysis of surgical indications and surgical volumes.

Peer-review: Externally peer-reviewed.

Conflict of Interest: None declared.

Authorship Contributions: Concept – F.T., Y.S.; Design – F.T.; Supervision – Y.S.; Materials – I.C.S., N.A., Y.I.; Data collection &/ or processing – Y.I., Y.S.; Analysis and/or interpretation – F.T., Y.S.; Literature search – Y.S., F.T., Y.I.; Writing – F.T., Y.S.; Critical review – I.C.S., N.A.

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