CLINICAL STUDY

POSTOPERATIVE COMPLICATIONS IN ELDERLY PATIENTS UNDERGOING NECK DISSECTION FOR HEAD AND NECK CANCER

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SUMMARY

Objective: We aimed to investigate postoperative local complications associated with neck dissection, as well as major adverse events, in elderly head and neck cancer patients who have undergone neck dissection.

Methods: Neck dissection surgeries performed for head and neck malignancies between 2019 and 2024 were reviewed. Demographic data, comorbidities, patients' medical histories, tumor type, localization, stage, surgical treatment details, and reconstruction methods were recorded. Postoperative pulmonary complications, major adverse events, and local neck dissection-related complications were evaluated within 30 days of surgery.

Results: A total of 195 patients were included in the study, comprising 119 (61%) under the age of 65, 48 (24.6%) aged 65-74, and 28 (14.4%) aged 75 and older. No mortality was observed within the first 30 days postoperatively; however, two cases in the 75-and-older age group experienced major adverse events. Postoperative pulmonary complications (PPCs) occurred in 13 patients (6.67%), while postoperative local neck dissection-related complications (PLCs) were observed in 20 patients (10.26%). Although PPCs were more frequent in the older age subgroups, this difference was not statistically significant (p = 0.104). In contrast, PLCs were significantly more common in the older age subgroups (p = 0.034). PPCs were more frequently observed in patients with comorbidities, whereas the rate of PLCs was associated with the reconstruction methods used for primary tumor resection sites.

Conclusion: Major adverse events, PPCs, and PLCs were more frequent in elderly neck dissection patients. PPCs were associated with comorbidities, while PLCs were linked to flap-based reconstructions.

Keywords: Neck dissection, elderly, geriatrics, cancer, complications

BAŞ BOYUN KANSERİ SEBEBİYLE BOYUN DİSSEKSİYONU YAPILAN YAŞLI HASTALARDA POSTOPERATİF KOMPLİKASYONLAR

ÖZET

Amaç: Bu çalışmada boyun diseksiyonu uygulanan ileri yaş baş ve boyun kanseri hastalarında, boyun diseksiyonuna bağlı postoperatif lokal komplikasyonları ve majör advers olayları araştırmayı amaçladık.

Gereç ve yöntemler: 2019-2024 yılları arasında baş ve boyun kanseri sebebiyle yapılan boyun diseksiyonu ameliyatları incelendi. Demografik veriler, ek hastalıklar, hastaların tıbbi öyküleri, tümör tipi, lokalizasyonu, evresi, cerrahi tedavi detayları ve rekonstrüksiyon yöntemleri kaydedildi. Cerrahi sonrası 30 gün içinde gelişen pulmoner komplikasyonlar, majör advers olaylar ve boyun diseksiyonuna bağlı lokal komplikasyonlar değerlendirildi.

Bulgular: Toplamda 195 hasta çalışmaya dahil edildi; bunların 119'u (%61) 65 yaş altı, 48'i (%24,6) 65-74 yaş arası ve 28'i (%14,4) 75 yaş ve üzerindeydi. İlk 30 gün içinde mortalite gözlenmedi; ancak, 75 yaş ve üzeri yaş grubundaki iki olguda majör advers olay meydana geldi. Postoperatif pulmoner komplikasyonlar (PPK) 13 hastada (%6,67), postoperatif boyun diseksiyonuna bağlı lokal komplikasyonlar (PLK) ise 20 hastada (%10,26) görüldü. PPK ileri yaş alt gruplarında daha sık görülmekle birlikte, bu fark istatistiksel olarak anlamlı değildi (p = 0,104). Buna karşılık, PLK ileri yaş alt gruplarında anlamlı derecede daha sık izlendi (p = 0,034). PPK'ler komorbiditeleri olan hastalarda daha sık görülürken, PLK oranı primer tümör rezeksiyonu yapılan bölgenin rekonstrüksiyon yöntemleriyle ilişkilendirildi.

Sonuç: Majör advers olaylar, PPK'ler ve PLK'ler yaşlı boyun diseksiyonu hastalarında daha sık görüldü. PPK'ler komorbiditelerle, PLK'ler ise flep tabanlı rekonstrüksiyonlarla ilişkili bulundu.

Anahtar Sözcükler: Boyun diseksiyonu, yaşlı, geriatrik, kanser, komplikasyon

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INTRODUCTION

Parallel to the increase in the elderly population within society, there has also been a rise in the number of elderly patients with head and neck cancer (HNC)[1]. Estimates based upon national health statistics and census data suggest that, even over the coming decade, there will be a significant increase in workload and demand for head and neck surgeons[2]. Guidelines have yet to provide personalized approaches tailored to

elderly individuals with comorbidities, frailty, and polypharmacy[3,4]. In the treatment of head and neck cancers, surgery, radiotherapy, and chemotherapy are employed either alone or in combination[5].

Head and neck cancer surgeries are associated with postoperative morbidity in approximately 40% of cases, most of which manifest within the first 30 days after surgery[6]. Although postoperative adverse events (AEs) following surgery have been widely reported in the literature, the factors predicting their occurrence remain inadequately defined. In surgical treatment of HNC, neck dissection may be added to the excision of the primary tumor to remove overt or occult metastatic lymph nodes. Neck dissection is a procedure with low rates of complications, morbidity, and mortality; however, it prolongs the duration of surgery[7]. Consequently, it may increase the risk of adverse events in elderly patients. Beyond the primary tumor resection, local complications such as hematoma, seroma, infection or chylous leaks may develop at the surgical site following neck dissection.

In this study, postoperative local complications associated with neck dissection, as well as major adverse events, were evaluated in head and neck cancer patients who have undergone neck dissection. The frequency of these events was compared between elderly and younger populations.

MATERIAL and METHODS

Study design

The current study was structured as a retrospective chart analysis. Ethical approval was obtained from the Institutional Scientific and Ethical Review Board (Decision number: TABED 1/491/2024). The study adhered to the principles outlined in the Helsinki Declaration.

Patients

Neck dissection surgeries performed between 2019 and 2024 at the Department of Otorhinolaryngology and Head and Neck Surgery, Ankara Bilkent City Hospital, were reviewed using the computer-based hospital data system. Cases in which at least one neck level was dissected due to head and neck cancer were included in the study. Cases involving neck dissection for benign diseases, subjects who had previously undergone neck surgery or radiotherapy, those with only zone 6 dissection in thyroid cancer, and cases whose medical records were not accessible through the system were excluded from the study.

Data collection

Data were obtained from the computer-based data system between September and November 2024. Patient-related details, including demographic information and medical history, were reviewed. Age was recorded based on the date of surgery. Treatment details included the type of surgery performed (e.g., total laryngectomy, mandibulectomy, or hemiglossectomy), the type of neck dissection (unilateral or bilateral, radical or selective), the number of neck levels dissected, and the flap type used in reconstruction, if applicable. Tumor-related details, including the cancer pathology type, were also recorded. The tumors were pathologically staged by using the eighth edition of the American Joint Committee on Cancer (AJCC) Staging Manual[8].

The 30-day postoperative outcomes of patients were evaluated, following an approach similar to that used in the American College of Surgeons National Surgical Quality Improvement Program. The primary aim of this study was to analyze postoperative pulmonary complications (PPCs), major adverse events, and neck dissection-related local complications across different age groups. Based on the study by Semsar-Kazerooni et al., PPCs were defined as pneumonia, unplanned intubation, and pulmonary embolism[9]. Major postoperative AEs included acute kidney injury, cerebrovascular accident, coma, myocardial infarction, cardiac arrest, sepsis, septic shock, and the need for more than four blood transfusions. Local complications related to neck dissection; wound complications at the incision site, chyle fistula, hematoma, and seroma, were also collectively evaluated as study outcomes.

Statistical analysis

Statistical analyses were performed using SPSS Statistics version 26.0 (IBM Corp., Chicago, IL, USA). Descriptive statistics for categorical variables were expressed as frequencies and percentages (%), while numerical variables were summarized using mean, standard deviation, and minimum and maximum values. The chi-square test or Fisher's

exact test was used to assess relationships between categorical variables. For categorical variables with more than two levels, pairwise comparisons were conducted using either the Chi-square test or Fisher's exact test, as appropriate. Bonferroni correction was applied to adjust for multiple comparisons. The distribution of numerical variables was evaluated using both visual (histograms and Q-Q plots) and analytical methods (Kolmogorov-Smirnov and Shapiro-Wilk tests). As the data did not exhibit a normal distribution, non-parametric tests were utilized for comparisons of means. Statistical significance was set at a p-value ≤ 0.05.

RESULTS

A total of 195 patients, including 146 males (74.9%) and 49 females (25.1%), were included in the study. The mean age of the patients was 59.98 ± 14.54 years (range, 19-94 years). The patient-related characteristics are summarized in Table 1. The patients were divided into three subgroups based on age: under 65 years, between 65 and 74 years, and 75 years or older.

The primary tumor site was the lip-oral cavity in 89 patients (45.6%) and the larynx-hypopharynx in 52 patients (26.7%). The tumor type was squamous cell carcinoma in 154 patients (79%). Tumors were classified as early-stage (0-II) in 80 patients (41%) and advanced-stage (III-IV) in 115 patients (59%). These tumor-related characteristics are summarized in Table 2.

Unilateral neck dissection was performed in 116 patients (59.5%), while bilateral neck dissection was conducted in 79 patients (40.5%). An average of 4.68 ± 1.83 (range, 1-10) neck levels were dissected per patient. Following tumor resection, the surgical site was primarily closed in 143 patients (73.3%). Reconstruction was performed using free flaps in 4 patients (2.1%), local flaps in 38 patients (19.5%), and regional flaps in 10 patients (5.1%). These surgery-related characteristics are summarized in Table 3.

Major adverse events occurred in two patients. The first, a 93-year-old, experienced cardiac arrest on postoperative day 1 while in the intensive care unit. Following successful resuscitation with CPR, the patient was discharged without any sequelae. The second, an 80-year-old, suffered a myocardial infarction on postoperative fourth week, with no mortality observed.

Among patients who underwent neck dissection for HNC, postoperative pulmonary complications (PPC; pneumonia, unplanned intubation, and pulmonary embolism) occurred in 13 cases (6.67%). These included one case requiring reintubation and tracheostomy (0.51%), two cases of pulmonary embolism (1.03%), and 10 cases of pneumonia (5.13%). The distribution of PPCs across different subgroups is summarized in Table 4. The group with comorbidities showed a significantly higher incidence of PPCs compared to the group without comorbidities ($p = 0.003$). While the relationship between smoking status and PPCs was close to significant, with smokers having a higher incidence of complications ($p = 0.052$), no significant differences were observed in PPC rates between the groups categorized by neck dissection type, reconstruction method, or age ($p > 0.05$). Pairwise comparisons between age groups, smoking status, and reconstruction methods were conducted using Fisher's exact test, and Bonferroni correction was applied for multiple comparisons. After correction, no subgroup differences remained statistically significant.

Postoperative local complications (PLC; wound complications at the incision site, chyle fistula, hematoma, and seroma) were observed in 20 patients (10.26%). Among these, 13 were wound-related issues, 4 were chyle fistulas, and 6 were fluid collections. The frequency of PLCs was significantly higher in elderly patients ($p = 0.034$). The distribution of PPCs and PLCs across age subgroups is summarized in Tables 5. A statistically significant higher rate was also observed in patients who underwent flap-based reconstructions ($p=0.007$). However, no significant relationship was found between PLC frequency and smoking, comorbidities, neck dissection type, or disease stage ($p > 0.05$). These findings are summarized in Table 6. Similarly to PPCs, pairwise comparisons between subgroups for PLCs also revealed no statistically significant differences when Bonferroni correction was applied. The overall incidence of any complication among the patients was 14.87% (n = 29). The mean age of

patients with complications was 65.76 ± 13.3 years, whereas the mean age of those without complications was 58.98 ± 14.55 years. This difference was found to be statistically significant (Mann-Whitney U, p = 0.047).

Table 1. Patient-Related characteristics

Features		No. (%)
Gender	Female	49 (25.1)
	Male	146 (74.9)
Comorbidities	Yes	120 (61.5)
	No	75 (38.5)
Smoking status	Non-smoker	63 (32.3)
	Former smoker	35 (17.9)
	Current smoker	97 (49.7)
Age groups	<65	119 (61)
	65-74	48 (24.6)
	>74	28 (14.4)

Table 2. Tumor-Related characteristics

Features		No. (%)
Primary tumor site	Lip-oral cavity	89 (45.6)
	Oropharynx	3 (1.5)
	Larynx-Hypopharynx	52 (26.7)
	Salivary gland	25 (12.8)
	Thyroid	13 (6.7)
	Sinonasal	1 (0.5)
	Skin	9 (4.6)
	Primary unknown	3 (1.7)
Histopathological diagnosis	Squamous cell carcinoma	154 (79)
	Malign melanoma	6 (3.1)
	Low grade salivary gland tumor	11 (5.6)
	High grade salivary gland tumor	10 (5.1)
	Papillary carcinoma	13 (6.7)
	Neuroendocrine tumor	1 (0.5)
Stage of the disease	Early stage (0-II)	80 (41)
	Advance stage (III-IV)	115 (59)

Table 3. Surgery-Related characteristics

Features		No.
Neck dissection	Unilateral	116 (59.5%)
	Bilateral	79 (40.5%)
Number of dissected level		4.68 ± 1.83 (range, 1-10)
Primary tumor site closure	Primary	143 (73.3%)
	Local flap	38 (19.5%)
	Regional flap	10 (5.1%)
	Free flap	4 (2.1%)

Table 4. Postoperative pulmonary complications

Features		PPC + (n=13)	PPC- (n=182)	P value
Comorbidities	Yes	13 (10.83%)	107 (89.17%)	P=0.003
	No	0 (0%)	75 (100%)	
Smoking status	Non-smoker	5 (7.94%)	58 (92.06%)	P=0.052
	Former smoker	5 (14.29%)	30 (85.71%)	
	Current smoker	3 (3.09%)	94 (96.91%)	
Stage of the disease	Early stage (0-II)	7 (8.75%)	73 (91.25%)	P=0.331
	Advance stage (III-IV)	6 (5.22%)	109 (94.78%)	
Neck dissection	Unilateral	6 (5.17%)	110 (94.83%)	P=0.311
	Bilateral	7 (8.86%)	72 (91.14%)	
Primary tumor site closure	Primary	7 (4.9%)	136 (95.1%)	P=0.104
	Local flap	5 (13.16%)	33 (86.84%)	
	Regional flap	0 (0%)	10 (100%)	
	Free flap	1 (25%)	3 (75%)	

Abbreviations: PPC: postoperative pulmonary complications

Table 5. Complication occurrence by age subgroups

Age groups	Total patients (n)	PPC Cases (n, %)	PLC Cases (n, %)
<65	119	5 (4.2%)	10 (7.8%)
65–74	48	4 (8.3%)	3 (6.3%)
>74	28	4 (14.3%)	7 (25.0%)
p-value		0.104	0.034

Abbreviations: PPC: postoperative pulmonary complications, PLC: Postoperative local complications

Table 6. Postoperative local complications

Features		PLC + (n=20)	PLC- (n=175)	P value
Comorbidities	Yes	13 (10.83%)	107 (89.17%)	P=0.737
	No	7 (9.33%)	68 (90.67%)	
Smoking status	Non-smoker	5 (7.94%)	58 (92.06%)	P=0.111
	Former smoker	7 (20%)	28 (80%)	
	Current smoker	8 (8.25%)	89 (91.75)	
Stage of the disease	Early stage (0-II)	8 (10%)	72 (90%)	P=0.922
	Advance stage (III-IV)	12 (10.43%)	103 (89.57%)	
Neck dissection	Unilateral	10 (8.62%)	106 (91.38%)	P=0.362
	Bilateral	10 (12.66%)	69 (87.34%)	
Primary tumor site closure	Primary	10 (6.99%)	133 (93.01%)	P=0.007
	Local flap	5 (13.16%)	33 (86.84%)	
	Regional flap	3 (30%)	7 /70%)	
	Free flap	2 (50%)	2 (50%)	

Abbrevations: PLC: Postoperative local complications

DISCUSSION

With the increasing aging population worldwide, the management of head and neck cancers in elderly patients has become a critical concern in modern healthcare[10]. Age-related physiological changes, coupled with the presence of comorbidities, pose significant challenges in determining optimal treatment strategies for this population. The aim of present study is to explore the specific complications associated with surgical treatment of head and neck cancers in elderly patients, emphasizing the need for individualized risk assessment and tailored therapeutic approaches. By addressing these challenges, we aimed to contribute to the development of evidence-based strategies that optimize treatment outcomes and improve quality of life for this vulnerable population.

In our study, two cases of major adverse events were observed. The first case was an 80-year-old patient diagnosed with T2N0 lip cancer who experienced a myocardial infarction in the fourth postoperative week, although no mortality was observed. The second case involved a 93-year-old patient with locally advanced T3N0 lip cancer, who suffered cardiac arrest on the first postoperative day. Cardiopulmonary resuscitation (CPR) was successfully performed, and the patient was discharged after careful follow-up. While the limited number of cases restricts definitive conclusions, these findings prompt us to critically reconsider the necessity of elective neck dissection in elderly patients. In certain cases, a "wait and see" approach may serve as a viable alternative, particularly in this vulnerable population[11]. A similarly high incidence of cardiac complications following surgery has been reported in elderly patients in the literature[12,13].

Postoperative pulmonary complications were observed in 13 patients (6.67%) in our study. Upon analysis, all these patients were found to have comorbidities. Although no statistically significant association was identified between smoking and PPCs, our findings suggest a potential relationship (p=0.052). The incidence of PPCs was higher in patients aged 75 years and older compared to those under 65 years (14.29% vs. 4.2%); however, this difference did not reach statistical significance. Two potential reasons could explain this finding. First, the limited sample size and low complication rate in our study may have hindered the achievement of sufficient statistical power. Second, biological age alone may not be an independent risk factor for complications[14]. Increasingly, frailty indices are being employed to predict postoperative complications, highlighting the importance of factors beyond chronological ag[4,15-17].

The rate of PPLs in the elderly population in our study was found to be statistically higher, consistent with the literature[18]. Although most of these complications are manageable, they can lead to prolonged hospital stays and associated problems[19]. One particularly interesting finding of our study was the high complication rates observed in the neck dissection regions among patients who underwent flap reconstruction. This may be attributed to the use of regional flaps, such as submental or pectoralis major flaps, which can potentially cause tension in neck dissection closures or lead to fluid collection in the surgical site. Additionally, despite the relatively low volume of free flap surgeries in our study, a local complication rate of 50% was observed. This may be explained by the prolonged operative times and the use of postoperative anticoagulant therapy in these cases.

When all complications were considered together, the group with complications was found to have a higher mean age compared to those without complications. Additionally, both major complications were observed in elderly patients (aged 80 and 94), further supporting the notion that older age may contribute to the development of postoperative complications. This highlights the importance of age as a risk factor to consider in the management of surgical patients.

Limits of the study

Our study is a retrospective analysis, and the data were obtained from the hospital's computer-based data system. Consequently, there is a possibility of missing information that

was not recorded in patient files. While this is less likely for major pulmonary or severe adverse events, the reported numbers for minor local complications may be lower than the actual figures. Additionally, as a single-center study, our sample size is relatively small. The inclusion of cases operated on during the COVID-19 pandemic may have introduced variations in surgical approaches, outcomes, and record-keeping compared to non-pandemic periods. Rather than relying solely on chronological age, incorporating factors such as frailty, nutritional status, and comorbidities alongside chronological age, may provide more accurate indicators for evaluating complications. However, the retrospective design of our study limits the feasibility of such comprehensive assessments. Despite being a single-center study, our case numbers allow for meaningful subgroup comparisons of complications. Moreover, our findings offer valuable insights for guiding the management of head and neck cancer in elderly patients.

CONCLUSION

Based on the results of our study, the rates of major adverse events, PPCs, and PLCs were higher in elderly patients undergoing neck dissection. Additionally, PPCs were more common in patients with comorbidities, while PLCs were more frequent in cases where flaps were used for reconstruction. These findings underscore the importance of considering age and comorbidity status when deciding on elective neck dissection and selecting the type of reconstruction. Alternative treatment options should be carefully discussed in multidisciplinary tumor boards to optimize patient outcomes.

Disclosure statement

The author declares that they have no conflict of interest.

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Authors' contributions

BH: Concept, design, data collection or processing, analysis or interpretation, literature search, writing, critical review

EA: Design, data collection or processing, analysis or interpretation, literature search

AY: Design, analysis or interpretation, literature search, critical review

NGY: Design, analysis or interpretation, literature search, critical review

MÇ: Design, analysis or interpretation, literature search, critical review

Aİ: Concept, design, analysis or interpretation, critical review

SE: Concept, design, analysis or interpretation, critical review

HHD: Concept, design, analysis or interpretation, critical review

REFERENCES

1. Noor A, Gibb C, Boase S, Hodge JC, Krishnan S, Foreman A. Frailty in geriatric head and neck cancer: A contemporary review. Laryngoscope. 2018 Dec;128(12):E416-e24.
2. Bhattacharyya N. The increasing workload in head and neck surgery: An epidemiologic analysis. Laryngoscope. 2011 Jan;121(1):111-5.
3. Baijal G, Gupta T, Hotwani C, Laskar SG, Budrukkar A, Murthy V, Agarwal JP. Impact of comorbidity on therapeutic decision-making in head and neck cancer: audit from a comprehensive cancer center in India. Head Neck. 2012 Sep;34(9):1251-4.
4. Shuman AG, Patel SG, Shah JP, Korc-Grodzicki B. Optimizing perioperative management of geriatric patients with head and neck cancer. Head Neck. 2014 May;36(5):743-9.
5. Machiels JP, René Leemans C, Golusinski W, Grau C, Licitra L, Gregoire V. Reprint of "Squamous cell carcinoma of the oral cavity, larynx, oropharynx and hypopharynx: EHNS-ESMO-ESTRO Clinical Practice Guidelines for diagnosis, treatment and follow-up". Oral Oncol. 2021 Feb;113:105042.
6. Suh JD, Sercarz JA, Abemayor E, Calcaterra TC, Rawnsley JD, Alam D, Blackwell KE. Analysis of outcome and complications in 400 cases of microvascular head and neck reconstruction. Arch Otolaryngol Head Neck Surg. 2004 Aug;130(8):962-6.
7. Holmes JD. Neck dissection: nomenclature, classification, and technique. Oral Maxillofac Surg Clin North Am. 2008 Aug;20(3):459-75.
8. Lydiatt WM, Patel SG, O'Sullivan B, Brandwein MS, Ridge JA, Migliacci JC, Loomis AM, Shah JP. Head and Neck cancers-major changes in the American Joint Committee on cancer eighth edition cancer staging manual. CA Cancer J Clin. 2017 Mar;67(2):122-37.

9. Semsar-Kazerooni K, Richardson K, Forest VI, Mlynarek A, Hier MP, Sadeghi N, Mascarella MA. Development and validation of the modified index of fragility in head and neck cancer surgery. J Otolaryngol Head Neck Surg. 2023 Jan 26;52(1):5.

10. Jégu J, Binder-Foucard F, Borel C, Velten M. Trends over three decades of the risk of second primary cancer among patients with head and neck cancer. Oral Oncol. 2013 Jan;49(1):9-14.

11. Canis M, Plüquett S, Ihler F, Matthias C, Kron M, Steiner W. Impact of elective neck dissection vs observation on regional recurrence and survival in cN0-staged patients with squamous cell carcinomas of the upper aerodigestive tract. Arch Otolaryngol Head Neck Surg. 2012 Jul;138(7):650-5.

12. Polanczyk CA, Marcantonio E, Goldman L, Rohde LEP, Orav J, Mangione CM, Lee TH. Impact of Age on Perioperative Complications and Length of Stay in Patients Undergoing Noncardiac Surgery. Annals of Internal Medicine. 2001 2001/04/17;134(8):637-43.

13. Hamel MB, Henderson WG, Khuri SF, Daley J. Surgical outcomes for patients aged 80 and older: morbidity and mortality from major noncardiac surgery. J Am Geriatr Soc. 2005 Mar;53(3):424-9.

14. Dunlop WE, Rosenblood L, Lawrason L, Birdsall L, Rusnak CH. Effects of age and severity of illness on outcome and length of stay in geriatric surgical patients. Am J Surg. 1993 May;165(5):577-80.

15. Goldstein DP, Sklar MC, de Almeida JR, Gilbert R, Gullane P, Irish J, Brown D, Higgins K, Enepekides D, Xu W, Su J, Alibhai SMH. Frailty as a predictor of outcomes in patients undergoing head and neck cancer surgery. Laryngoscope. 2020 May;130(5):E340-e5.

16. Abt NB, Richmon JD, Koch WM, Eisele DW, Agrawal N. Assessment of the Predictive Value of the Modified Frailty Index for Clavien-Dindo Grade IV Critical Care Complications in Major Head and Neck Cancer Operations. JAMA Otolaryngol Head Neck Surg. 2016 Jul 1;142(7):658-64.

17. Robinson TN, Walston JD, Brummel NE, Deiner S, Brown CHt, Kennedy M, Hurria A. Frailty for Surgeons: Review of a National Institute on Aging Conference on Frailty for Specialists. J Am Coll Surg. 2015 Dec;221(6):1083-92.

18. Kaki PC, Patel AM, Brant JA, Cannady SB, Rajasekaran K, Brody RM, Carey RM. Geriatric Nutritional Risk Index and Postoperative Outcomes Following Head and Neck Cancer Surgery. Head Neck. 2024 Dec 30;10.1002/hed.28052.

19. Gerude MF, Dias FL, de Farias TP, Albuquerque Sousa B, Thuler LC. Predictors of postoperative complications, prolonged length of hospital stay, and short-term mortality in elderly patients with malignant head and neck neoplasm. ORL J Otorhinolaryngol Relat Spec. 2014;76(3):153-64.