Original Article

Postoperative pulmonary complication as an emerging complication in major head and neck cancer surgery: A retrospective study

ABSTRACT

Purpose: Postoperative pulmonary complications (PPCs) are one of the most significant complications following head and neck cancer surgery (HNCS). Patients requiring tracheostomy, free tissue transfer reconstruction, and postoperative ventilation in an intensive care unit (ICU) may have a high incidence of PPCs. This study aimed to identify the most likely situations for developing PPCs in HNCS.

Materials and Methods: A retrospective analysis of 40 patients who had undergone HNCS has been conducted. We individually traced each patient for 7 days postoperatively and collected data on various parameters.

Result: The incidence of PPCs after HNCS is more with free flap reconstruction. Patient-related risk factors with PPCs were advanced age, smoking, body mass index (BMI) >25, and bilateral or unilateral neck dissection. Postoperative ICU stay was significantly related to an increased incidence of PPCs. In terms of specific surgical sites, both the maxilla and mandible also showed significant relationship with PPCs. Tracheostomy was also considered a related factor in developing PPCs.

Conclusion: To reduce PPCs in HNCS, patients with one or more of these risk factors should be subjected to exaggerated postoperative pulmonary care.

Keywords: Head and neck cancer surgery (HNCS), postoperative pulmonary complications (PPCs), risk factors

INTRODUCTION

Head and neck cancers are one of the most common entities among all cancers in the present-day clinical scenario. Anatomical aberration and complicated anatomical structures, airway incompetency, and healthy reparative procedures for bigger defects are the most challenging part, which makes the surgical procedure prolonged. These multifactorial issues result in postoperative complications involving vital organs and the hemodynamical status of the patient.

In particular, for medically compromised patients, there are numerous complications seen after head and neck cancer surgery (HNCS) such as flap failure, deep vein thrombosis, and portal hypertension.

The complications related to the respiratory system are referred to as postoperative pulmonary complications (PPCs), which include pneumonia, pneumothorax, pulmonary edema, bronchospasm, acute lung injury (ALI) and chronic obstructive pulmonary disease (COPD) and acute respiratory distress

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syndrome (ARDS), pulmonary embolism, atelectasis, and respiratory failure.[1]

In developing countries, PPCs cause prolonged hospital stays and increased mortality and jeopardize the output of surgical management.[2] There are several factors that may contribute to PPCs, such as smoking habits, preoperative tracheostomy, a long duration (>4 hours) of anesthesia, free flap reconstruction, and planned postoperative mechanical ventilation in an intensive care unit (ICU), and these may have a significant role.[1,3]

Rao *et al*.[4] did a study on 73 patients, of whom 34 patients had PPCs, and smoking history was a significant factor in it. Weber *et al*.[5] evaluated 225 head and neck cancer patients and identified patient smoking history mostly correlated with PPCs. McCulloch *et al*.[6] did a study on 144 head and neck cancer patients and stated that smoking history as a primary variable was significantly correlated with PPCs. Bilateral neck dissections were also identified as risk factors for PPCs in oral cancer surgery, which also increased hospital stay.

The aim of this study was to find out the most likely situations, which may give rise to PPCs in patients undergoing HNCS so that the propensity of PPC after HNCS can be reduced.

MATERIALS AND METHODS

In this retrospective study, we have 40 patients who have undergone head and neck surgery for oral squamous cell carcinoma from January 01, 2015, to October 31, 2020. The age of the patients included in this study is more than 18 years and above. We have collected data from postoperative day 1 to postoperative day 7. The various parameters that had been considered are surgical site, type of neck dissection, need for tracheostomy, locoregional or free flap reconstruction, and ICU stays of less or more than 4 days. The exclusion criteria of this study are patients with preexisting comorbidities, which are not included [Annexure]. The present study was done after the approval of the institutional ethical committee with Ref no. GNIDSR/IEC/15-20/07 dated 28/02/2021. The patients read and signed the informed consent form.

In our study, we have performed several sets of Pearson's correlation tests to observe the distribution of the data and exclude biasing in different groups. For the power of the study, a one-way analysis of variance test has been performed for regression analysis; for confidence intervals of different parameters, the coefficient of variables is measured; and for data analysis and to rule out the false null hypothesis, the nonparametric Mann–Whitney U-test was performed by the Statistical Package for the Social Sciences (SPSS) software.

RESULT

The results of our retrospective study of 40 patients who have undergone HNCS are represented through the tables of coefficient variables including the various dependable variables [Annexure].

In our study, the site has been divided into four groups: mandible (24), maxilla (5), both mandible and maxilla (2), and tongue (9). No difference has been found in our study with respect to the surgical site, excluding both the maxilla and mandible, which shows a significant difference (the *P*-value for the maxilla group is 0.113, the *P*-value for the mandible group is 0.348, the *P*-value for both the maxilla and mandible groups is 0.039, and the *P*-value for the tongue group is 0.702) [Table 1].

Ages more than 50 years are more prone to have PPCs with a significant difference in result in terms of age less than 50 years (the *P*-value is 0.001) [Table 2].

Table 1: Postoperative day 1

	Mean rank	Confidence interval	*P*
Age <50 years	24.14	0.133	0.01
Age >50 years	14.43	0.659	
Male	21.71	1.893	0.376
Female	18.25	0.869	
Smoker	25.28	1.84	0.009
Nonsmoker	15.73	0.223	
Tongue	21.17	-0.707	0.849
Both maxilla and mandible	26	2.165	0.039
Maxilla	11.3	-1.076	0.558
Mandible	21.71	0.523	0.436
Tracheostomy	16.88	0.208	0.113
BMI <18	16.64	1.71	0.130
BMI 18.5–25	18	1.831	0.360
BMI >25	27.15	3.105	0.012

Table 2: Postoperative day 2

	Mean	Confidence interval	*P*
Age <50 years	24.4	2.478	0.006
Age >50 years	14	1.683	
Male	21.79	0.554	0.347
Female	18.11	0.377	
Smoker	25.15	1.455	0.011
Nonsmoker	15.85	0.877	
Tongue	20.44	-0.907	0.345
Both maxilla and mandible	23	1.763	0.113
Maxilla	12.7	-0.726	0.785
Mandible	21.94	1.2	1.01
Tracheostomy	18.69	0.599	0.436
BMI <18	17.43	0.841	0.231
BMI 18.5–25	16.62	1.414	0.151
BMI >25	27.69	3.086	0.006

A total of 17 of 40 patients in our study have spent more than 4 days in ICU with a ventilator, and they have shown a significant difference in PPCs after surgery, which ranged up to the postoperative 7th day (the *P*-value is 0.005).

In the case of gender predilection among 40 patients, 26 were male and 14 were female, but there are no significant changes observed between the two groups (the *P*-value is 0.492) [Table 3].

In the case of body mass index (BMI), the group has been divided into three parts, that is, less than 18.5 (14 cases), between 18.5 and 25 (13 cases), and more than 25 (13 cases). It was seen that in the case of BMI above 25, up to the 7th postoperative day, a significant difference has been observed in the course of PPCs rather than in other groups (the *P*-value is 0.011) [Table 4].

In terms of the type of reconstruction, 24 patients have undergone locoregional flaps and 16 patients have undergone free flap reconstruction. Patients who underwent free flap reconstruction had shown more amount of PPCs (the *P*-value is 0.029).

Considering smoking habits as a risk factor in our study, we have found that PPCs are more common in smokers and they are significantly persistent up to the 7th postoperative day in the case of smokers (the *P*-value is 0.01) [Table 5].

In our study, 22 cases have undergone unilateral neck dissection and 18 have undergone bilateral neck dissection, and no significant difference has been found in the two groups (the *P*-values for unilateral and bilateral neck dissections are, respectively, 0.338 and 0.125) [Table 6].

A tracheostomy was needed in 24 patients of 40 as per the surgery protocol based on the surgical site. No significant difference has been found between the group for tracheostomy and the group without tracheostomy (the *P*-values for the tracheostomy and non-tracheostomy groups are, respectively, 0.967 and 0.885) [Table 7].

Table 3: Postoperative day 3

	Mean	Confidence interval	*P*
Age <50 years	25.12	1.001	0.001
Age >50 years	12.8	2.129	
Male	21.46	0.082	0.492
Female	18.71	0.058	
Smoker	25.88	0.249	0.003
Nonsmoker	15.13	1.13	
Tongue	20.56	-0.87	1
Both maxilla and mandible	24.25	1.733	0.656
Maxilla	17.9	-0.521	0.605
Mandible	20.71	0.833	0.902
Tracheostomy	19.84	0.315	0.774
BMI <18	16.93	1.954	0.162
BMI 18.5–25	17.31	2.04	0.240
BMI >25	27.54	3.222	0.007

Table 4: Postoperative day 4

	Mean	Confidence interval	*P*
Age <50 years	24.18	1.74	0.009
Age >50 years	14.37	1.055	
Male	21.65	0.225	0.492
Female	18.36	0.176	
Smoker	26.05	0.7801	0.002
Nonsmoker	14.95	0.6958	
Tongue	21.28	-0.084	0.824
Both maxilla and mandible	23	1.289	0.785
Maxilla	14.8	-0.521	0.261
Mandible	21.19	0.412	0.652
Tracheostomy	19.69	1.241	0.733
BMI <18	17.5	1.557	0.243
BMI 18.5–25	17	1.664	0.197
BMI >25	27.54	2.337	0.011

Table 5: Postoperative day 5

	Mean	Confidence interval	*P*
Age <50 years	24.8	1.144	0.012
Age >50 years	14.53	1.056	
Male	21.54	0.27	0.457
Female	18.57	0.19	
Smoker	25.2	0.313	0.010
Nonsmoker	15.8	1.066	
Tongue	21.22	-0.395	0.672
Both maxilla and mandible	20	0.73	0.974
Maxilla	16.3	0.102	0.402
Mandible	21.15	0.203	0.672
Tracheostomy	19.38	0.498	0.633
BMI <18	17.57	0.845	0.254
BMI 18.5–25	17.19	1.114	0.217
BMI >25	26.96	2.129	0.014

Table 6: Postoperative day 6

	Mean	Confidence interval	*P*
Age <50 years	23.16	1.633	0.065
Age >50 years	16.07	0.819	
Male	22.08	0.854	0.254
Female	17.57	0.461	
Smoker	26.08	0.028	0.002
Nonsmoker	14.93	0.986	
Tongue	19.11	-0.715	0.702
Both maxilla and mandible	19.75	0.406	0.926
Maxilla	16.4	-0.86	0.425
Mandible	21.94	0.365	0.345
Tracheostomy	20.06	0.884	0.859
BMI <18	18	0.841	0.332
BMI 18.5–25	18.19	0.962	0.391
BMI >25	25.5	1.474	0.06

Table 7: Postoperative day 7

	Mean	Confidence interval	*P*
Age <50 years	22.92	0.808	0.094
Age >50 years	16.47	0.676	
Male	22.44	0.468	0.154
Female	16.89	0.449	
Smoker	26.05	1.694	0.0025
Nonsmoker	14.79	0.327	
Tongue	20.17	-0.701	0.924
Both maxilla and mandible	14	-0.027	0.467
Maxilla	17.7	-0.757	0.578
Mandible	21.75	0.607	0.420
Tracheostomy	20.41	2.405	0.967
BMI <18	17.36	0.575	0.220
BMI 18.5–25	18.27	0.775	0.407
BMI >25	26.12	1.505	0.03

DISCUSSION

As smoking aggravates pulmonary complications itself, such as pneumonia, bronchospasm, COPD, and ARDS, it is considered an independent risk factor. Rao *et al*.[4] did a study on 73 patients, of whom 34 patients had PPCs, and smoking history was a significant factor in it. Weber *et al*.[5] evaluated 225 head and neck cancer patients and identified patient smoking history mostly correlated with PPCs. McCulloch *et al*.[6] did a study on 144 head and neck cancer patients and stated that smoking history as a primary variable was significantly correlated with PPCs. In our study as well, we found that PPCs are more significantly persistent in smokers than in nonsmokers.

Aging is associated with changes in immune response impairment of alveolar macrophage functions and increases cellular apoptosis during sepsis, leading to greater severity of infection. In our study, we found that those aged more than 50 years are prone to have PPCs.[7-9]

Patients with elevated BMI who undergo surgery also tend to have longer operative times and endure more blood loss when compared with patients with normal BMI who undergo comparable procedures.[10] Recently, a study by Damien *et al*.[11] also stated that the incidence of PPCs is more in patients with greater BMI. In our study, the development or occurrence of PPCs was significantly higher in patients with BMI above 25 years.

Several earlier studies reported the incidence of PPCs after radical head and neck surgery and reconstruction with the microvascular free flap of about 32.7%,[11] 16%,[12] and 11.4%.[13] Xu *et al*.[14] concluded that major oral cancer surgery with free flap reconstruction and tracheotomy is associated with a high risk for the development of postoperative pneumonia (POP). In our study as well, we found that patients who underwent free flap reconstruction have a higher incidence of PPCs.

The incidence of development of PPCs is more with longer ICU stays postoperatively, and a study also confirmed that postoperative ventilation in an ICU has a high incidence of PPCs.[1,11,14] In ICU, ventilator-associated pneumonia acts as a super-added role for having PPCs in longer ICU stay.[15] Another study by Li *et al*.,[16] 2016, established that male patients undergoing major oral cancer surgery and tracheotomy are more prone to pneumonia. In this study as well, we found that 23 of 40 (42.5%) patients have spent more than 4 days in the ICU with a ventilator postoperatively.

In a prospective randomized clinical trial study study by Ong *et al*.,[17] it was clearly seen that poor pulmonary functions and postoperative atelectasis emerged as significant risk factors for pulmonary infection, and they also said that an extended course of antibiotics did not prevent the development of postoperative pulmonary infections in patients undergoing major head and neck surgery with tracheostomy. Other studies have also confirmed that tracheostomy is also a significant factor in developing a higher incidence of PPCs.[11] However, we did not find it as a significant factor, which may be because of less amount of sample size.

CONCLUSION

From our study, we concluded that among all the parameters, age, BMI, smoking status, microvascular free flap, and longer ICU stay can be correlated as the risk factors for PPCs.

Limitations

Inadequate sample size is the main limitation as our study involved only a single center. A multicenter study with a large sample size might have produced more effective results.

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Conflicts of interest

There are no conflicts of interest.

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ANNEXURE: CHART (OBSERVED DATA FROM RETROSPECTIVE STUDY)

Sl. no.	Age	Sex	BMI	Smoking	Site	Neck dissection	Type of reconstruction	ICU stay	Tracheostomy
1	<50	M	<18.5	Y	Mn	Bi	LR	>4 days	N
2	>50	M	>25	N	Tongue	Uni	FF	<4 days	Y
3	>50	F	18.5–25	N	Mn	Uni	LR	<4 days	Y
4	>50	M	>25	N	Tongue	Bi	LR	>4 days	N
5	<50	F	<18.5	N	Mn	Uni	LR	<4 days	Y
6	<50	M	18.5–25	Y	Mn	Uni	FF	>4 days	N
7	>50	M	<18.5	N	Mx	Uni	FF	<4 days	N
8	<50	F	>25	N	Tongue	Uni	LR	>4 days	N
9	>50	M	<18.5	Y	Mx	Uni	LR	<4 days	Y
10	>50	F	<18.5	N	Mn	Bi	FF	<4 days	N
11	>50	F	18.5–25	N	Mn	Uni	LR	>4 days	N
12	>50	M	>25	Y	Mx	Uni	FF	>4 days	Y
13	<50	M	<18.5	Y	Mn	Bi	LR	<4 days	N
14	<50	F	18.5–25	N	Mn	Uni	LR	<4 days	Y
15	>50	M	<18.5	Y	Mn	Bi	LR	>4 days	N
16	<50	M	18.5–25	N	Mx	Uni	LR	<4 days	N
17	>50	M	>25	Y	Mn	Uni	FF	>4 days	Y
18	>50	M	<18.5	Y	Mn	Bi	LR	<4 days	Y
19	>50	F	<18.5	N	Mn	Bi	LR	<4 days	N
20	<50	M	>25	N	Mn	Uni	LR	<4 days	Y
21	<50	F	18.5–25	N	Mn	Bi	FF	<4 days	Y
22	>50	F	<18.5	N	Both	Uni	FF	>4 days	N
23	>50	F	<18.5	Y	Mn	Uni	LR	>4 days	Y
24	<50	M	18.5–25	N	Mn	Bi	LR	<4 days	Y
25	>50	M	<18.5	Y	Tongue	Bi	FF	>4 days	Y
26	<50	M	<18.5	Y	Tongue	Uni	LR	<4 days	N
27	>50	M	>25	Y	Mn	Uni	LR	>4 days	Y
28	<50	M	18.5–25	Y	Mx	Bi	FF	<4 days	N
29	<50	F	18.5–25	N	Mn	Uni	LR	<4 days	Y
30	>50	F	18.5–25	N	Tongue	Uni	LR	<4 days	N
31	>50	M	>25	Y	Mn	Uni	LR	<4 days	Y
32	>50	M	>25	Y	Tongue	Bi	FF	<4 days	Y
33	>50	M	18.5–25	Y	Mn	Bi	FF	>4 days	Y
34	>50	M	>25	Y	Mn	Bi	FF	>4 days	Y
35	>50	F	>25	N	Tongue	Uni	LR	>4 days	N
36	<50	F	<18.5	N	Both	Uni	LR	<4 days	Y
37	>50	M	>25	Y	Mn	Bi	FF	>4 days	Y
38	>50	M	18.5–25	Y	Mn	Bi	FF	>4 days	Y
39	>50	M	>25	Y	Tongue	Bi	FF	<4 days	Y
40	<50	M	18.5–25	N	Mn	Bi	LR	<4 days	Y