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Original Research Article

Postoperative pulmonary complications following head and neck oncosurgery - Case control study

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ABSTRACT

Introduction: Head and neck cancers (HNC) constitute about one-third of all cancers in India. A combination of surgery, chemotherapy and radiotherapy is used to manage them. There is a high incidence of PPCs following head and neck surgeries. The probable mechanisms behind it are alteration in swallowing mechanisms and impairment in protective factors of the laryngeal apparatus.
Aim: To study the association between the clinicodemographic and perioperative parameters and the occurrence of PPCs following head and neck oncosurgery.
Materials and Methods: This case-control study was conducted in150 patients after head and neck oncosurgery. 50 patients as cases with complications and 100 patients as control with no complications were included in the study after getting informed consent and results were statistically analyzed and discussed. A pre-tested semi-structured case study form was used to collect patient information.
Results: Mean ages among cases and controls were 58.76 ± 10.40 and 56.10 ± 12.61. Weight loss was present in 26% of patients and 8% of controls. Malignancy of the tongue was the most common among both patients and controls, constituting 22% and 25%, respectively, followed by mouth and larynx. Preoperative albumin levels, presence of ARI within one month of surgery and lack of preoperative pulmonary rehabilitation had a significant association with the development of PPCs.
Conclusion: From this study, we concluded correction of the modifiable preoperative risk factors might prove beneficial in reducing the incidence of PPCs.

1. Introduction

Head and neck cancers (HNC) constitute about one-third of all cancers in India, which is in sharp contrast to Western nations, where it ranges from 1% to 5%.[1] A combination of surgery, chemotherapy and radiotherapy is used to manage them. Most of the surgically treated patients have advanced cancer and undergo major surgeries.[2] Like with any surgery; there is a risk of postoperative complications. More than half of HNC patients are nutritionally compromised from cancer itself and have a long history of tobacco and alcohol abuse.[3] In addition to being independent risk factors for postoperative complications, tobacco and alcohol also initiate and perpetuate other comorbidities, further increasing the risk. They are also particularly implicated with postoperative pulmonary complications (PPCs).[4,5]

There is a high incidence of PPCs following head and neck surgeries. The probable mechanisms behind it are alteration in swallowing mechanisms and impairment in protective factors of the laryngeal apparatus. Silent and frank aspirations occur in the postoperative period following HNC resections. Moreover, most of the patients undergo tracheostomy along with the primary surgery, which results in ineffective cough and retention of secretions. All these factors initiate a vicious cycle leading to the development of

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PPCs.[6]

PPCs have a significant impact on surgical morbidity and mortality, especially in the first postoperative week.[7,8] A descriptive study has also shown considerable differences in the 1-year and 5-year mortality rates among patients with and without postoperative pulmonary complications after major surgery: 45.9% versus 8.7% at one year and 71.4% versus 41.1% at five years.[9] Despite having both short and long-term effects, pre, intra- and postoperative predictive factors of PPCs remain incompletely explored. Studies have been conducted for this purpose but have certain limitations as a result of being nonspecific concerning the type of surgery, oriented to one particular complication and not inclusive of intraoperative risk factors.[10] Since patients undergoing HNC surgeries are particularly vulnerable to developing PPCs and a scarcity of data with them as a study population; this study aims to study the association between the clinicodemographic and perioperative parameters and the occurrence of PPCs following head and neck oncosurgery.

2. Materials and Methods

This case-control study was conducted at the Department of Surgical Oncology, Regional Cancer Centre, Coimbatore Medical College and Hospital from May 2019 to October 2019. Postoperative patients after head and neck oncosurgery, operated under general anaesthesia, admitted in the Department of Surgical Oncology during the study period were included in the study. Patients who developed pulmonary complications after head and neck oncosurgery, in accordance with the definitions of the secondary variables, were taken as cases and patients with no complications in the 1-week postoperative period were taken as the controls. Patients who developed other types of complications and those not willing to participate in the study were excluded from the study. A total of 150 patients with 50 cases and 100 control were included in the study.

A pre-tested semi-structured case study form was used to collect patient information. The form had six parts:

1. Socio-demographic details: It includes the age, sex, socioeconomic status and the residential address of the patients. The income, occupation and education were used to classify the patients according to their socioeconomic status (Modified Kuppuswamy scale).
2. Clinical parameters: It includes the history of weight loss (more than 10% in 6 months), long term steroid intake, and associated comorbidities like hypertension, diabetes mellitus, COPD and personal habits like tobacco, smoking and alcohol. It also includes the details about the site, stage and histopathological type of the tumour.
3. Preoperative parameters: It includes laboratory investigations like haemoglobin, serum albumin, ASA score, chest X-ray, preoperative pulmonary rehabilitation and SpO2. It also enquires the presence of preoperative sepsis and acute respiratory infection (ARI) within one month before surgery.
4. Surgical parameters: It includes information about the type and duration of surgery, reoperation, perioperative nasogastric tube, reconstruction, fluid management, blood loss and blood transfusion.
5. Postoperative parameters: It gives postoperative data like haemoglobin, SpO2, time in ICU, frequency of suction, day of tracheostomy closure and day of nasogastric tube removal.
6. Complications: It includes
   (a) ARDS – Ventilated, bilateral infiltrates on CXR, minimal evidence of left atrial fluid overload within seven days of surgery.[10]
   (b) Pneumonia – CXR with at least one of the following: infiltrate, consolidation, cavitation; plus at least one of the following: fever >38o C with no other cause, white cell count <4 or >12 x 109 litre-1, >70 yrs. of age with altered mental status with no other reason; plus at least two of the following: new purulent/changed sputum, increased secretions/suctioning, further/worse cough/dyspnea/tachypnea, rales/bronchial breath sounds, worsening gas exchange.[10]
   (c) Bronchospasm – Newly detected expiratory wheeze treated with bronchodilators.[10]
   (d) Aspiration pneumonitis – Acute lung injury after inhalation of regurgitated gastric contents.[10]
   (e) Pneumothorax – Air in pleural space with no vascular bed surrounding the visceral pleura.[10]
   (f) Pleural effusion – CXR with blunting of costophrenic angle, loss of sharp silhouette of the ipsilateral hemidiaphragm in an upright position, displacement of adjacent anatomical structures, or (in supine position) hazy opacity in one hemithorax with preserved vascular shadows.[10]
   (g) Atelectasis - Lung opacification with the mediastinal shift, hilum or hemidiaphragm shift towards the affected area, with compensatory hyperinflation in the adjacent non-atelectatic lung.[10]
   (h) Bronchus obstruction – Wheezing and expiratory stridor without infectious symptoms responding to bronchodilation therapy.[8]
   (i) Respiratory depression – breathing frequency of less than 10 per minute.[8]
   (j) Respiratory failure – Ventilator dependence for >1 postoperative day or re-intubation.[10]

2.1. Statistical methods

Univariate analysis was done using a t-test for continuous variables and chi-square or Fischer's exact test for

categorical variables. The variables are giving p-value < 0.05 were then subjected to conditional forward multivariate logistic regression analysis to identify parameters that are independent risk factors of PPCs. The results of it are presented as odds ratios with 95% confidence interval. A p-value < 0.05 is considered statistically significant.

3. Results

The mean age among cases and controls was 58.76 ± 10.40 and 56.10 ± 12.61, respectively. A male predominance was noticed among cases (78%), which was statistically significant (p-value = 0.006). In the control group, most of them belonged to the lower middle socioeconomic status (72%), whereas in the case group majority were of lower economic status (42%), as shown in Table 1. Malignancy of the tongue was the most common among both cases and controls, constituting 22% and 25%, respectively. Table 2 demonstrates that among the clinical factors, history of significant weight loss, diabetes, smoking and COPD were significantly associated with the occurrence of PPCs (p-value < 0.05). Among the preoperative parameters, preoperative albumin levels, presence of ARI within one month of surgery and lack of preoperative pulmonary rehabilitation had significant association with the development of PPCs with p value<0.0001, as shown in Table 3. The most common procedure performed for clearance of primary tumour was wide local excision (18.7%) followed by hemiglossectomy (14.7%), as shown in Table 4. No significant association was found between postoperative parameters and occurrence of PPCs (Table 5). The most frequent PPC encountered was pneumonia (44%) followed by aspiration pneumonitis (18%), as shown in Figure 1. Upon multivariate analysis of factors that had a significant association in univariate analysis, preoperative pulmonary rehabilitation had a protective effect in preventing the occurrence of PPCs as suggested by the OR < 1. Other factors, namely >10% weight loss within 6 months before surgery, diabetes mellitus, COPD, preoperative albumin levels, and ARI within one month of surgery, were identified as independent risk factors for developing PPCs (Table 6).

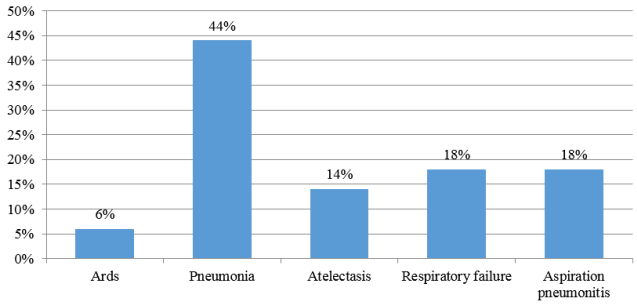

Fig. 1: Distribution of postoperative pulmonary complication.

4. Discussion

The most common complication encountered in our study population was pneumonia which is similar to the study conducted by Manzoor T et al.[11] The current study analyzed the association between various risk factors and the occurrence of PPCs in patients undergoing head and neck cancer surgeries. In our study, age was not a significant risk factor for PPCs (p-value = 0.105). It was in contrast to the survey conducted by Arozullah M et al., which showed that patients with higher age developed PPCs more frequently.[12] Similarly sex was not identified as an independent risk factor for the occurrence of PPCs in contrast to the studies conducted by Blum JM et al. and Johnson RG et al.[13,14] Weight loss >10% within six months was found to be a significant risk factor for predicting PPCs (p-value = 0.003, OR = 7.996, CI=2.077 – 30.789) which is in concordance with the results of Arozullah et al.[12] Significant weight loss leads to impairment in immune responses and can potentially cause infectious complications, thus explaining the association. Diabetes was found to be significantly associated with the development of PPCs (p-value < 0.0001). However, a study conducted by Bustamante AF et al. did not show a significant association of diabetes mellitus with PPCs (p-value = 0.18) which differed from our results.[15] Canet J et al. stated that preoperative anaemia caused a three-fold increased risk of PPC in patients undergoing any type of surgery.[16] However, our study did not find preoperative haemoglobin estimation a significant factor in predicting PPCs. This may be due to the preoperative correction of anaemia in our hospital before surgery. There was a significant association between preoperative low serum albumin and the occurrence of PPCs in our study (p-value < 0.0001, OR= 6.306, CI = 2.278 – 17.452). Like our results, Xu J et al. also reported that low serum albumin is a significant predictor of PPCs.[17] Low serum albumin (< 3 g/dl) indicates chronic nutritional detriment, which is associated with respiratory muscle weakness and is linked to alteration in lung dynamics, leading to higher rates of PPCs.ASA score was not predictive of PPCs in our study, similar to a previous study.[17] Canet J et al. showed that preoperative spO2 < 96% was weakly associated with PPCs, but strongly linked when spO2 <90%.[18] In our study, all patients had preoperative spO2 >95%; thus, its association with PPC could not be determined. ARI within one month of surgery was found to be an independent risk factor for PPCs in our study (p-value <0.0001, OR = 5.744, CI =2.010 – 16.412), similar to a previous study.[16] Pulmonary rehabilitation comprises deep breathing exercise and pulmonary physiotherapy. It preserves lung function postoperatively, particularly in patients with pre-existing lung diseases and obese patients. According to Nagarajan K et al.[19] our study concurred with the above research by showing that preoperative pulmonary rehabilitation

Table 1: Distribution of age and socioeconomic status among cases and controls.

Socio-demographic variables		Cases n (%) (n=50)	Controls n (%) (n=100)	p value
Mean Age		58.76 ± 10.40	56.10 ± 12.61	0.105
Socioeconomic status	Upper lower	10(20)	25(50)	0.096
	Lower	21(42)	27(54)	
	Upper middle	9(18)	12(24)	
	Lower middle	10(20)	36(72)	

Table 2: Distribution of clinical parameters among cases and control.

Parameters		Cases n (%) (n=50)	Controls n (%) (n=100)	p value
Weight loss >10% within six months	Yes	13(26)	8(8)	0.003
	No	37(74)	92(92)	
Long term steroid intake	Yes	3(6)	10(10)	0.545
	No	47(94)	90(90)	
Hypertension	Yes	28(56)	60(60)	0.659
	No	22(44)	40(40)	
Diabetes Mellitus	Yes	31(62)	34(34)	0.001
	No	19(38)	66(66)	
COPD	Yes	25(50)	33(33)	0.044
	No	25(50)	67(67)	
Tobacco chewing	Yes	23(46)	36(36)	0.237
	No	27(54)	64(64)	
Smoking	Yes	36(72)	50(50)	0.01
	No	14(28)	50(50)	
Alcohol	Yes	17(34)	43(43)	0.289
	No	33(66)	57(57)	

Table 3: Distribution of preoperative parameters among cases and controls.

Preoperative parameters		Cases n (%) (n=50)	Controls n (%) (n=100)	P value
Mean haemoglobin (g/dl)		12.11 ± 1.66	11.75 ± 1.51	0.071
Serum albumin	>3.5 g/dl	27(54)	83(83)	<0.0001
	<3.5 g/dl	23(46)	17(17)	
ASA score	I,II	13(26)	23(23)	0.685
	III, IV	37(74)	77(77)	
ARI within 1 month of surgery	Yes	20(40)	13(13)	<0.0001
	No	30(60)	87(87)	
Preoperative pulmonary rehabilitation	Yes	16(32)	67(67)	<0.0001
	No	34(68)	33(33)	

Table 4: Distribution of type of surgery undergone by cases and controls.

Type of surgery	Cases n (%) (n=50)	Controls n (%) (n=100)	Total n (%)
Modified radical neck dissection only	5(10)	9(9)	14(9.3)
Hemimandibulectomy	1(2)	2(2)	3(2)
Wide local excision	12(24)	16(16)	28(18.7)
Total Laryngopharyngoesophagectomy	0	2(2)	2(1.3)
Total Larygectomy	9(18)	11(11)	20(13.3)
Composite resection	2(4)	13(13)	15(10)
Partial Maxillectomy	1(2)	10(10)	11(7.3)
Subtotal/total Maxillectomy	2(4)	4(4)	6(4)
Parotidectomy	1(2)	7(7)	8(5.3)
En bloc excision	3(6)	2(2)	5(3.3)
Thyroidectomy	5(10)	5(5)	10(6.7)
Hemiglossectomy	6(12)	16(16)	22(14.7)
Hemimandibulectomy + Hemiglossectomy	3(6)	3(3)	6(4)

Table 5: Distribution of postoperative parameters among cases and controls.

Postoperative Parameters		Cases n (%) (n=50)	Controls n (%) (n=100)	P value
Mean haemoglobin (g/dl)		11.67 ± 1.6587	11.30 ± 1.5389	0.154
SpO2	>95%	47(94)	86(86)	0.145
	<95%	3(6)	14(14)	
Time in ICU	Nil	0	13(13)	0.02
	1-3 days	8(16)	19(19)	
	>3 days	42(84)	68(68)	
Frequency of suction	<3 times/day	0	7(7)	0.19
	3-5 times/day	9(18)	11(11)	
	>5 times/day	5(10)	11(11)	
	Not applicable	36(72)	71(71)	
Tracheostomy	Yes	14(28)	29(29)	0.898
	No	36(72)	71(71)	
Day of tracheostomy closure	10^{th} day	5(10)	18(18)	0.27
	Permanent tracheostomy	9(18)	11(11)	
	Not Applicable	36(72)	71(71)	
Day of nasogastric tube removal	<8 days	5(10)	10(10)	0.99
	>8 days	34(68)	69(69)	
	Not applicable	11(22)	21(21)	

Table 6: Independent risk factors for PPCs by multivariate logistic regression analysis.

Risk factors	p-value	Odds ratio	95% Confidence Interval
Weight loss >10% within 6 months	0.003	7.996	2.077 - 30.789
Diabetes Mellitus	0.014	3.149	1.260 - 7.868
Smoking	0.009	3.702	1.396 - 9.817
Albumin	<0.0001	6.306	2.278 - 17.452
ARI within 1 month of surgery	0.001	5.744	2.010 - 16.412
Preoperative pulmonary rehabilitation	<0.0001	0.105	0.036 - 0.301

significantly reduced the incidence of PPCs (p-value 0.0001, OR=0.105, CI= 0.036 -0.301). None of the operative factors was significantly associated with PPCs in our study. This is in sharp contrast to Xu J et al. study, which showed a significant association between the intraoperative and PPCs.[17] Postoperative factors were not significantly associated with the development of PPCs. Our result was in line with the study conducted by Ong SK et al.[20]

5. Conclusion

To conclude, the independent risk factors for PPCs following HNC surgeries were 10% weight loss within six months before surgery, diabetes mellitus, smoking, ARI within one month of surgery, low preoperative serum albumin and lack of preoperative pulmonary rehabilitation. Hence, correction of these modifiable preoperative risk factors may prove beneficial in reducing the incidence of PPCs.

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7. Conflict of Interest

The authors declare that they have no conflict of interest.

8. Source of Funding

None.

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