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ROLE OF PROPHYLACTIC TRACHEOSTOMY IN HEAD AND NECK CANCER PATIENTS TREATED WITH RADIOTHERAPY

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ABSTRACT

Purpose: To determine the severity of mechanical obstruction which is one of the important factors deciding the need for tracheostomy prophylactically, hence avoiding treatment breaks during radiotherapy. **Material and Methods:** All head and neck cancer patients who were referred for treatment with either concurrent chemoradiation/ definitive radiotherapy/ palliative radiotherapy between January 2009 and June 2017 were taken retrospectively into the study. Computed Tomotherapy(CT) scan taken at the time of first simulation of all patients were individually studied. The slice which shows the narrowest portion of the airway in the larynx was selected and airway was contoured in the same slice. The volume of this contour was measured automatically by the Eclipse treatment planning system version 11. This volume in cubic centimetre (cc) was divided by the slice thickness (in cm) which gives measurement of the area of narrowest airway contour (in cm^2). We measured the area of the narrowest airway in plain simulation CT scan images of 22 patients who did not have laryngeal obstruction and used these values as reference. The results gave a median value of 2 cm^2 with a range of 1.08- 2.92. Hence, all patients with narrowest airway contour lesser than 1 cm^2 were classified as having radiologically significant airway narrowing **Results:** Total of 377 patients were analysed. Out of which a significant proportion of patients with head and neck cancer patients planned for definitive radiotherapy or chemoradiation require tracheostomy (14%). Identifying this subset would help in avoiding unnecessary tracheostomies for patients who may not require based on subjective evaluation and also avoiding gap during radiotherapy in patients who may benefit from prophylactic tracheostomy prior to start of radiation. **Conclusion**: Based upon the above results, it can be concluded that all highest (80% risk) and high risk (41.5% risk) patients would benefit from tracheostomy. All intermediate risk (23.5% risk) patients should be individually assessed and decision for prophylactic tracheostomy can be taken based upon other co-morbidities.

KEYWORDS: Prophylactic tracheostomy, Head and neck cancer, Radiotherapy.

INTRODUCTION

Worldwide, head and neck cancer accounts for more than 550,000 cases and 380,000 deaths annually.[1] In India, it accounts for one fourth of male cancers and one tenth of female cancers.[2] Around 40,000 pharyngeal cancers (excluding nasopharyngeal cancer) and 29,000 laryngeal cancers occur in India every year.[3] Mortality in India due to head and neck cancer is at least half the incidence due to its late presentation for treatment (stage III - 39%, stage IV -23%).[4]

Most common clinical presentation of these cancers include dysphagia, odynophagia, hoarseness of voice, swelling in the neck, otalgia, haemoptysis and difficulty in breathing. Head and neck cancers are associated with high mortality because there is interference with vital functions of life such as breathing and swallowing.[5] Severe respiratory compromise might happen due to extension of the disease, causing laryngeal obstruction. An emergency tracheostomy will not only be life-saving but also can make the delivery of the definitive treatment more effective without causing unnecessary breaks and probably improved patient tolerance to treatment.

In India, as most of the head and neck cancers present in advanced stages, radiotherapy remains the most important modality of treatment. Mucositis is one of the major radiation-related acute reactions. Clinical course of mucositis is well described, the characteristic symptoms being, erythema, oedema, tenderness, pain, dysphagia, and hoarseness. The typical onset of symptoms is approximately two weeks after initiation of radiation treatment.[6] Hence, there are chances of developing airway obstruction during the course of radiation treatment due to radiation induced oedema, despite the absence of overt signs of same prior to the initiation of treatment. Airway compromise could lead to an emergency tracheostomy during the course of treatment, with resultant treatment breaks for post-procedure recovery and for re-planning. Moreover, studies have

shown that elective tracheostomies have less complication rates than emergency tracheostomies.[7]

Hence for the better and effective delivery of the definitive therapy without unnecessary delay in the start of treatment for patients who may not need tracheostomy and for better tolerance of patients to radiation therapy without unnecessary breaks during treatment for patients who may require tracheostomy, we tried to identify the subgroup of patients who would probably benefit by upfront prophylactic tracheostomy before starting radiation rather than waiting for the symptoms to appear which would cause a break in radiotherapy. Other than mechanical obstruction of the airway, there could be many functional problems which can cause respiratory compromise like pre-existing lung abnormalities, cardiac function impairment or low haemoglobin. This study mainly focuses on determining the severity of mechanical obstruction which is one of the important factors deciding the need for tracheostomy.

METHODS AND MATERIALS

All head and neck cancer patients diagnosed with head and neck cancer with primaries arising from oropharynx, hypopharynx and larynx who were referred for treatment with either concurrent chemoradiation/ definitive radiotherapy/ palliative radiotherapy between January 2009 and June 2017 were taken retrospectively into the study. All patients had undergone CT based planning. Plain CT was done using a third generation 16 slice CT scanner. CT scan taken at the time of first simulation of all patients were individually studied. The slice which shows the narrowest portion of the airway in the larynx was selected and airway was contoured in the same slice. As the window level in which the CT was set could affect the airway contour, it was kept at a constant value of +150 and -250 HU where air and mucosal surface can be clearly distinguished.

The airway contour was copied and pasted over adjacent slice. The volume of this contour was measured automatically by the Eclipse treatment planning system version 11. This volume in cubic centimetre (cc) was divided by the slice thickness (in cm) which gives measurement of the area of narrowest airway contour (in cm^2).

Before collecting the data, there was a need to determine the cut off value below which the narrowing of the airway in larynx could be considered as radiologically significant. As review of literature did not yield any results for this, we measured the area of the narrowest airway in plain simulation CT scan images of 22 patients who did not have laryngeal obstruction and used these values as reference. The results gave a median value of 2 cm^2 with a range of 1.08- 2.92. Hence, all patients with narrowest airway contour lesser than 1 cm^2 were classified as having radiologically significant airway narrowing.

Those patients who had significant laryngeal narrowing were analysed to assess the number of patients who worsened clinically and required tracheostomy for airway maintenance, either before the start of definitive radiation, or during the course of radiation treatment. Those who did not require a tracheostomy despite similar laryngeal narrowing were analysed in terms of tolerance to the planned course of radiation treatment.

RESULTS

Totally, there were 377 patients treated between January 2009 to June 2017 whose data were collected retrospectively. Among them, 105 had oropharyngeal, 153 hypopharyngeal and 119 laryngeal primaries. 320 patients were males and 57 were females. CT scan was evaluated for all the patients and a total of 179 patients (47.5%) were found to have radiologically significant airway obstruction and 53 patients among them underwent tracheostomy (14%).

Primary tumour was the cause for radiologically significant airway obstruction in all the patients rather than enlarged metastatic lymph nodes. Males were found to have more rates of tracheostomies (15%) than females (8.7%) but this result could be due to greater number of males compared to females in our study. Primaries from larynx (29.4%) were associated with more rates of tracheostomies than oropharynx (2.8%) and hypopharynx (9.8%). Mean duration within which RT was started from the time of simulation was 4.2 days.

Based on our observation on requirement of tracheostomy, all the patients with airway narrowing could be stratified into following groups:

Table 1: Risk stratification based on the narrowest area of the airway before starting the treatment.

Risk stratification [n=179]	Area of narrowest airway (in cm^2)	Number of patients	Patients with tracheostomy	Patients without tracheostomy		
				Completed intended treatment	Died due to respiratory failure	Defaulted / died due to other reasons
Low risk[1]	0.5-0.9	103 - 58.1%	6 (5.8%)	91 (88%)	01	05
Intermediate risk[2]	0.4	17 - 9.4%	4 (23.5%)	13 (76%)	0	0
High risk[3]	0.2-0.3	24 - 13.4%	10 (41.6%)	13 (54%)	01	01
Highest risk[4]	0.1	10 - 5.5%	8 (80%)	02 (20%)	0	0
Mandatory tracheostomy[5]	0	25 - 13.96%	25 (100%)			

All patients with airway contour area of 0 required tracheostomy. In our study, 25 patients belonged to this group. 103 patients belonged to low risk group, 17 patients in intermediate risk group, 24 patients in high risk group and 10 patients in highest risk group. Among patients who had airway narrowing but did not undergo tracheostomy and completed entire course of planned radiation were 119, out of which 86 received definitive radio/chemoradiotherapy with 2Gy/#, 18 received definitive radio/chemoradiotherapy with >2Gy/# and 15 received palliative RT. 49 patients underwent tracheostomy upfront, 3 patients after CT simulation and 1 during radiotherapy.

Also, among patients who did not have radiologically significant airway obstruction, there was one patient who underwent emergency tracheostomy after 13 fractions of radiotherapy. This patient had other risk factors like elderly age (83years), severe COPD and poor performance status. And re-simulation after tracheostomy also revealed moderate pleural effusion in both lungs. This patient had an airway area of 1.2 cm^2 during simulation (which was within normal range) and post tracheostomy, CT scan revealed the airway area which had narrowed to 0.4 cm^2.

Two patients who needed tracheostomy during radiation (including the case mentioned above) developed stridor after 10^{th} and 13^{th} fraction of RT with 2Gy per fraction regimen indicating that end of 2^{nd} week and 3^{rd} week of radiation would be very critical for patients who already have some airway obstruction and are not tracheotomised.

DISCUSSION

The incidence of carcinoma larynx is more common in India just followed by pharyngeal cancers (except nasopharynx).[1] But, in the present study pharyngeal cancers were more compared to laryngeal primary tumours. Similar to most recent data, we had more number of males than females patients. Most common indication for an emergency tracheostomy was laryngeal cancers which was also true in the present study results.[8] There were no previous studies done to assess the degree of laryngeal obstruction caused by tumours. Most of these patients had obstruction at the level of glottis where vocal cord movements affect the area of narrowest airway. Many patients of head and neck cancer will have vocal cord palsy due to infiltration of recurrent laryngeal nerve or superior laryngeal nerve, which can also cause changes in airway area and can affect respiratory compromise. Effects of these two factors were not studied in this study.

A study by Withers et al found that rapid tumour regrowth occurred during extensions of radiotherapy treatment from approximately 5-8 weeks in almost 500 patients with oropharyngeal cancer.[7] The study concluded that clonogen repopulation in squamous cell carcinomas of the head and neck accelerates following a lag period of 4±1 weeks subsequent to the initiation of radiotherapy. Accelerated repopulation is known to be a major cause for treatment failure in head and neck cancer patients.[8,9] And it is proven that reduction in overall treatment time will improve survival in head and neck cancer.[10,11] Hence, avoiding gaps due to requirement of tracheostomy in between radiation can contribute to sub optimal effect of therapy.

There are other physiological factors like age, performance status, co-morbidities of lung and heart, haemoglobin levels which can affect the respiratory status which can further narrow down the indications for elective tracheostomy.

CONCLUSIONS

A significant proportion of patients with head and neck cancer patients planned for definitive radiotherapy or chemoradiation would require tracheostomy (14%). Identifying this subset would help in avoiding unnecessary tracheostomies for patients who may not require based on subjective evaluation and also avoiding gap during radiotherapy in patients who may benefit from prophylactic tracheostomy prior to start of radiation.

Based upon the above results, it can be concluded that all highest (80% risk) and high risk (41.5% risk) patients would benefit from tracheostomy. All intermediate risk (23.5% risk) patients should be individually assessed and decision for prophylactic tracheostomy can be taken based upon other co-morbidities. Rest of the patients have higher chances of tolerating the treatment without requiring tracheostomy and only symptomatic ones may benefit from the procedure, unless there is excessive delay in starting radiotherapy.

Further studies on functional status of the patient like age, co-morbidities of lung, cardiac function, smoking history can be done which will help in taking a better clinical decision whether a patient is likely to benefit from prophylactic tracheostomy or not, especially among low and intermediate risk group.

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