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Can we predict the subset of head and neck cancer patients with laryngeal obstruction who will benefit from elective tracheostomy

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Abstract

Introduction: Head and neck cancers are among the 10 most common cancers globally and are the most common cancers in developing countries. Airway obstruction is one of the major morbidities caused by these tumours. Prompt relief of the obstruction would not just save lives but also makes delivery of definitive treatment more effective. The severity of symptoms depends upon the site of obstruction, degree of obstruction and also other physiological factors. Here, we attempted to analyse the correlation between the degree of obstruction at the level of larynx with outcome of the patients in terms of tracheostomy rates and completion of definitive treatment without tracheostomy.

Materials and methods: All patients diagnosed to have primary cancers of head and neck (includes oropharynx, hypopharynx and larynx) who were treated with were included in the study. Area of the narrowest airway was measured on simulation CT. All the patients who had radiologically significant airway narrowing were analysed in terms of tracheostomy rates.

Results: Out of 377 head and neck cancer patients who were treated, radiologically significant narrowing of laryngeal airway was observed in 179 patients. 53 patients of them required tracheostomy. Laryngeal airway narrowing could be classified into low, intermediate, high and highest risk for tracheostomy with corresponding tracheostomy rates of 5.8%, 23.5%, 41.6% and 80% respectively.

Conclusions: All highest risk patients will require prophylactic tracheostomy whereas high risk patients may benefit from tracheostomy. Intermediate risk patients can be considered depending upon other factors like age and co-morbidities.

Keywords: tracheostomy, elective, head and neck cancer, laryngeal narrowing.

Introduction

Worldwide, head and neck cancer accounts for more than 550,000 cases and 380,000 deaths annually.[1] In India, It constitutes almost one third of all cancer cases.[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 [3] (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.[5] Head and neck cancers are associated with high mortality because there is interference with vital functions of life such as breathing and swallowing.[6] 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 cancer presents in advanced stages, radiotherapy forms the most important modality of treatment. Mucositis in head and neck is one of the major acute radiation reactions and the clinical course of mucositis is well described; characteristic symptoms include erythema, oedema, tenderness, pain, difficulty in swallowing, and hoarseness. The typical onset of symptoms is approximately 2 weeks after initiation of RT.[7] Hence, even if the patient does not show overt signs of airway obstruction prior to the start of treatment, he may develop it later during the course of radiotherapy due to radiation induced oedema.

An emergency tracheostomy done during radiotherapy will result in gap during radiotherapy due to post-procedure recovery time and need for re-planning. Also, there is evidence that elective tracheostomies have less complication rates than emergency tracheostomies.[8] 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 elective tracheostomy before starting radiation rather than waiting for the symptoms to appear which would cause a break in radiotherapy and increase the morbidity to the patients.

Other than mechanical obstruction of the airway, there could be many functional problems which can cause respiratory compromise like existence of 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 primaries arising from oropharynx, hypopharynx and larynx who were admitted for treatment with either concurrent chemo radiation or definitive radiotherapy or palliative radiotherapy 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 was 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 (fig 1). 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 (either above or below as shown in fig 2). The volume of this contour was measured automatically by the Eclipse treatment planning system version 11 (fig 23). 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.

The patients who had significant laryngeal narrowing were analysed in terms of number of patients who clinically worsened to the level of requiring tracheostomy to maintain their airway function either before starting radiation or during radiation. The patients with similar airway narrowing who didn't require tracheostomy were analysed in terms of their tolerance to entire course of planned radiotherapy.

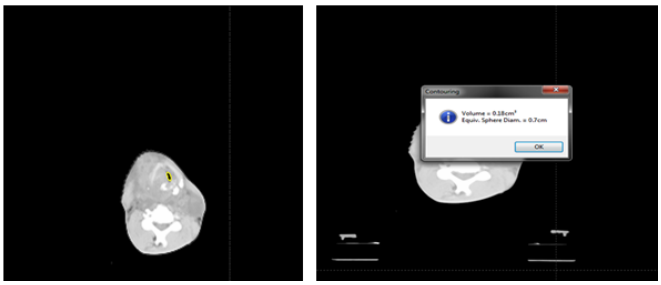

Figure 1 &2: Showing the narrowest airway contoured (fig 1) and Volume of the contoured airway.

Results

Totally, there were 377 patients treated with radiotherapy whose data were collected retrospectively. Among them, 105 were primaries from oropharynx, 153 were primaries of hypopharynx and 119 were primaries from larynx. 320 patients were males and 57were 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:

Risk stratification	Area of narrowest airway (in cm^2)	Patients with tracheostomy	Patients without tracheostomy		
			Completed intended treatment	Died due to respiratory failure	Defaulted / died due to other reasons
Low risk	0.5-0.9	6 (5.8%)	91 (88%)	01	05
Intermediate risk	0.4	4 (23.5%)	13 (76%)	0	0
High risk	0.2-0.3	10 (41.6%)	13 (54%)	01	01
Highest risk	0.1	8 (80%)	02 (20%)	0	0

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 not underwent tracheostomy and completed entire course of planned radiation, 86 received definitive radiotherapy/chemo-radiotherapy with 2Gy/#, 18received definitive radiotherapy/chemo-radiotherapy 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 scans revealed the airway area which had narrowed to 0.4 cm^2.

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

Discussion

The incidence of larynx cancer 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 the most recent data, we had more number of males than females.

Most common indication for an emergency tracheostomy was laryngeal cancers[9] which was also true in the present study results. 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.

A study by Withers *et al* [10] found that rapid tumour regrowth occurred during extensions of radiotherapy treatment from ~5–8 weeks in almost 500 patients with oropharyngeal cancer. 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[11].

And it is proven that reduction in overall treatment time will improve survival in head and neck cancer[12, 13]. Hence, avoiding gaps due to requirement of tracheostomy in between radiation can contribute to sub optimal effect of therapy.

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

Based upon the above results, it can be concluded that all highest and high risk patients would benefit from tracheostomy. All intermediate risk patients should be individually assessed and decision for elective 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.

Conclusions

A significant proportion of patients with head and neck cancer patients planned for definitive radiotherapy or chemo radiation would require tracheostomy. 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.

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