

## Research Article

# Positive Predictive Value of Computed Tomography Virtual Laryngoscopy in Detecting Laryngeal Carcinoma Taking Histopathology as Gold Standard

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### Abstract

**Background:** Computed tomography virtual laryngoscopy (CTVL) is favored diagnostic tool in detecting laryngeal carcinoma because it delivers excellent temporal and spatial resolution.

**Objective:** To determine the positive predictive value of computed tomography virtual laryngoscopy in detecting laryngeal carcinoma taking histopathology as gold standard.

**Methods:** A cross sectional survey was conducted at department of Radiology, Mayo Hospital Lahore. The completion of study was done in six months [Feb 16, 2019 till Aug 16, 2019]. After obtaining approval from ethical committee and informed consent from subjects, 64 subjects were included in the study who presented in the Department of the Radiology having carcinoma of larynx on CTVL and then sent to department of ENT of mayo hospital, where they underwent direct laryngoscopy and afterwards biopsy obtained sent to the department of histopathology. All the subjects undergoing CT scan examination on the CT machine of hospital. Contrast injection was given to all subjects undergoing CT scan, through power injector at the rate of 4ml per min and dosage of 0.1ml/kg. Same machine was used to conduct all CT scans and was inferred through same radiologist and all the histopathology was performed by same pathologist to exclude bias.

**Results:** The mean age of patients was  $44.38 \pm 9.57$  years with minimum and maximum age as 22 and 60 years. There were 47(73.4%) male and 17(26.6%) female cases. On histopathology the laryngeal carcinoma was diagnosed in 56(87.5%) of the cases while it was negative in 8(12.5%) of the cases. On CT the laryngeal carcinoma was diagnosed in 59(92.2%) of the cases while it was negative in 5(7.8%) of the cases. The Positive Predictive Value of CT was 89.83%, while its sensitivity was 94.64%, specificity was 25.00%, negative predictive value was 40.00% and diagnostic accuracy was 85.94%.

**Conclusion:** Through the findings of this study it is concluded that positive predictive value of computed tomography virtual laryngoscopy is high (89.83%) in detecting laryngeal carcinoma taking histopathology as gold standard. CT is a precise and non-invasive imaging method in detecting laryngeal carcinoma.

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### Introduction:

Anatomically, The larynx is considered as a complex organ that take part in respiratory processes and voice production<sup>1</sup>. One of the most prevalent cancers of head and neck is Laryngeal carcinoma throughout the world<sup>2,3</sup>. It can take origin from non-epithelial or

epithelial parts of the larynx. The most frequent histologic variant is "Squamous cell carcinoma" which take accounts for almost "85–95%" of all malignant cancers of larynx<sup>4</sup>. There are 2 most significant contributing factors "smoking" and "alcohol" intake. Patients most commonly present with hoarseness of voice.

Most commonly available treatments are primary radiation or surgery alone<sup>5</sup>. There are numerous diagnostic tools utilized to distinguish laryngeal carcinomas such as Computed Tomography Virtual laryngoscopy (CTVL) ultrasound (US), positron emission tomography (PET) narrow band imaging (NBI), magnetic resonance imaging (MRI), computed axial tomography (CAT), contact endoscopy (CE), autofluorescence (AF), White light (WL) endoscopy, and stroboscopy<sup>6-8</sup>. According to Reem H Basinouy, positive predictive value (PPV) of CTVL was reported as 0.79 in identifying laryngeal carcinoma<sup>9</sup>.

As there is no local published data present on this topic to the best of the candidate's knowledge and keeping in mind the advantage of CTVL in detecting the extent of the tumor there is a need to perform this study in local population so that PPV of CTVL could be determine in local population which can help us better plan regarding the treatment plan for the patients and can help us in reducing the mortality and morbidity associated with the laryngeal carcinoma.

#### Methods:

This cross sectional survey was done at department of Radiology, Mayo Hospital Lahore. The study was completed in 6 months [Feb 16, 2019 till Aug 16, 2019]. Sample size of 64 cases was calculated with 95% confidence level and 10% margin of error while taking expected positive predictive value of CTVL to be 79% in diagnosing laryngeal carcinoma<sup>9</sup>. The data was collected using Non Probability, Consecutive Sampling. Cases of with either gender having age 18-60, with presence of laryngeal carcinoma symptoms and cases who have provided informed and written permission to take part in the study were included. All cases, sensitive to iodinated contrast according to history, having renal insufficiency with serum creatinin  $\geq 1.2$ mg/dl or liver dysfunction with serum bilirubin  $\geq 1.5$ mg/dl in previous 1 week according to history, cases having INR  $\geq 1.2$  in preceding three days according to clinical record and cases gone through radiation therapy to neck in previous six weeks according to clinical record were excluded. After taking approval by ethical committee and informed consent from subjects, 64 subjects who initially presented in the Department of the Radiology having carcinoma of larynx on CTVL and then sent to

department of ENT of mayo hospital, where they underwent direct laryngoscopy and afterwards biopsy obtained sent to the department of histopathology. All the subjects underwent CT scan examination on the CT machine of hospital. Contrast injection was given to all subjects undergoing CT scan, through power injector at the rate of 4ml per min and dosage of 0.1ml/kg. The test was conducted from skull base to level of aortic arch in cranio-caudal direction. The subjects were instructed not to swallow. The parameters utilized were following; 3 mm collimation, 1.5 pitch, 1 mm reconstruction interval, range 16–18 cm FOV, 130–200 mA, 120–140 kV and  $512 \times 512$  matrix to achieve images. The obtained images were provided to the work station and CTVL were developed by using software. Images were inferred by a radiologist from radiology department.

Carcinoma of the larynx on CTVL was labelled when subjects presented with voice hoarseness and breathing difficulty or continuous cough  $\geq 3$  weeks (according to clinical record) underwent CTVL for suspected larynx carcinoma and presence of these features on CTVL were categorized as laryngeal carcinoma.

Presence of an irregular mass in larynx having asymmetrical edges, having reasonable enhancement in comparison with adjacent soft tissue.

Carcinoma on Histopathology was regarded over histopath analysis of biopsy sample having cells with keratin pearls, high ratio of nucleus to cytoplasm with intercellular bridges and assaulting the usual laryngeal stroma. All the gathered information was documented and recorded over an attached Performa. Same machine was used to achieve all CT scans and was inferred through same radiologist of the radiology department and all the histo-path analysis was performed through same pathologist in order to exclude any bias and confounding variables controlled by exclusion. All the collected data was entered into SPSS version 21. Numerical variables; age was presented by mean  $\pm$ SD. Categorical variables i-e gender and carcinoma on histopathology was presented by frequency and percentage. Positive predictive value was calculated as well as sensitivity, specificity, negative predictive value and diagnostic accuracy. Data was stratified for age and gender and size of lesion and duration of symptoms to

address effect modifiers. Post stratification PPV was calculated.

### Results:

The mean age of patients was  $44.38 \pm 9.57$  years with minimum and maximum age as 22 and 60 years. There were 25(39.1%) females who were 18-40 years old and 39(60.9%) females were 40-60 years old. There were 47(73.4%) male and 17(26.6%) female cases. On histopathology the laryngeal carcinoma was diagnosed in 56(87.5%) of the cases while it was negative in 8(12.5%) of the cases. On CT the laryngeal carcinoma was diagnosed in 59(92.2%) of the cases while it was negative in 5(7.8%) of the cases. The Positive Predictive Value of CT was 89.83% (Table-1). On stratifying data, the Positive Predictive Value for 18-40 years old cases was 86.96% and for 40-60 years old cases was 91.67%. The Positive Predictive Value for male and female cases was 88.10% and 94.12% respectively, for small and large sized lesion was 91.43% and 87.50% respectively and for cases having duration of symptoms as 3-6 weeks and 7-12 weeks was 97.30% and 77.27% respectively. The sensitivity, specificity, negative predictive value and diagnostic accuracy were 94.64%, 25.00%, 40.00% and 85.94% respectively (Table-2).

of laryngeal carcinoma. Geographic contrasts takes place in occurrence as a result of the distinctive common hazard factors, for the most part alcohol and tobacco, among populaces that likewise affect more men due to high exposure of those risk factors<sup>10</sup>.

Cancer can take place in any area of the larynx; the most well-known site remains the glottis, trailed by the supra-glottis and the sub-glottis<sup>11</sup>. The symptoms incorporate stridor, hoarseness, sore throat, presence of mass in neck or continuous cough, rely upon the size and area of the growth. Every now and again, glottic cancers are analyzed in initial phases, on the grounds that an alteration in voice quality is observed somewhat right off the bat throughout the disease course. In any case, supra-glottic and sub-glottic cancers frequently occur in advance cancer in light of the fact that their manifestations are more subtle<sup>12</sup>.

Fiberoptic as well as indirect laryngoscopy plays the primary part in assessing laryngeal sores uniquely the lesions of glottic and supraglottic region, however there are sure regions which are not ideally analyzed creating the assessment less precise and deficient<sup>13</sup>. Direct laryngoscopy is utilized to take biopsy and permits direct perception of mucosa. Nonetheless, it is

**Table 1:** Comparison of Laryngeal Carcinoma on CT in Laryngeal Carcinoma on Histopathology

		Laryngeal Carcinoma on Histopathology		Total
		Positive	Negative	
<i>Laryngeal Carcinoma on CT</i>	<i>Positive</i>	53	6	59
	<i>Negative</i>	3	2	5
<i>Total</i>		56	8	64

Chi-square = 3.750, p-value = 0.053 (Insignificant)

Positive Predictive Value = 89.83%

**Table 2:** PPV of Laryngeal Carcinoma on CT and on Histopathology with respect to different variables

	Age (years)		Gender		Size of lesion		Duration	
	18-40	40-60	Male	Female	Small	Large	3-6	7-12
<i>PPV</i>	86.96%	91.67%	88.10%	94.12%	91.43%	87.50%	97.30%	77.27%

### Discussion:

Laryngeal carcinoma is considered as 2<sup>nd</sup> most common cancer of aero aero digestive tract after oral cavity carcinoma. The prevalence of head and neck carcinoma is expanding quickly, representing >550,000 cases every year around the world, in which "130,000" are new cases

obtrusive, needs sedation and relies upon the specialist's skill, furthermore visualization is restricted just to lumen with limitation of transmural assessment, just as, the larynx has complicated structural anatomy and different locales as ventricle, subglottic region, and commissures that might not be effectively and

completely assessed via direct laryngoscopy<sup>14</sup>.

Different diagnostic techniques are introduced like CT and MRI and it is currently conceivable to analyze laryngeal sores morphologically as well as quantitatively<sup>15</sup>. CT virtual endoscopy is also a non-invasive imaging methodology permitting perception of intraluminal surfaces by 3D portrayal of 2D recreation of air/delicate tissue interfaces<sup>16</sup>. Multislice CT is significant in assessing laryngeal diseases such as subglottic larynx, front and back commissures, pre-epiglottic and para-glottic areas, ligament and extra laryngeal parts as obtrusive laryngoscopy is restricted in its capacity to assess these locales<sup>17-18</sup>. Multi-slice CT at the same time procure extra informational indexes, for example, sagittal and coronal views in multiplanes, CT laryngoscopy, angiography, and surprisingly excellent cervical spine examination. The CT virtual laryngoscopy findings when correlated with biopsy suggest that, CT virtual laryngoscopy turns out to be all the more generally used with routine customary laryngoscopy assessment of the neck particularly in arranging surgery<sup>19</sup>.

In current the mean age of patients was  $44.38 \pm 9.57$  years with minimum and maximum age as 22 and 60 years. There were 47(73.4%) male and 17(26.6%) female cases. On histopathology the laryngeal carcinoma was diagnosed in 56(87.5%) of the cases while it was negative in 8(12.5%) of the cases. These findings confirmed higher male to female ratio, older age and higher percentage of laryngeal carcinoma. A clinical trial recruited 96% men subjects and 4% women from 48 to 64 years old (mean, 56 years). 20 (87%) cases had laryngeal cancer<sup>20</sup>.

In current study on CT the laryngeal carcinoma was diagnosed in 59(92.2%) of the cases while it was negative in 5(7.8%) of the cases. The Positive Predictive Value of CT was 89.83%. According to Reem H Basinouy, positive predictive value (PPV) of CTVL was reported as 79% in identifying laryngeal carcinoma<sup>9</sup>. The findings of current study was better than previously reported study<sup>9</sup>.

Recently an examination is performed to assess the 64-multislice CT utilization with virtual laryngoscopy in determination and pre-restorative management of laryngeal and hypopharyngeal cancer in correlation

with traditional laryngoscopy. 40 cases having laryngeal and hypopharyngeal cancer were exposed to 64-multislice CT assessments with multiplanar transformation and CT-virtual laryngoscopy. The outcomes were contrasted with direct and indirect laryngoscopy. Various factors like primary intrusion of front or back commissure, subsite of the mass, and subglottic augmentation of mass were examined and the Chi-square test was utilized to contemplate the relationship in every 2 factors. The outcome showed phenomenal relationship in direct laryngoscopy and CTVL in identifying and localization of essential subsite of laryngeal cancer. A considerably critical contrast was present in two modalities favoring CTVL in distinguishing extension of subglottic area, foremost and back commissures attack ( $p\text{-value} \leq 0.001$ ) just as in assessing the secret spaces of the hypopharynx. Consequently the examination has presumed that direct endoscopy was more important, anyway in distinguishing mucosal surface inconsistencies and vocal cord association analyzed as cord fixation ( $p\text{-value} \leq 0.001$ )<sup>21</sup>.

One more examination was performed to assess the CTVL utilization in distinguishing endo-laryngeal injuries in laryngeal growths. Virtual laryngoscopic images were obtained through axial CT scan of twenty one cases with diagnosed laryngeal cancer. Discoveries from rigid telescopic video laryngoscopy (RTV) and CTVL images were assessed and contrasted with respect to surgical records. The fundamental discoveries of the examination uncovered that injuries confined in tongue base, aryepiglottic folds, pyriform sinus, and arytenoids were all around pictured via RTV and CTVL. However the 2 modalities were not observed efficacious in distinguishing ventricular lesions, ventricular cavities, and the foremost commissure. Virtual laryngoscopy was better than RTV in imaging the subglottic region and vocal cords. In this manner, it very well may be inferred that virtual laryngoscopy is a non-invasive and solid method that gives endolaryngeal surfaces and cancer expansion perception. It very well might be helpful in staging larynx cancer and arranging the proper surgical option<sup>7</sup>. Hence, Virtual laryngoscopy can be utilized in upcoming times because it is non-invasive and consistent modality which gives perception of endo-laryngeal area and cancer expansion. It very well might be helpful in staging larynx cancer and



arranging the proper surgical option<sup>7</sup>.

### Conclusion:

Through the findings of this study it is concluded that positive predictive value of computed tomography virtual laryngoscopy is high (89.83%) in detecting laryngeal carcinoma taking histopathology as gold standard. CTVL is a precise and non-invasive imaging method in detecting laryngeal carcinoma.

**Ethical Approval:** Given

**Conflict of Interest:** The authors declare no conflict of interest.

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