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THREE DIMENSIONAL VIRTUAL BRONCHOSCOPY IN CASES WITH AIRWAY PATHOLOGIES: AN EARLY EXPERIENCE FROM A TERTIARY CARE CENTER OF NEPAL

ABSTRACT:

Objective:

To evaluate the findings of the airway in virtual 3D bronchoscopy and to compare it with the findings on laryngotracheal evaluation (LTE) or rigid bronchoscopy in patients with suspected airway pathology and also to evaluate the added benefits of incorporating virtual 3D bronchoscopy in airway surgery practice.

Materials & Methods:

This was a prospective observational study conducted in the Department of ENT-Head and Neck Surgery of T.U. Teaching Hospital, Nepal from December 2018 to December 2019. Cases presenting with laryngotracheal obstruction resulting from stenosis, malacia, foreign body(FB) or any congenital pathologies with a multidetector computed tomography scan done for the concerning pathology were included in the study. Cases without CT scan done or without the readable Digital Imaging and Communication in Medicine (DICOM) files for 3D reconstruction were excluded from the study. Three-dimensional bronchoscopy was performed by the author. We used M.S. excel to record the data.

Results:

A total of seven cases were evaluated. Three-dimensional bronchoscopy revealed pathologies (FB in two cases and airway stenosis in three cases) in five cases which was similar to the findings in rigid bronchoscopy and LTE. Two cases with suspected aspiration hadno pathologies detected on 3D bronchoscopy as well as on rigid bronchoscopy.

Conclusion:

Virtual 3D bronchoscopy is a very helpful tool in diagnosing airway pathologies especially in children and can be a good alternative to the diagnostic rigid bronchoscopy and endoscopic LTEwhen intervention is not required.

Keywords: Airway, Bronchoscopy, Three dimensional, Virtual

INTRODUCTION

Pediatric airway surgery is a relatively new field in otorhinolaryngology in Nepal. Considering the fact that the pediatric population have delicateairway anatomy and physiology compared to the adults, airway pathologies and their management in this group of population is often very challenging. Airway surgery in the pediatric population demands a good management plan before embarking on surgery. Moreover, diagnosing the airway pathology in children on an OPD basis is quite difficult using flexible scopes and most of the times, airway evaluation has to be done under general anaesthesia. Imaging of the airway in this scenario can fill this void.

Computed tomography (CT) scan despite drawbacks like radiation exposure and contrast related adverse reactions, hasadvantages of short imaging time, lesser need for sedation, good spatial resolution and better visualization of the lungparenchyma over MRI.[1] Further, the introduction of virtual three dimensional (3D) bronchoscopy has added much more value to its use. Three-dimensional bronchoscopy is a software-generated 3D reconstruction of the airway which provides a simulation of conventional bronchoscopy.[2] It would be a sound rationale if airway pathologies are identified early by virtual 3D bronchoscopy which could offer better planning of the management in cases that need airway intervention and defer the need for evaluation under anaesthesia in cases with a negative scan.

Thus, the aim of our study was to evaluate the findings of the airway in virtual 3D bronchoscopy and to compare it with findings on laryngotracheal evaluation (LTE) or rigid bronchoscopy in patients with suspected airway pathology and also to evaluate the added benefits of incorporating virtual 3D bronchoscopy in airway surgery practice.

MATERIALS AND METHODS

This was a prospective observational study conducted in the Department of ENT-HNS of Maharajgunj Medical Campus, T.U.Teaching Hospital, Kathmandu Nepal. The study was conducted over a period of one year (December 2018-December 2019). Cases of all gender and sex, presenting with laryngotracheal obstruction resulting from stenosis, malacia, foreign body(FB) or any congenital pathologies with amultidetector computed tomography scan done for the concerning pathology were included in the study. Cases without CT scan done e.g., those with clear clinical evidence of FB aspiration or without the readable DICOM files for 3D reconstruction were excluded from the study. The DICOM files were uploaded to the computer software OsiriX MD (Pixmeo SARL, Geneva, Switzerland). Three-dimensional bronchoscopy was then performed by the author. Any suspicious lesion identified was discussed among the other two airway surgeons to come to a consensus. Any disparity regarding the opinion on the pathology seen was reassessed following the bronchoscopy or laryngotracheal evaluation and the findings on 3D bronchoscopy and laryngotracheal evaluation were then compared. We used M.S. excel to record the data.

RESULTS

A total of eight cases met the inclusion criteria, however, one case had to be excluded due to unreadable DICOM files. Among the cases, one was adult (34 years) and the rest were pediatric cases (below 15 years). M: F ratio was 2:1. All the cases presented with shortness of breath. One case presented with unresolving left lung pneumonia, three cases had a suspicious history of FB aspiration (chicken bone, pen cap and rice grain respectively), one had a history of prolonged intubation following accidental acid (Harpick®) ingestion, one case had a history of prolonged intubation following the suicidal attempt by hanging and one had a spontaneous onset of stridor.

Three-dimensional bronchoscopy revealed pathologies in five cases. One case with the history of unresolved pneumonia and one with the history of suspected rice grain aspiration had normal findings on 3D bronchoscopy. The findings co-related well in all cases during intraoperative LTE evaluation along with normal bronchoscopic findings in cases with negative 3D bronchoscopy. The 3D bronchoscopic images of all the cases with positive findings are shown in Figure I to V. Table 1 compares the virtual bronchoscopic findings and findings on laryngotracheal evaluation.

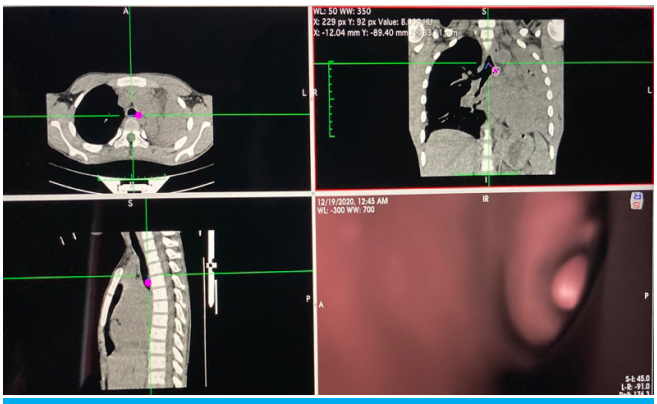

Figure I : Virtual 3D bronchoscopy showing FB (Pen cap) in right main bronchus (Case 3)

Table 1. Findings of the cases on virtual 3D bronchoscopy, conventional bronchoscopy and laryngotracheal evaluation

Cases	Age/ sex	Presenting symptom	Virtual 3D bronchoscopic finding	Findings on laryngotracheal evaluation (LTE)/ rigid bronchoscopy	Advantages during surgery/ LTE
1	1Y/M	Shortness of breath with unresolving pneumonia	No pathologic findings	No pathologic findings	None
2	2 Y/F	Shortness of breath following suspected aspiration of rice grain	No pathologic findings	No pathologic findings	None
3	5Y/M	Shortness of breath following suspected aspiration of a pen cap	FB seen left main bronchus	FB (pen cap) seen left main bronchus	Identification of the site of impaction prior to surgery and anticipated difficulties
4	3Y/F	Shortness of breath following suspected aspiration of chicken bone	FB seen subglottis	FB (Chicken bone) seen subglottis	Identification of the site of impaction prior to surgery and anticipated difficulties
5	6 years/F	Progressive shortness of breath for 3 months	Grade III sub glottic stenosis	Grade III sub glottic stenosis	Assessment of the length of stenosis and airway distal to the obstruction
6	9 years/M	Shortness of breath following prolonged intubation	Grade III sub glottic stenosis	Grade III sub glottic stenosis	Assessment of the length of stenosis and airway distal to the obstruction
7	24Y/M	Shortness of breath following prolonged intubation due to accidental acid ingestion	Grade III tracheal stenosis	Grade III tracheal stenosis	Assessment of the length of stenosis and airway distal to the obstruction

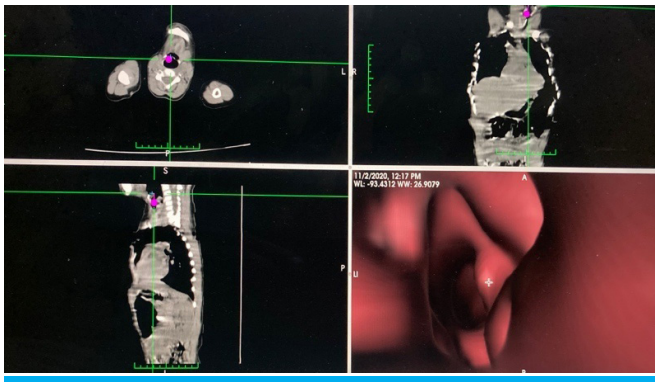

Figure II: Virtual 3D bronchoscopy showing FB(chicken bone) in subglottis (Case 4)

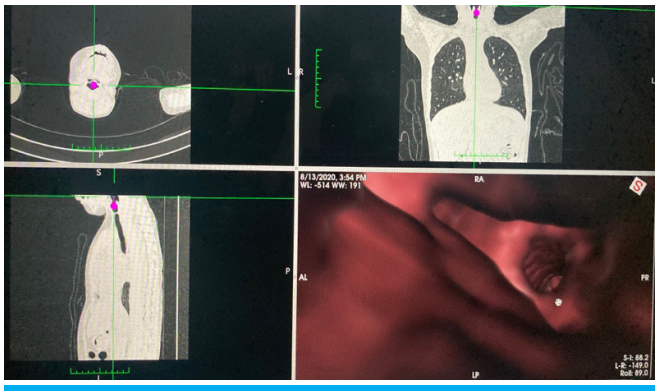

Figure. III: Virtual 3D bronchoscopy showing subglottic stenosis (Case 5)

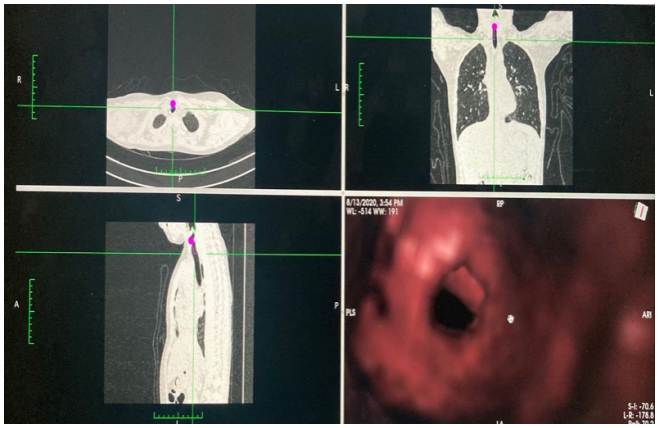

Figure IV: Virtual 3D bronchoscopy showing subglottic stenosis (Case 6)

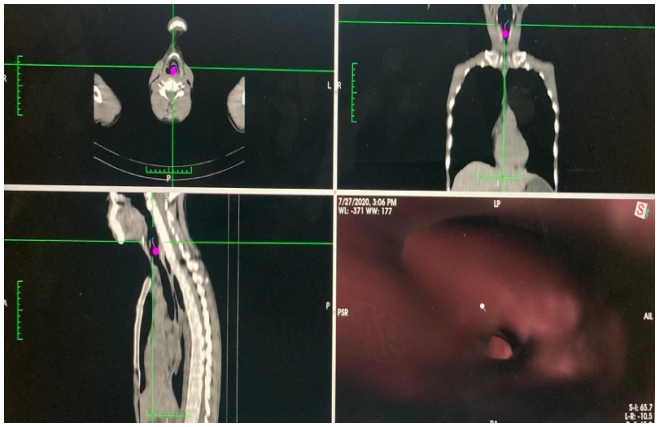

Figure V : Virtual 3D bronchoscopy showing tracheal stenosis (Case7)

DISCUSSION

This study is the first of its kind to be done in Nepal. Virtual 3 D bronchoscopy in our study seemed to be very advantageous in cases with an airway pathology especially in the pediatric population offering an advantage of identifying the site and size of the lesion and thus allowing proper planning of the treatment. All cases who underwent 3D bronchoscopy had similar findings when compared to the findings on conventional bronchoscopy and LTE evaluation.

The history of bronchoscopy dates back to the late 18thcentury when Prof. Gustav Killian removed a pork bone in the right main bronchus of a farmer. Chevalier Jackson later developed the rigid bronchoscope with an optical illumination and suction attached to it.[3] A huge leap has then been made in the field of bronchoscopy until now.

Foreign body aspiration being very common in children often lacks a definite history and the clinician has to rely on the clinical findings most of the times to decide on doing rigid bronchoscopy. The study by Acharya K showed a statistically significant association between the history of chocking and the presence of foreign body during rigid bronchoscopy.[4]Tomaske et al. reported a good specificity (96-98%) of the clinical triad (choking/coughing, wheezing and unilateral diminished breath sounds) in predicting the presence of the foreign body in the airway.[5] Despite having a good correlation between the clinical findings and bronchoscopic findings, in many cases, the history of aspiration is not obvious. Presentations such as long-standing cough, unresolving pneumonia, respiratory distress of unknown etiology often make it difficult for the attending clinician to decide for rigid bronchoscopy as the procedure itself carries with it a risk of anesthetic and surgical complications. Apart from foreign body airway, structural airway pathologies like airway stenosis are also quite common in pediatric population. Intubation trauma is the commonest etiology so far with presenting symptoms being respiratory distress.[6]trauma, mostly related to intubation, is the commonest so far. This study retrospectively evaluates various aetiological factors resulting in airway stenosis and the associated patient-related factors. Objectives. The objectives of this study were to evaluate the common patient-related factors, aetiology, site, and mode of presentation of airway stenosis and to evaluate the duration of intubation resulting in airway stenosis. Materials and methods. This was a retrospective study carried out at the Department of ENT-HNS, Institute of Medicine, Nepal. Record files from January 2014 to January 2019 of all cases with endoscopic diagnosis of airway stenosis were evaluated. Demographic data, site, severity, aetiology, time, and mode of presentation were noted. The severity of stenosis was graded based on Cotton–Meyer (CM These pathologies also demand an endoscopic evaluation of the airway and necessary intervention if required.

CT scan in these case scenarios has a lot to offer and with the advent of 3D bronchoscopy, it is now possible to evaluate the 3D reconstructed airway simulating the conventional bronchoscopy without any anesthetic and surgical intervention. Jung e al. in their study could detect foreign body in the airway in all cases by virtual 3D bronchoscopy.[7] Similarly, Haliloglu et al. showed the sensitivity and specificity of 100% of CT bronchoscopy

when compared with rigid bronchoscopy.[8] Another study by Naga et al. also showed that the virtual bronchoscopy had sensitivity, specificity and accuracy of 100% in localizing the site of airway stenosis.[9]

Despite having such good results there are yet some disadvantages of CT scan and virtual bronchoscopy with radiation hazard being the most important one. Moreover, smaller children need sedation for a CT scan to be done. The virtual bronchoscopy cannot tell the colour and exact shape of the foreign body. Also, it cannot detect levels beyond the third brochus.[7]

Considering the aforementioned advantages and disadvantages, we recommend CT scan and 3D bronchoscopy to be done only in those cases with suspected FB aspiration, who are clinically stable with no obvious clinical findings and history suggestive of aspiration before doing any intervention. In cases with airway stenosis, it is, however, a good decision to have a CT scan done prior to LTE to plan the management.

Our study had various limitations. A relatively fewer number of cases was one of them. Also, we only included the cases that had done a CT scan before presenting us. Inhomogeneity of the slice thickness and improper positioning of the patient made us exclude one case.

CONCLUSION

Virtual 3D bronchoscopy is a very helpful tool in diagnosing airway pathologies especially in the children and can be a good alternative to the diagnostic rigid bronchoscopy and endoscopic LTEwhen intervention is not required.

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