Prevalence of sub superior bronchus. A bronchoscopic study

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Abstract

Background: The sub superior bronchus (B*) is an atypical/ accessory bronchus in lower lobe. With the global increase in indication of segmentectomy especially for lung cancer, it has received higher attention from thoracic surgeons. The aim of our study was to properly identify B* during bronchoscopy and elucidate its prevalence.

Methods: A thorough examination of bronchial tree was done during bronchoscopy in 60 patients. The indications were mostly for suspected malignancy. All the segmental bronchi (B1-10) were properly identified. Any accessory bronchus in lower lobar bronchus below B6 was labelled as B* and a video/ photo was captured for discussion among the investigators.

Results: B* was identified in 31.6% cases with an incidence of 21.6% in right side and 10% in left side. B6, (B7), B8, B9+10 configuration was found to be associated mostly with the presence of B* in right side (p=.005) whereas B* was exclusively associated with that configuration in left side (p<.001).

Conclusion: Proper identification of B* can be done by bronchoscopy and its prevalence (31.6%) is not uncommon.

Keywords: bronchoscopy; tracheobronchial tree, segementectomy

Introduction

The human lung is classically divided into 10 bronchopulmonary segments in the right side and 8-9 in the left, as standardized by "Terminologia Anatomica" (TA 2019). However, the anatomical variation like S* has not been formally recognized in TA 2019.[1]

The sub superior segment (S*) is an atypical pulmonary segment of the lung lower lobe, and it is located between the superior and basal segments that cannot be classified into the 19 typical segments present in both lungs. S* was first defined and named by Boyden in 1945.[2] S* is a transverse wedge of lung tissue interpolated between the S6 and basal segments. Very few studies and reports on S* have been published since the time of Boyden's study, and most of the studies included small sample sizes and were autopsy studies. The definition, prevalence, and anatomical characteristics of S* are uncertain and inconsistent.[2]

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Boyden calculated the prevalence of S* at 48% and briefly described the anatomical characteristics of its bronchi and pulmonary vessels in 50 cadaveric dissections.[3,4]

S* carries its own bronchus, artery and vein (B*, A* and V*), respectively. Therefore, tumors located at S* or adjacent to it may be considered for S* segmentectomy or more frequently bisegmentectomy (S6 +S* or S10 + S*). In such scenarios, proper identification of B* and A* is extremely important.

Our study aimed at bronchoscpic confirmation of presence or absence of B* in patients undergoing bronchoscopy for any other indication, mostly for suspected malignancy or undiagnosed but suspected pulmonary tuberculosis.

Materials and Methods:

Patients:

A prospective study from 2024 september-2025 February (6 months) was conducted after ethical clearance from institutional review committee. All the patients undergoing bronchoscopy for various indications (mostly suspected malignancy, undiagnosed tuberculosis, staging of esophageal/ lung cancer) were included in the study.

Procedure:

All fiberoptic bronchoscopy (Olympus fiberoptic bronchoscope with 6 mm external diameter) was done in endoscopy suite under local anesthesia in supine position. Monitoring was done by continuous pulse oximetry, electrocardiography and sphygmomanometry. Pre oxygenation was done via face mask with oxygen at 6L/min or nasal cannula to achieve oxygen saturation of >90%.

Local anesthesia was given via transtracheal route or 'spray-as-you-go' technique using 1% lidocaine. In the transtracheal route, 10 ml of 1% lidocaine was taken and 8ml was injected directly into trachea via cricothyroid membrane and remaining 2ml was flushed in bilateral nostrils (1ml each nostrils). 15% lidocaine spray was used to anesthetize oropharynx and laryngopharynx.

Tracheobronchial tree including bronchial segments B1-B10 was examined thoroughly and nomenclature was recorded as per Collin's classification.[5]

Definition of B*:

Lower lobar bronchus along with B6-10 in right side and B6, B8 (B7+8)-10 in left side was confirmed and photo/ video was captured for additional review among all the investigators. In right side, any accessory segmental bronchus arising below B6 and residing between B6-B7, B7- first branch of basal trunk or 1st and 2nd branch of basal trunk was labelled as B*. In left side, any accessory segmental bronchus below B6 and residing between B6-common basal trunk or below first branch of basal trunk was labelled as B* (Figure 1).[2,6]

Format of pictorial documentation of right S* and B* has been shown in figures 2-5.

Fig. 1. Definition and Pattern of B*.

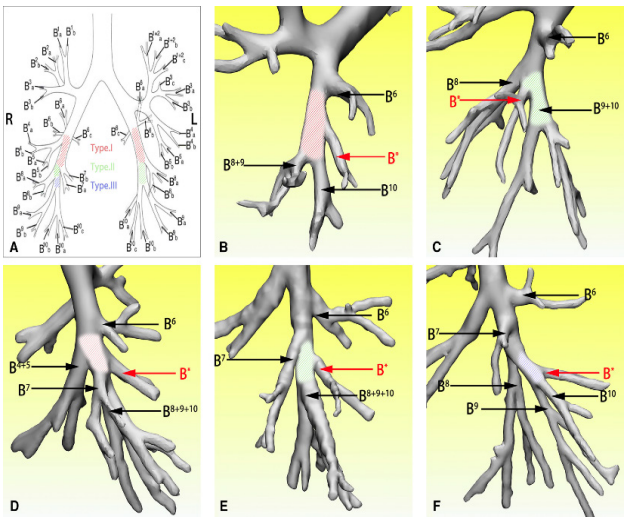


Fig. 2. Segments of right lung.

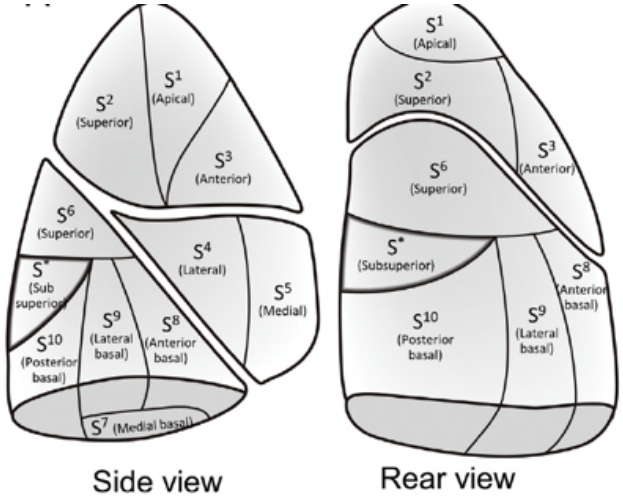


Fig. 3. Segments and subsegments of right lung.

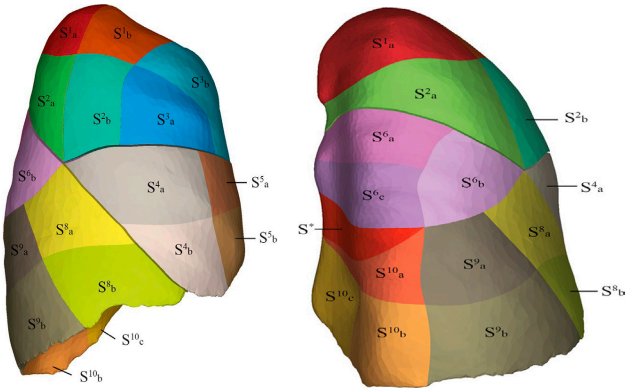
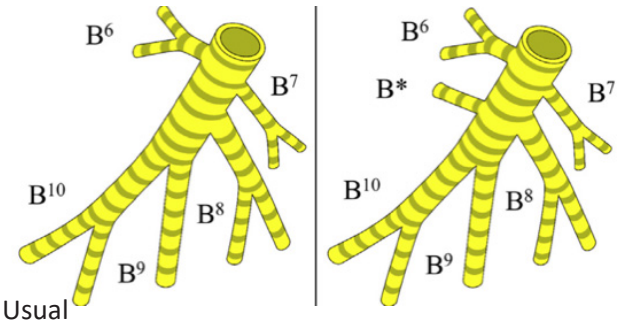


Fig. 4. Bronchial divisions in right lower lobe.



Statistical analysis: The data was entered into the Statistical Package for the Social Sciences (SPSS-26) for analysis.

Results:

A total of 71 patients underwent bronchoscopy. In 11 patients, proper evaluation of lower lobar segmental bronchi could not be done, hence they were excluded, and 60 patients were taken for complete evaluation. Overall B* was identified in 19 (31.6%) cases (Table 1).

Fig. 5. Bronchoscopic identification of B*.

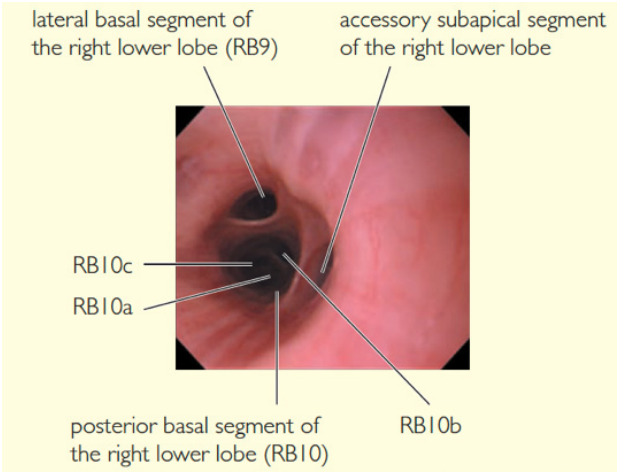


Table 1. Prevalence of B*.

Parameter	N	%
Male	33	55
Female	27	45
Prevalence of B*	19	31.6
Right	13	21.6
Left	6	10

In 1 case, B* was present in both right and left side.

Table 2. Pattern of right lower lobar bronchus (not considering B*).

Pattern	N	%
B6, B7+8, B9+10	6	10
B6, B7, B8, B9+10	17	28.3
B6, B7, B8, B9, B10	17	28.3
B6, B7, B8+9, B10	20	33.3

Table 3. Pattern of left lower lobar bronchus (not considering B*)

Pattern	N	%
B6, B8, B9+10	18	30
B6, B8, B9, B10	20	33.3
B6, B8+9, B10	22	36.7

In right side, B* was found in B6, B7, B8+9, B10 (n=5) and B6, B7, B8, B9+10 (n=8) pattern

(p = .005). In left side, B* was found exclusively in LB6, B8, B9+10 pattern (p <.001). above findings have been shown in tables 4.

Table 4. Lower lobar bronchial pattern vs B*.

Pattern		B* present	B* absent	p
RLLB	B6, B7, B8, B9, B10	0	17	.005
	B6, B7+8, B9+10	0	6	
	B6, B7, B8+9, B10	5	9	
	B6, B7, B8, B9+10	8	15	
LLLB	B6, B8, B9, B10	0	20	<.001
	B6, B8+9, B10	0	22	
	B6, B8. B9+10	6	12	

Pattern of bronchial divisions in right lower (RLLB) and left lower lobar bronchi (LLLB) were studied separately without considering the presence or absence of B*(table 2-3). In right side, the commonest pattern was B6, B7, B8+9, B10 (33.3%). In left side, B6, B8+9, B10 was the most common pattern (36.7%)

Discussion:

Lobectomy remained a gold standard procedure for malignancy since 1995. Therefore, a detailed anatomy of bronchi, pulmonary arteries and veins was never a subject of interest and discussion among thoracic surgeons.

JCOG0802/ WJOG4607L multicentric randomized controlled trial confirmed the superiority of segmentectomy over lobectomy for peripheral clinical stage Ia (tumor size < 2 cm with consolidation to tumor ratio > 0.5).[7] This led to a rapid growth in sub lobar resection, particularly segmentectomy for smaller lesions. Since then, segmental and subsegmental anatomy including S* has received increased attention from thoracic surgeons.[8]

Only few studies have been published regarding prevalence of S* after Boyden's detailed anatomical dissection of lungs in 50 cadavers.[2] S* arises from aberrant bronchial budding during 7th-8th week of gestation and it is more prevalent in right side than in left side (4:1).

In the past decade, 3-D CT has rapidly developed for use in thoracic surgery, providing an equally accurate but more accessible method to evaluate the pulmonary segmental anatomy compared with autopsy studies.[9,10] HRCT may show a triangular opacity inferior to B6.

In a review of 270 three-dimensional CT angiography and bronchography of right lung, Nagashima found the perveance of 20.4% of right B6*.[10]

Zhou et al performed a detailed multicentric analysis of 2194 CT images with 3–D reconstruction with Deep Insight software. They found a prevalence of S* of 34.6% with 16.23% % in right side, 13.22% in left side and 2.6% in both sides.[6] Authors followed the principles of various patterns of B* as per Boyden's anatomical dissection (Fig. 1).

A classical and contemporary way of identification of bronchial varaitions is bronchoscopy indeed. Bronchoscopy has become an essential tool in the field of Pneumology. Initially its function was merely descriptive of the airway, however, the development of high resolution video bronchoscopy has made it possible to expand its diagnostic as well as therapeutic capabilities.[5] It is powerful and objective tool for proper identification of bronchial anatomy including B*. Despite a routine practice of diagnostic bronchoscopies for various indications, again very few studies have emphasied about the presence of B*.

In bronchospic study of 41 patients in right side and 46 pts in left side, Konschake et al found prevalence of B* 19.4% in right side and 0% in left. [11]

In another study of bronchoscopy (n=181) by Vaz Rodrigues, one case was found in right (0.6%) and 1 in left (0.6%).[12]

To the best of our knowledge, our study is first of its kind from Nepal. It has very well shown the prevalence of B* to be 31.6% and is not uncommon finding during bronchoscopy. In our study, right B* was twice as high as left B*, which is similar to the results published by Zhou et al.[6] B6, (B7) B8, B9+10 pattern was

associated frequently with presence of B* in right side. In left side, B* existed exclusively only in above pattern. This could indirectly indicate that bronchoscopist should look for B* particularly in above mentioned configuration.

The principle of segmentectomy recommends a minimum of 2 cm tumor free margin or twice the diameter of tumor to achieve a R0 resection.[13] The recognition of existence of S* appears to be extremely important during segmentectomy of S6 or S10 requiring adjacent segment/ subsegment resection to achieve R0 resection. In such scenarios, bisegmentectomy (S6+S* or S*+S10) would be the ideal procedure. Similarly, a complex segmentectomy e.g. S6c+ S* maybe needed in certain cases. Shimizu demonstrated technical feasibility of bisegmentectomy (S6 + S* and S6 + wedge of S9).[14]

Conclusion:

We performed, to our knowledge the first bronchoscopic study in Nepal to find prevalence of B* and to predict its probability of existence in B6, (B7), B8, B9+10 pattern of lower lobar bronchus. It helps surgeon to better understand S* during segmentectomy to avoid collateral damage. The present study has few limitations: single centered study and small sample size.

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