

Accidental breakage of needle tip during endobronchial ultrasound-guided transbronchial needle aspiration: A case report and review of literature

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ABSTRACT

Endobronchial ultrasound-guided transbronchial needle aspiration (EBUS-TBNA) is commonly recommended for the diagnosis of mediastinal lymphadenopathy with malignant and nonmalignant etiology. EBUS-TBNA has been preferred over mediastinoscopy because of several advantages such as comparable diagnostic accuracy, safety, cost-effectiveness, and less invasiveness. Hemorrhage, mediastinitis, pneumonia, mediastinal abscess, empyema, lung abscess, pericarditis, and pneumothorax have been reported as major complications of EBUS-TBNA. Equipment malfunction has been observed mostly in the form of breakage of EBUS scope parts such as working channel, optical fibers, and ultrasound probe. Needle malfunction either involving assembly leading to inability to retract the needle within the sheath or accidental breakage of the needle tip has also been reported but the evidence is still limited. We encountered an accidental breakage of needle tip while performing EBUS-TBNA procedure in a 58-year-old male having subcarinal lymphadenopathy suspected to have lung cancer. We were able to successfully retrieve the broken fragment bronchoscopically without any complications.

KEY WORDS: Endobronchial ultrasound-guided transbronchial needle aspiration, mediastinal lymphadenopathy, needle malfunction

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INTRODUCTION

Endobronchial ultrasound-guided transbronchial needle aspiration (EBUS-TBNA) is commonly recommended for the diagnosis of mediastinal lymphadenopathy with varying etiology.^[1] It can establish diagnosis and staging of lung cancer with comparable diagnostic accuracy (pooled sensitivity of 88%–93% and specificity of 100%) to mediastinoscopy considered as gold standard.^[2,3] EBUS-TBNA now preferred over mediastinoscopy because

of safety, cost-effectiveness and less invasiveness.^[4] It provides real time ultrasound guidance for the confirmation of needle puncture site that facilitates the accurate collection of a sample from the lesion for pathological diagnosis. Hemorrhage, mediastinitis, pneumonia, mediastinal abscess, empyema, lung abscess, pericarditis, and pneumothorax have been reported as major complications of EBUS-TBNA in recent years.^[5,6] A survey from Japan

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has described equipment malfunction as complication in 1.33% of cases.^[4] This has been observed mostly in the form of breakage of EBUS scope parts such as working channel (74%), optical fibers (16%), and ultrasound probe (7%). Malfunction of needle involving assembly leading to inability to retract the needle within the sheath has been reported.^[7-9] Needle malfunction in the form of accidental breakage or snapping of its tip during the procedure has also been reported.^[10-20] We herein report an accidental breakage of needle tip as a rare complication while performing EBUS-TBNA procedure in a 58-year-old male suspected to have lung cancer.

CASE REPORT

A 58-year-old male, chronic reformed smoker with severe chronic obstructive pulmonary disease was admitted with cough, breathlessness, and significant weight loss since the past 2 months. Contrast-enhanced computed tomographic imaging of thorax revealed bilateral emphysematous changes and pleural based soft-tissue density mass lesion of size 50 mm × 49 mm having irregular margin located in the anterior segment of the left upper lobe along with subcarinal lymphadenopathy of size 28 mm × 20 mm as shown in Figure 1a and b. Positron emission tomographic imaging showed fluorine-deoxyglucose avid enhancement in both mass lesion (standardized uptake value [SUV]_{max}-16.4) as well as subcarinal lymph node (SUV_{max}-6). The possibility of lung cancer with subcarinal lymph node metastasis suspected. EBUS-TBNA was performed with EBUS scope (EB19-J10U; Pentax Medical, Montvale, New Jersey, USA) under general anesthesia from subcarinal lymph node station (station-7) for the diagnosis and staging of lung cancer using a 22 G Echo Tip Pro Core needle (High Definition, Cook Endoscopy Inc., Limerick, Ireland). The

first and second aspirations to obtain core tissue from lymph node were performed without any complication but the tissue yield was inadequate. Needle movement was smooth inside the lymph node. During the third aspiration, a resistance was felt initially while piercing the node, but the needle had penetrated the node as confirmed on ultrasonic imaging as shown in Figure 1c. However, the needle did not move back and forth smoothly and ultrasound vision of needle was lost subsequently. The scope was retained as it is within the airway to prevent injury. The needle slider was pulled proximally until a clicking sound was heard and needle adjuster was locked for ensuring safety. It was ensured with bronchoscopic view of EBUS scope that needle was not protruding outside the sheath, after complete retraction of the needle slider proximally. However, a broken needle tip was localized in the lateral wall of carina during inspection of airways as shown in Figure 1d. The needle assembly was then gently removed. EBUS Scope was also withdrawn subsequently. Conventional bronchoscopy (EB19-J10, Pentax Medical, Montvale, New Jersey, USA) was performed immediately and broken needle fragment was removed using alligator forceps without any complications. Broken proximal end of needle has shown in in Figure 1e. The size of the fragment was 15 mm as shown in Figure 1f. We did not observe any damage to the EBUS scope by the broken needle tip. Repeat EBUS as well as X-ray fluoroscopy after the successful removal of the broken tip confirmed no other residual materials. EBUS procedure was completed using a new needle and aspirate sample was sent for analysis. There was no evidence of malignancy based on the results of cytological and histopathological examinations of aspirate specimens obtained from the enlarged lymph node. However, the diagnosis of squamous cell carcinoma was established on histopathological examination of

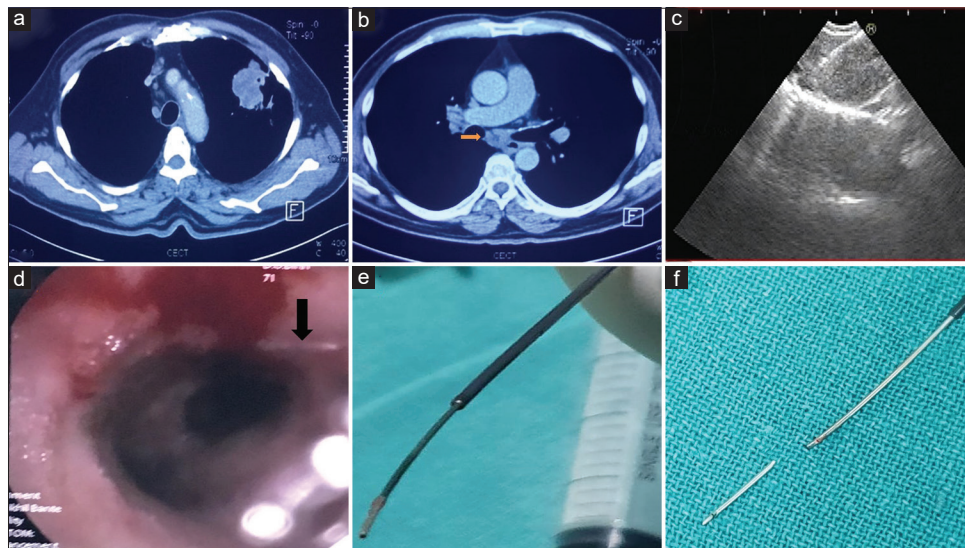


Figure 1: (a) Axial cuts of computed tomography thorax showing pleural based soft tissue density mass lesion of size 50 mm × 49 mm having irregular margin located in anterior segment of left upper lobe (b) subcarinal lymphadenopathy of size 28 mm × 20 mm (indicated by horizontal arrow) (c) ultrasonic image showing needle stuck in the subcarinal lymph node (station 7) (d) endobronchial ultrasound bronchoscopic view showing flash view of broken metallic needle fragment left in lateral wall of the carina at 2 o' clock position (e) broken proximal end of endobronchial ultrasound needle (f) broken needle tip after removal with length 15 mm

sample obtained from ultrasound-guided transthoracic biopsy from mass lesion. The patient was discharged the next day without any procedure-related complications. The complication as well as needle batch number were notified and forwarded to the company manufacturing EBUS-TBNA needles.

DISCUSSION

EBUS-TBNA is generally considered a safe procedure, with an overall complication rate of 1.4%.^[5] Needle tip breakage is a rare complication of EBUS-TBNA as observed in our case which was successfully removed with alligator biopsy forceps under bronchoscopic guidance. Various authors have reported similar experience as described in Supplementary Table 1.^[7-20] A nationwide survey by the Japan Society for Respiratory Endoscopy focused on complications associated with EBUS-TBNA aspiration and reported the breakage of the puncture needle in 15 (0.20%) cases.^[4] The details of this complication were not described although reported for first time. The first case of needle tip breakage was reported in detail by Özgül *et al.*,^[10] followed by other reports.^[11-20] The retrieval of the broken fragment of EBUS needle by flexible bronchoscopy was successfully reported in most of these cases.^[11,12,14,16,18-20] Unsuccessful attempts were also reported where fragments migrated to dependent lobes of lung which were expelled by spontaneous coughing^[8,13,17] or migrated to gastrointestinal tract followed by expulsion in faeces.^[10] Vial *et al.* observed retained needle fragment within the lymph node with mucosal thickening and inflammatory changes at same area that could not be retrieved with bronchoscopy.^[15] The consequences of needle fragment retention have not been identified but could include migration with vascular disruption or embolization and a chronic inflammatory reaction to foreign body. Invasive procedures such as thoracotomy might be required if there are higher risks of complication. However, final decision for removal depends on the clinician considering risk-benefit ratio. Kuint *et al.* reported a case of EBUS needle breakdown resulting in fatal hemorrhage requiring mechanical ventilation.^[13] Few studies have also reported needle assembly malfunction due to the separation of the shaft of needle and sheath-sliding mechanism^[7,9] or involvement of spring/coil mechanism,^[8] resulting in failure to retract the needle within the sheath during or after the procedure. The broken needles were still attached to the rest of the apparatus even after withdrawal of whole assembly but removed in one piece without any residue materials in the patients. Needles projecting inappropriately outside the sheath can not only damage the bronchoscope but can also cause injury to airways. No mortality has been reported with EBUS needle malfunction. Few reasons have been proposed for needle malfunction. These include manufacturing defect,^[7,10,17] kinking of weakest point in the needle assembly (junction between the long, shiny electroplated portion, and the coarse end of the needle),^[10,12,14] multiple punctures,^[16] accessing a hard

lymph node or hitting the bronchial cartilage,^[12,13,17] excessive load on needle tip by operator that might have less experience and tangential position of the needle requiring more angulation and excessive bending.^[7,12,16,17,20] All these factors except lymph node hardness, might be responsible for this complication in the present case. There could be increased risk of complication in elderly where the cartilaginous rings of airways are calcified and distance between rings is also less. The length of broken tip fragment in majority of cases including current one, are reported to be around 15 mm which seems to be the weakest point of needle and are more prone to kinking or snapping on multiple passes. Needle breakage has been observed irrespective of needle type. We have encountered this complication at our center with 22G Echo Tip Pro Core needle whereas previous studies have reported mostly with 21G/22G Olympus ViziShot or 22G Cook ECHO-HD-EBUS-P needles.^[7-20] Technical modifications need to be improvised to rectify this existing issue. SonoTip EBUS needles comprising nitinol (nickel and titanium alloy) can be used to overcome these limitations. Advantages of these needles are resistance to permanent bends and kinks at curved or angulated positions, maintenance of integrity even after multiple passes and also adoption of twist-lock technology for precise sheath and needle length adjustments.^[21] Although theoretically this needle may sound to be better, the experience with it is limited. There are not enough comparative data to suggest that this needle is better than others. The expanding evidence regarding this complication of EBUS-TBNA needle breakage could be of major concern for bronchoscopists in near future. The complication can be minimized by avoiding excessive needle bending, thorough inspection of needle assembly before proceeding for every pass and maintaining visual inspection of needle integrity during and after the procedure.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the journal. The patient understands that name and initials will not be published and due efforts will be made to conceal identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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Supplementary Table 1: Accidental needle breakage as complication while performing endobronchial ultrasound-guided transbronchial needle aspiration: Summary of case reports

Author/years	Age (years)/sex	Working or established diagnosis	EBUS needle used	Lymph node station sampled	Number of pass during occurrence of malfunction	Form of needle malfunction	Proposed reason(s) for malfunction	Management modality	Complications encountered if any to patient or equipment
Dhillon and Yendamuri (2013) ⁽⁷⁾	1 st case 43/male 2 nd case 33/female	Prior renal cell carcinoma with metastasis Result - No evidence of malignancy Prior rectal carcinoma with metastasis Result - noncaseating granuloma	22G Olympus ViziShot needle (model NA-201SX-4022) 21G Olympus ViziShot needle (model NA-201SX-4021)	Right paratracheal (4 right) Right and left inrahilar (11 right and 11 left)	First Pass not mentioned for 11 left	Needle assembly malfunction in both cases Entire needle unexpectedly Outside the sheath even on withdrawal of whole assembly suggesting breakage from attachment inside sheath Separation of sheath-sliding shaft into two halves while pushing in node	Manufacturing defect Excess force of needle insertion into the airway Removed in both cases as single piece	Detection of malfunction after removing the needle from the EBUS scope Removed in both cases as single piece	Nil in both cases
Özgül <i>et al.</i> (2014) ⁽¹⁰⁾	62/male	Incidental mediastinal widening on CXR Preoperative evaluation for bilateral inguinal hernia	22-gauge Olympus needle (model NA-201SX-4022)	Subcarinal (7)	Third	Distal 11 mm fragment broken or snapped	Manufacturing defect Kinking of weaker or thinner dimpled area	Detected initially in bronchus by EBUS scope Migration to transverse colon confirmed on X-ray abdomen Spontaneous expulsion in faeces Detected by conventional bronchoscopy Successful removal with alligator forceps	Nil
Sharma <i>et al.</i> (2015) ⁽¹¹⁾	55/male	Prior sarcooidosis Pancreatic mass with? Metastasis	22G cook EchoTip® Ultra Endobronchial HD Ultrasound Needle	Right hilar (10 right) Right paratracheal (4 right)	2 passes from 10 right Pass taken from 4 right - first	Distal 15 mm broken within lymph node in lower trachea embedded in bronchial wall	Manufacturing defect Kinking of weaker or thinner dimpled area	Detected by EBUS scope Migration to transverse colon confirmed on X-ray abdomen Spontaneous expulsion in faeces Detected by conventional bronchoscopy Successful removal with alligator forceps	Nil
Tariq (2016) ⁽¹²⁾	74/male	Prior treated case of rectal carcinoma as well as left upper lobe moderately differentiated lung adenocarcinoma Proven nodal recurrence of lung adenocarcinoma	22G cook EchoTip® Ultra Endobronchial HD Ultrasound Needle	Subcarinal (station 7)	First	15 mm broken distal end of the needle left stuck in the right main bronchial wall below the carina	Hitting to bronchial cartilage ring Excessive force by bronchoscopists Site of fracture at weak point close to the junction between the long, shiny electroplated portion and the coarse end of the needle	Detected by conventional bronchoscopy Retrieval by forceps with bronchoscopy	Nil
Kunt <i>et al.</i> (2016) ⁽¹³⁾	69/male	Nonsmall cell lung cancer Metastatic nodal adenocarcinoma	22G Olympus ViziShot needle	Right paratracheal (4 right)		Needle lodged in bronchial mucosa	Lymph node stiffness caused by tumor infiltration	Removal unsuccessful Migration further to anterior segment of right lower lobe detected on CXR Spontaneous removal with coughing after 3 days	Significant endobronchial hemorrhage Acute respiratory failure requiring mechanical ventilation

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Supplementary Table 1: Contd...

Author/years	Age (years)/sex	Working or established diagnosis	EBUS needle used	Lymph node station sampled	Number of pass during occurrence of malfunction	Form of needle malfunction	Proposed reason(s) for malfunction	Management modality	Complications encountered if any to patient or equipment
Chalisse <i>et al.</i> (2016) ^[14]	65/male	Small cell carcinoma		Right paratracheal (4 right)	Third pass	Needle and guidewire still inserted in the right para tracheal position 2 cm from main carina even after withdrawal	Kinking of wire connected to needle during insertion into the working channel	Detection by conventional bronchoscope	Nil
Vial <i>et al.</i> (2016) ^[15]	57/male	Nonsmall cell carcinoma Stage III A	Not mentioned	Left paratracheal (4 left)	Not mentioned	Fracture located at the point where the catheter enters the handle of the needle apparatus	Retained needle fragment within the lymph node with mucosal thickening and inflammatory changes at same area	Successful removal as intact unit	Nil
Adamowicz <i>et al.</i> (2016) ^[16]	79/male	? infection or sarcoidosis	22G needle (expect slimline needle, boston scientific)	Subcarinal (7)	Second pass	Distal part of the needle embedded in the esophagus wall with proximal part attached to the needle sheet	Torqueing Multiple punctures Rigid lymph node	Detection by standard gastroscope	Mild para-esophageal pneumomediastinum
Zamora <i>et al.</i> (2017) ^[18]	52/male	Left hilar mass with lymphadenopathy? malignant		Left hilar (10 left)				Removed successfully with polypectomy snare, alligator forcep and endoscopic basket	Parietal hematoma Conservative management
Hanna <i>et al.</i> (2018) ^[17]	47/male	? metastasis B cell lymphoma of nasopharynx and mediastinum	22G Boston scientific needle	Left paratracheal (4 left)	Second pass	Malfunction of spring/coil mechanism of EBUS-TBNA needle leading to premature advancement of needle within the working channel		Damage recognized during sterilization of scope	Damage to working channel of bronchoscope
Rivero <i>et al.</i> (2019) ^[18]	63/male	Suspected malignancy in nodal enlargement Final - inconclusive	21G needle (NA-201SX-4021 model)	Subcarinal (station 7)		Broken needle tip lying between the carina and right main bronchus followed by rapid migration to the posterior basal segment of the right lower lobe	Tangential position of the needle requiring more angulation Harder than usual cartilaginous rings or lymph nodes	Confirmation by CXR Removal by bronchoscopy unsuccessful	Nil
de Yegga Sánchez <i>et al.</i> (2019) ^[19]	80/female	Stage IV lung adenocarcinoma	22G cook EchoTip® Ultra Endobronchial HD Ultrasound Needle	Right paratracheal (4 right) Subcarinal (7)	First pass in subcarinal (7)	Distal 1.5 mm portion of the needle placed in the medial wall of the intermediary bronchus and remained outside despite the proximal portion being extracted	Manufacturing defects of the needle	Removal by spontaneous coughing in decubitus position	Nil
						Distal 1.5 mm portion of needle breakage and embedded in lateral wall of carina		Retrieved successfully by bronchoscopy	Retrieved successfully by radial jaw forceps

Contd...

Supplementary Table 1: Contd...

Author/years	Age (years)/sex	Working or established diagnosis	EBUS needle used	Lymph node station sampled	Number of pass during occurrence of malfunction	Form of needle malfunction	Proposed reason(s) for malfunction	Management modality	Complications encountered if any to patient or equipment
Goel <i>et al.</i> (2019) ⁽⁹⁾	43/male	Tuberculosis	21G Olympus ViziShot needle (model NA-201SX-4021)	Subcarinal (station 7)	First pass	Needle assembly malfunction due to separation of shaft of needle and sheath-sliding mechanism resulting in failure to retract the needle within the sheath	Excessive load on the aspiration needle tip created by forceful pushing by assistant at the same time when operator was pulling the needle out	Detection of malfunction during the procedure Removed in one piece	Nil
Uchimura <i>et al.</i> (2019) ⁽²⁰⁾	81/male	Lung adenocarcinoma	22G Olympus ViziShot needle (model NA-201SX-4022)	Subcarinal (station 7)	Second pass	Distal 13 mm of the needle broken and stuck in the right main bronchus with considerable bending	Excessive load on the aspiration needle tip created by forceful pushing by assistant at the same time when operator was pulling the needle out Reduction of durability of needle by pulling out the stylet Puncturing of hard lymph node	Confirmation by conventional bronchoscopy Successful removal with alligator forceps under conventional bronchoscopic guidance	Nil
Current case	58/male	Biopsy from mass lesion - Squamous cell carcinoma Subcarinal lymphadenopathy - No atypical cells	22G cook EchoTip® Ultra Endobronchial HD Ultrasound pro-core Needle	Subcarinal (station 7)	Third pass	Broken needle fragment of length 15 mm which was localized in the lateral wall of carina		Confirmation by conventional bronchoscopy Successful removal with alligator forceps under conventional bronchoscopic guidance	Nil

CXR: Chest X-ray, EBUS: Endobronchial ultrasound, EBUS-TBNA: EBUS-guided transbronchial needle aspiration, PET: Positron emission tomographic, CT: Computed tomography