Case Report

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. 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. EBUS-TBNA now preferred over mediastinoscopy because of safety, cost-effectiveness and less invasiveness. 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. A survey from Japan
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]$_{\text{max}}$-16.4) as well as subcarinal lymph node (SUV$_{\text{max}}$-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 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:](image_url) (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) 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 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.\(^{[11,12,14,16-20]}\) Unsuccessful attempts were also reported where fragments migrated to dependent lobes of lung which were expelled by spontaneous coughing\(^{[6,13,17]}\) 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,\(^{[6]}\) 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 and 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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| Author/years | Age | Sex | Working or established diagnosis | Lymph node station sampled | Number of pass during occurrence of malfunction | Form of needle malfunction | Proposed reason(s) | Management modality | Complications encountered if any to patient or equipment |
|-------------|-----|-----|---------------------------------|---------------------------|---------------------------------------------|--------------------------|-------------------|-------------------|----------------------------------------------------------|
| Dhillon & Yendamuri (2013) | 43 | male | Prior renal cell carcinoma with metastasis | Right paratracheal (4 right) | First | Needles assembly malfunction in both cases | Manufacturing defect, excess force of needle insertion into the array | Detection of malfunction after removal of needle from the EBUS scope, removed in both cases as single piece | Nil in both cases |
| Özgül et al. (2014) | 62 | male | Incidental mediastinal widening on CXR | Subcarinal (7) | Subcarinal (7) | Needle assembly malfunction in both cases | Manufacturing defect, kinking of weaker or thinner dimpled area | Decision by EBUS scope, removal in both cases as single piece | Nil in both cases |
| Sharma et al. (2015) | 55 | male | Prior treated case of rectal carcinoma and lung | Right hilar (10 right) | Right hilar (10 right) | Needle assembly malfunction in both cases | Manufacturing defect, kinking of weaker or thinner dimpled area | Decision by conventional bronchoscopy, retrieval with forceps | Nil in both cases |
| Tariq (2016) | 74 | male | Prior treated case of rectal carcinoma as well as left upper lobe moderately differentiated lung adenocarcinoma | Subcarinal (station 7) | Subcarinal (station 7) | Needle assembly malfunction in both cases | Manufacturing defect, kinking of weaker or thinner dimpled area | Decision by conventional bronchoscopy, retrieval with forceps | Nil in both cases |
| Kurti et al. (2016) | 69 | male | Normal cell lining and metastatic nodules | Right paratracheal (4 right) | Right paratracheal (4 right) | Needle assembly malfunction in both cases | Manufacturing defect, kinking of weaker or thinner dimpled area | Decision by conventional bronchoscopy, retrieval with forceps | Nil in both cases |
| 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 |
|----------------------------------|-----------------|------------------------------------------|----------------------------------------|---------------------------|-----------------------------------------------|---------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|---------------------------------------------------------------------------|---------------------------------------------|
| Chalise et al. (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 |
|                                  |                 |                                          |                                        |                           | Fracture located at the point where the catheter enters the handle of the needle apparatus                  | Fracture located at the point where the catheter enters the handle of the needle apparatus |
|                                  |                 |                                          |                                        |                           |                                | Kinking of wire connected to needle during insertion into the working channel                 | Weakening and fracture of affected area during needle deployment                  | Detection by conventional bronchoscope                                      | Nil                                                                 |
| Vial et al. (2016)[15]           | 57/male         | Nonsmall cell carcinoma                  | Right paratracheal (4 left)            | Not mentioned             | Retained needle fragment within the lymph node with mucosal thickening and inflammatory changes at same area |
|                                  |                 |                                          |                                        |                           | Retained needle fragment within the lymph node with mucosal thickening and inflammatory changes at same area |
|                                  |                 |                                          |                                        |                           |                                | Detection by PET-CT and EBUS Retrieval unsuccessful Observation                             | Detection by PET-CT and EBUS Retrieval unsuccessful Observation                             | Nil                                                                 |
| Adamowicz et al. (2016)[16]      | 79/male         | ? infection or sarcoidosis                | Subcarinal (7)                         | Second pass               | Distal part of the needle embedded in the esophagus wall with proximal part attached to the needle sheet |
|                                  |                 |                                          |                                        |                           | Distal part of the needle embedded in the esophagus wall with proximal part attached to the needle sheet |
|                                  |                 |                                          |                                        |                           |                                | Detection by standard gastroscope Removed successfully with polypectomy snare, alligator forcep |
|                                  |                 |                                          |                                        |                           |                                | Damage recognized during sterilization of scope Spontaneous expulsion of spring like structure of needle apparatus by coughing after 2 days |
|                                  |                 |                                          |                                        |                           |                                | Damage to working channel of bronchoscope                                                  | Damage to working channel of bronchoscope |
| Zamora et al. (2017)[18]         | 52/male         | Left hilar mass with lymphadenopathy? malignant | Left hilar (10 left)                  | Malfunction of spring/ coil mechanism of EBUS-TBNA needle leading to premature advancement of needle within the working channel |
|                                  |                 |                                          |                                        |                           | Malfunction of spring/ coil mechanism of EBUS-TBNA needle leading to premature advancement of needle within the working channel |
|                                  |                 |                                          |                                        |                           |                                | Detection by CXR Removal by bronchoscopy unsuccessful Removal by spontaneous coughing in decubitus position |
| Hanna et al. (2018)[19]          | 47/male         | ? metastasis B cell lymphoma of nasopharynx and mediastinum | Left paratracheal (4 left)             | 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 |
|                                  |                 |                                          |                                        |                           | 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 |
|                                  |                 |                                          |                                        |                           |                                | Confirmation by CXR Removal by bronchoscopy unsuccessful Removal by spontaneous coughing in decubitus position |
| Riviero et al. (2019)[20]        | 63/male         | Suspected malignancy in nodal enlargement Final - inconclusive | Subcarinal (station 7)                 | Distal 15 mm portion of the needle placed in the medial wall of the intermediary bronchus and remained outside despite the proximal portion being extracted |
|                                  |                 |                                          |                                        |                           | Distal 15 mm portion of the needle placed in the medial wall of the intermediary bronchus and remained outside despite the proximal portion being extracted |
|                                  |                 |                                          |                                        |                           |                                | Detection by CXR and conventional bronchoscopy Retrieved successfully by bronchoscopy    | Nil                                                                 |
| de Vega Sánchez et al. (2019)[21]| 80/female       | Stage IV lung adenocarcinoma              | Right paratracheal (4 right)           | First pass in subcarinal (7) | Distal 15 mm portion of needle breakage and embedded in lateral wall of carina |
|                                  |                 |                                          |                                        |                           | Distal 15 mm portion of needle breakage and embedded in lateral wall of carina |
|                                  |                 |                                          |                                        |                           |                                | Detection by conventional bronchoscopy Removed successfully by radial jaw forceps            | Nil                                                                 |

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 *et al.* (2019) | 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 | Detection of malfunction during the procedure Removed in one piece | Nil |
| Uchimura *et al.* (2019) | 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 | 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