ORIGINAL ARTICLE

Safety and yield of blind pleural biopsy using Tru-cut needle in exudative pleural effusion

Fazal Akbar FCPS (Med), MRCP, FCPS (Pul); Salah Matti MD, MRCP

Abstract:

Introduction: Pleural biopsy is a vital diagnostic tool for investigation of an exudative pleural effusion. Biopsy performed with image guidance is commonly recommended but blind procedure is equally safe and effective. We investigated safety and efficacy of using Tru-cut cutting needle to biopsy pleura without image guidance for investigation of undiagnosed exudative pleural effusion.
Methods: Patients with undiagnosed moderate size unilateral exudative pleural effusion were included. Samples obtained were sent for histology and mycobacterial cultures. Subjects with inadequate samples or non-diagnostic results were referred for CT guided or thoracoscopic biopsies. Diagnosis and outcome was studied at 3years following the procedure.
Results: 27 patients underwent biopsy, with adequate pleural samples obtained from 24 patients (89%). With blind technique, 37% had underlying malignancy, 22 % chronic inflammation and 4% granulomatous infection with overall sensitivity of 74%. Two third (10/15) of patients with malignant effusion at 3 years were picked up by Tru-cut biopsy at presentation. All patients tolerated procedure with no immediate or late complications.
Conclusion: Pleural biopsy with Tru-cut needle is a safe and effective method of investigation of an undiagnosed exudative pleural effusion.

Introduction:

In adults newly developed exudative pleural effusions where there is no evidence of an acute infection, further investigations are mandatory to exclude malignancy or tuberculosis. Common cause in industrialised countries is malignancy whereas tuberculosis is the leading agent in developing world however this proportion is changing due to the risk factors of smoking and asbestos exposure[1, 2]. Sensitivity index for pleural fluid cytology is low and the diagnostic yield improves when combined with pleural tissue, examined histologically and cultured for mycobacteria[3-5].

Since its introduction several decades ago pleural biopsy has become a standard procedure in investigating pleural tuberculosis and malignancy [6, 7]. Commonly biopsies are performed by closed technique without image guidance using reverse bevel needle, such as Abrams or Cope needle. Both techniques and needles have been evolving to improve the yield [8-10]. Image guidance improves sensitivity [11-13] but requires cost in resources and skills. Thoracoscopy remains the gold standard as the biopsy site is selected under direct vision but involves higher risk and more complications[14, 15].

Blind pleural biopsies have varied sensitivity from 24%-66% using Abrams needle[3, 16,17]. Complications of pneumothorax, haemothorax and accidental breaking of needle have been described[3, 18]. Other needles like Raja and Cope needles have

similar rate of success[9, 19]. Cutting needles are used frequently to biopsy pleura under image guidance with superior sensitivity[10, 11]. We studied the safety and efficacy of Percutaneous use of Tru-cut needle in performing pleural biopsy blindly without image guidance in subjects with undiagnosed unilateral exudative pleural effusion. The complications were noted and the final clinical outcome at 3 years was a benchmark for diagnosis.

Methods:

Study setting and patient selection:

Study was performed prospectively at a district general hospital (Royal United Hospital, Bath, UK). All patients included had a moderate size effusion on chest X-ray occupying >25% of the ipsilateral pleural cavity and had pleural fluid protein content >35G/L, in whom there was no clinical suspicion of infection or pulmonary embolism. Patients excluded were those with: (1) bilateral effusion (2) transudative pleural fluid (3) cardiac failure (4) hypoalbuminaemia (5) bleeding diathesis and (6) patients who had malignant cells in pleural fluid.

Biopsy needle and procedure technique:

Biopsies were performed with Tru-cut needle 14Ga. TWx 4.5" (11.4cm) with centimetre depth markings, 20 mm specimen notch (Allegiance Healthcare Corporation, McGaw Park, USA). Procedure was performed by one of the two investigators (FA or SM). All patients were consented and positioned sitting with arms and head resting on an overbed table. Site of biopsy was identified clinically, where there was an uncertainty about best site for biopsy then ultrasound scan was deployed. With sterile technique 10 ml of lignocaine was infiltrated into skin, intercostal muscle and parietal pleura in the space one intercostal space below the upper level of maximum dullness in the scapular line. Presence of pleural fluid was confirmed by aspirating while anaesthetising the parietal pleura. A skin depth stab incision was made just above the lower rib. Needle was introduced in an open position just above the lower rib and advanced tangentially inward, downward and laterally until a sensation of "giving way" was felt. The needle was withdrawn about 0.5 centimetre back and biopsy was performed. Samples were taken until a good core specimen was obtained. On average 3-4 specimens were sent in formalin for histology and one sample in saline for mycobacterial cultures as recommended[20, 21]. Patients were observed for bleeding and a chest X-ray was performed after 4-6 hours to exclude a pneumothorax. All patients with confirmed mesothelioma had received radiotherapy to the biopsy site for preventing tumour growth along the needle tracks.

Tissue samples with no pleural tissue were regarded as *"inadequate"*. Samples with malignant histology were analysed further with cytochemistry and immunostaining to confirm the underlying histological diagnosis. If there was suspicion of malignancy but firm conclusion could not be made, the sample was labelled *"non-contributory"* and the patient was referred for further investigations.

Other investigations:

All patients underwent a CT scan examination of their chest and upper abdomen. In addition to the normal full blood count, clotting profile, inflammatory markers and serum biochemistry serological tests for collage vascular diseases were also performed in cases where the biopsy report was inflammatory. Where there was no evidence found of either granulomatous disease or malignancy on closed biopsy,

patients were referred for Video Assisted Thoracoscopic Surgery (VATS) and biopsy or CT guided biopsy. Those patients where there was no definite diagnosis made, were followed up for any recurrence of effusion or appearance of malignant or tuberculous disease. Data was available for 3 years post procedure.

Results:

27 patients fulfilled inclusion criteria and underwent pleural biopsy. 9 female and 18 male, age range 54-91 (median age 76). All patients tolerated the procedure with no vasovagal reaction, bleeding, pneumothorax or iatrogenic infection.

Specimens from 24 patients had adequate pleural tissue for histological analysis: biopsy success rate 89%. The histological diagnoses in these patients are listed in Table-1.

Table-1

Diagnosis on blind biopsy	n=27
Malignant disease	10 (37%)
Tuberculosis	1 (4%)
Chronic inflammation	6 (22%)
Pleural fibrosis	3 (11%)
Inadequate specimen	3 (11%)
Non-contributory	1 (4%)
Normal pleura	3 (11%)

3 patients with chronic inflammation and all subjects with pleural fibrosis were explored further with thoracoscopic biopsies due to their risk factors. VATS biopsies in these patients confirmed histological appearances similar to blind biopsies. Remaining 3 patients with chronic inflammation were observed. One had previous trauma to chest wall a year ago, another had positive serum Rheumatoid factor, and the third refused further investigations. All patients with chronic inflammation and pleural fibrosis remained asymptomatic with no indication of malignancy or tuberculosis after 3 years follow-up.

Patients whose blind biopsies were inadequate (n=3), non-contributory (n=1) or showed normal pleura (n=3), were sent for further examination either with thoracoscopy (n=6) or CT guided biopsy (n=1). One patient was confirmed as Non-small cell carcinoma (CT-biopsy) and 2 with mesothelioma (VATS biopsy). Of remaining 4 patients who had negative VATS, 2 developed malignancy with recurrence of effusion on follow-up (10 months and 18 months later): a mesothelioma and an undifferentiated carcinoma.

15 patients were confirmed malignancy in this study, 13 at presentation and 2 with follow-up. The 15 malignant causes were 6 mesothelioma, 3 non-small cell carcinoma, 3 adenocarcinoma, one plasmacytoma / myeloma, one undifferentiated carcinoma and one breast carcinoma. Blind biopsies with tru-cut could confirm only 10 of them. Sensitivity was 67 % for all malignant cases at 3 years follow-up but if we were to exclude those confirmed at follow-up the sensitivity for malignant diseases at presentation would be 10/13 (77%).

Only one patient was found to have an epitheloid granuloma on closed blind biopsy and this was confirmed tuberculosis by mycobacterial culture of pleural tissue.

Discussion:

We have shown the blind closed percutaneous technique using tru-cut needle is a safe and sensitive method. It confirmed the diagnosis of either malignancy or

tuberculosis and prevented 47% of cases with exudative pleural effusion to undergo investigations like thoracoscopy with known hazards.

The samples were adequate in 89% and diagnostic in 74% (20/27) as all patients with chronic inflammation or fibrosis did not change the histological diagnosis either with thoracoscopy or at follow-up. The yield improved further by 13% through thoracoscopy mainly in those where the samples were inadequate or suspicious but not confirmatory of malignancy on blind biopsies. 2 patients were not diagnosed despite had all the investigations but manifested 10 months and 18 months later. CT guided biopsy was performed in only one patient as this technique was not routinely used prior to 2003 in this hospital.

Walshe et al[5] in their audit showed a satisfactory biopsy specimen in 19/25 (76%) patients however the adequacy of the sample was higher in the study by Christopher and colleagues[23]. Both studies were cross sectional and did not include the follow-up data and the true sensitivity for diagnosis of malignancy could not be established. If we were to look at the yield for malignancy at presentation in this study the result of 77% is similar to others[5, 23, 24]. The diagnostic yield in this study with tru-cut needle relates favourably to others when using Abrams needle performed blindly[4, 5, 12]. This may be because of higher risk of crushed artefacts and small sample size[22] with Abrams needle.

Since the incidence of tuberculosis is low in this part of England, only one case was confirmed to be due to tuberculous pleurisy. Similar results of low incidence of tuberculous effusion has been reported by Maskell et al[12]. The yield of tru-cut pleural biopsy has been confirmed to be high for tuberculosis (75-100%) in other studies performed in tuberculosis prevalent countries[23, 24] and hence it is equally valuable in diagnosis of tuberculous effusion.

Patients who had chronic inflammatory effusions or pleural fibrosis had benign disease on follow-up and remained well after 3 years. A similar proportion of benign undiagnosed effusions have been noted in other studies[4, 5,12,23]. Only one patient had positive rheumatoid factor in our population although immunological tests were performed in all patients in this group.

One of the limitations is the small number of patients included. Large randomised controlled trials are required to compare the different needles used through blind technique. With superior results using image guidance most of the centres would proceed to perform either CT or Ultrasound guided biopsies however in developing countries this technique is still widely used. The diagnostic yield also is influenced by the experience of the operator and the number of times the biopsy is repeated. We did not repeat the blind biopsy in any of our patients and operators in this study learnt the skills just before the study. Further experience in this technique would improve the success and yield of pleural sampling. Automatic tru-cut cutting needle needs less dexterity and requires further evaluation.

There were no immediate or late complications found in our patients and the procedure was well tolerated by all subjects. The procedure was equally safe when tru-cut needle was used by blind technique inserted perpendicular to the skin[23]. Abrams needle has been associated with pneumothorax and haematoma[3]. Due to considerable morbidity and mortality associated with thoracoscopy and the additional resources required for image-guided biopsy, blind pleural biopsy is still a safe and cost effective and use of tru-cut needle is superior in their yield. However further large controlled studies are required to compare Tru-cut needle with Abrams and other needles by blind technique.

Conclusion:

Our study shows that blind tru-cut cutting needle biopsy is safe and effective initial line of investigation for undiagnosed exudative unilateral pleural effusion. Those with negative pleural biopsies should be sent for further investigations including CT guided biopsy or thoracoscopy. Experience and skills are expected to improve the sensitivity further.

References:

1) Thun M, Luiz da Costa e Silva V. Introduction and overview of global tobacco surveillance in Shafey O, Dolwick S and Guidon E (eds). Tobacco Control country profiles, 2nd Ed. American Cancer Society, Atlanta, GA, 2003, pp 302-3
2) Jehan N, Hamidullah S, Ahmad I, Javed A. RS/GIS database and epidemiological studies of malignant mesothelioma and asbestosis in North Pakistan. Proceeding GIS 2002 International conference. March 11-13, 2002, Le Royal, Meridien, Bahrain, P 267-281
3) Maskell NA, Butland RJA on behalf of the British thoracic society standards of care committee: BTS guidelines for the investigation of a unilateral pleural effusion in adults. Thorax 2003; 58(Suppl II): ii8-ii17
4) Prakash UB, Reiman HM. Comparison of needle biopsy with cytologic analysis for the evaluation of pleural effusion: analysis of 414 cases. Mayo Clin Proc 1985; 60: 158-64.
5) Walsh AD, Douglas JG, Kerr KM, McKean ME, Godden DJ. An audit of the clinical investigation of pleural effusion. Thorax 1992; 47: 734-7
6) DeFrancis N, Klosk E, and Albano E. Needle biopsy of the parietal pleura. N Engl J Med 1955; 252:948-49
7) Abrams LD. A pleural biopsy punch. Lancet 1958; 1: 30-1
8) Cope C. New pleural biopsy needle. JAMA 1958; 167: 1107-08
9) Kirsch CM, Kroe M, Jensen WA, Kagawa FT, Wehner JH, and Campagna AC. A modified Abrams needle biopsy technique. Chest 1995; 108: 982-86
10) Ogirala RG, Agarwal V, Vizioli LD, Pinsker KL, Aldrich TK. Comparison of the Raja and the Abrams pleural biopsy needles in patients with pleural effusion. Am Rev Respir Dis 1993; 147(5): 1291-4
11) Adams RF, Gleeson FV. Percutaneous image-guided cutting-needle biopsy of the pleura in the presence of a suspected malignant effusion. Radiology 2001; 219: 510-14
12) Maskell NA, Gleeson FV, Davies RJO. Standard pleural biopsy versus CT-guided cutting-needle biopsy for diagnosis of malignant disease in pleural effusions: a randomised controlled trial. Lancet 2003; 361: 1326-31
13) Diacon AH, Schuurmans MM, Theron J, Schubert PT, Wright CA, Bolliger CT. Safety and yield of ultrasound-assisted transthoracic biopsy performed by pulmonologists. Respiration 2004; 71: 519-522
14) Harris RJ, Kavuru MS, Rice TW, et al. The diagnostic and therapeutic utility of thoracoscopy. A review. Chest 1995; 108: 828-41.
15) Blanc FX, Atassi K, Bignon J, Housset B. Diagnostic value of medical thoracoscopy in pleural disease: A 6-year retrospective study. Chest 2002; 121: 1677-1683

16) Edmondstone WM. Investigation of pleural effusion: comparison between fibreoptic thoracoscopy, needle biopsy and cytology. Resp Med 1990; 84: 23-26
17) Poe RH, Israel RH, Utell MJ, Hall MJ, Greenblatt DW, Kallay MC. Sensitivity, specificity and predictive value of closed pleural biopsy. Arch Intern Med 1984; 144: 325-8
18) Chang DB, Yang PC, Lee LN, Luh KT. Metallic weakness and breakage of Abrams pleural biopsy needle. Chest 1991; 99(2): 524
19) Morrone N, Algranti E, Barreto E. Pleural biopsy with Cope and Abrams needle. Chest 1987; 92: 1050-2
20) Kirsch CM, Kroe DM, Azzi RL, Jensen WA, et al. The optimal number of pleural biopsy specimens for a diagnosis of tuberculous pleurisy. Chest 1997; 112: 702-06
21) Jimenez D, Perez-Rodriguez E, Diaz G, Fogue L, Light RW. Determining the optimal number of specimens to obtain with needle biopsy of the pleura. Respiratory Medicine 2002; 96: 14-17
22) Ogirala RG, Agarwal V, Aldrich TK. Raja pleural biopsy needle. A comparison with the Abrams needle in experimental pleural effusion. Am Rev Respir Dis 1989; 139: 984-7
23) Christopher DJ, Peter JV, Cherian AM. Blind pleural biopsy using a Tru-cut needle in moderate to large pleural effusion-An experience
24) McLeod DT, Ternouth I, Nkanza N. Comparison of the Tru-cut biopsy needle with the Abrams punch for pleural biopsy. Thorax 1989; 44: 794-6