The Use of Computerised Tomography Guided Percutaneous Fine Needle Aspiration in the Evaluation of Solitary Pulmonary Nodules

Abstract:

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Abstract

The evaluation of a solitary pulmonary nodule (SPN) has changed over the years with increased access to percutaneous computed tomography (CT) guided fine needle aspiration (FNA), where bronchoscopy is unhelpful. The aim of our study was to evaluate the sample adequacy, diagnostic and complication rate of CT-FNA of a SPN at our academic teaching hospital over an 18 month period. CT-FNA was performed by a radiologist, with a cytopathologist in attendance to determine the adequacy of the sample obtained. The size of the nodule, sample material and any complications were recorded. Overall the sensitivity of CT-FNA in the evaluation of pulmonary nodule was 93%; the specificity was 99% with Positive predictive value of 99% and Negative predictive value of 67% (Figure 3). Pneumothorax was the most common complication that occurred in 26/101 (26%) patients post CT-FNA, of these 7 (27%) required chest drain insertion, while 19 (73%) were managed conservatively. CT FNA is a useful tool for the diagnosis of a SPN, with our diagnostic accuracy comparable to other studies reported in literature. However, CT-FNA may not provide adequate sample volume to perform ancillary testing and has a moderate complication rate.

Introduction

Percutaneous lung biopsy was initially described in 1883 in order to diagnose pneumonia. However, the procedure has some limitations to obtain adequate sample size and is without morbidity, and rarely mortality. One of the most common complications is pneumothorax which is 15%. Furthermore, it is best practice that an experienced cytopathologist is in attendance at the time of sampling to confirm adequate sampling and appropriate processing of the specimen. CT-FNA may not provide adequate sampling to perform additional immunocytochemistry that is often necessary to subdivide non-small cell carcinoma into either squamous cell carcinoma or adenocarcinoma. In addition testing for epidermal growth factor receptor (EGFR) gene mutation has become important in a subset of non-small cell carcinomas and currently requires a tissue biopsy for analysis. The aim of our study was to evaluate the diagnostic accuracy, complication rate and sample adequacy with the use of CT-FNA where bronchoscopy and sputum cytology is unhelpful in determining the pathology of a SPN.

Methods

A retrospective analysis was performed of all patients who had percutaneous CT-FNA for a SPN, at the Adelaide & Meath Hospital (AMNCH) from Jan 2007 to June 2009. Informed consent was obtained before the procedure which was performed by an experienced interventional radiologist. A 22 gauge Chiba needle was used for sampling with computerized scan of thorax. The CT-scanner was a toshiba multislice 64 (model aquilion tsx-101a). Each needle path was visualized to the pleura and the shortest possible distance to the SPN was chosen. Procedures were performed under local anaesthesia without conscious sedation.

A cytopathologist was present during all procedures and prepared direct air-dried smears stained with a modified Giemsa stain to assess the nature and adequacy of the sample obtained. The specimens were then taken to the laboratory for processing and if deemed necessary additional immunocytochemistry was attempted on cytospin slides to further characterize the lesion. All malignant cases were categorised as small cell carcinoma or non-small cell carcinoma (NSCLC) and the latter were sub-classified into squamous cell carcinoma, adenocarcinoma or undifferentiated large cell carcinoma. The specimen was defined as non-diagnostic if no malignancy was seen and no specific benign diagnosis could be made. The specimen was categorised as suboptimal, if insufficient material was present to perform ancillary immunocytochemistry. After the procedure a chest x-ray was performed. If a small, asymptomatic pneumothorax developed, it was managed conservatively. If the patient had a large or symptomatic pneumothorax a chest tube was inserted. All results were discussed at a multidisciplinary lung cancer meeting.

Results

101 patients were included in the study. The mean age was 69+11 (range 36-88yrs). 54(54%) were male (Figure 1). The median size of the lesion was 2.3cm (range 1-11cm). 59(56%) patients had right sided whereas 45 (45%) had left sided lung lesion. Lesions in the upper lobes were more common. There were 26(101)(26%) in the left upper lobe, 17(101)(17%) in lower left lobe, 25(101)(25%) in right upper lobe and 23/101(23%) in right lower lobe and 8/101(7%) in right middle lobe.

CT-FNA was diagnostic in 80% (80/101) patients and non-diagnostic in 20% (21/101) patients. In 70% (70/101) of the patients, the diagnosis was primary lung carcinoma. Of these adenocarcinoma was diagnosed in 35%, squamous cell carcinoma in 14%, undifferentiated large cell carcinoma in 18%, and small cell carcinoma in 3%. Non-malignant lesions were diagnosed in 10% (10/101). Benign neoplasms were diagnosed in 2%, Aspergilloma in 1%, organising pneumonia 1%, and others in 6% (metastatic breast carcinoma in 3, renal cell carcinoma in 1). The CT-FNA was non-diagnostic in 20% (21/101) patients. They were followed up and discussed at a multidisciplinary lung cancer meeting. 57% (12/21) were proven benign on subsequent biopsy and follow-up imaging, 29% (6/21) turned out malignant on further biopsy and 14% (3/21) did not have further specimens obtained. Within the CT-FNA patients that were diagnostic, 25% (20/80) were suboptimal for additional immunocytochemistry which resulted in a failure to subtype NSCLC.

Overall the Sensitivity of CT-FNA in the evaluation of pulmonary nodule was 93%; the Specificity was 99% with Positive predictive value of 99% (Figure 3). Pneumothorax was the most common complication that occurred in 26% (26/101) post CT-FNA of these 7(27%) required chest drain insertion and 19(73%) were managed conservatively. There was no mortality or other serious complications in our group (Figure 4).

Discussion

CT-FNA is a valuable tool in the diagnosis of a SPN, the sensitivity and specificity of CT-FNA in the diagnosis of SPN was 93% and 99 percent, respectively, which is comparable to other studies reported in literature. The presence of a cytopathologist during the CT-FNA procedure may improve the diagnostic quality and accuracy, as in our study, which concurs. A previous study has shown that the diagnostic accuracy was 99% in the group where a cytopathologist was present, compared to 88% where the gross appearance was judged for adequacy of the sample obtained by the radiologist without on-site cytopathological evaluation. Moreover, the training experience of the cytopathologist as has been demonstrated in a study, where the diagnostic quality and efficacy was not affected by the training experience of cytopathologist. Immediate cytological evaluation not only adds the certainty of having obtained adequate sample, but also reduces the number of passes which in turn reduce the risk of pneumothorax and hospital stay. However, this practice is not consistent across institutions, and depends upon the availability of a cytopathologist and cost issues.

In order to obtain definitive tumour typing additional material is often necessary for ancillary immunocytochemistry.
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Definitive subtyping of non-small cell lung cancer (NSCLC) has important therapeutic and prognostic implications and thereby requires tissue biopsy. However, conventional diagnostic practice in patients with a non-squamous NSCLC. A prior study has reported that 76% of CT-FNA samples, when assessed on-site by a cytopathologist were adequate for tumour typing, a finding similar to that seen in our study. These again suggest that cytopathology was not available in 22%. A further study, where CT-Core Tru-cut biopsy with coaxial needle was used, found 100% success rate in achieving samples adequate for detailed immunohistochemical staining and EGFR gene mutation analysis. Moreover, data on 123 patients, who had CT-guided core biopsy with coaxial needle, found a diagnostic yield of 99.7% for CT Core Tru-cut biopsy therefore may improve diagnostic quality by obtaining larger sample size to perform immunohistochemistry compared to CT-FNA but a drawback of this approach is the absence of on-site evaluation by a pathologist to ensure adequate and viable tissue.

Pneumothorax is the most common complication. In our study 26% developed pneumothorax and only 7% required a chest drain insertion which is similar to rates observed in other studies. Various factors influence the rate of pneumothorax, including age, sex, lung function the presence of emphysematous bullae, size, depth, trajectory to access the lesion, pleural contact and location of the lesion, and procedure related variables such as needle, imaging used and experience of operator. The optimal time to do a chest radiograph post-procedure is not clear. Pneumothorax usually occurs immediately, a further 9% are detected by chest radiography 1 hour after biopsy, and an additional 2% are detected at 4h. In a study of 673 patients who underwent percutaneous transthoracic needle biopsy, no pneumothorax developed more than 4 hours after the procedure. Therefore, the potential hazard of undetected pneumothorax leads some clinicians to request chest radiograph at 4 hours. In a further study of 458 patients, the incidence of delayed pneumothorax was 3.3%. Female gender and the absence of an emphysematous change were identified as risk factors for delayed pneumothorax.

Therefore patients should be warned about the potential for chest pain and increasing breathlessness and the importance of seeking urgent medical advice. Immediate chest radiograph should be performed if patients develop acute respiratory symptoms. Less common complications with CT-guided lung biopsy, although not found in our study, were reported as 0.061% with air embolism, 0.061% with pulmonary haemorrhage, 0.092% with haemothorax and 0.10% with tension pneumothorax.

In summary CT-FNA is a both a sensitive and highly specific technique in the diagnosis of lung carcinoma but may not be sufficient to allow definitive sub-type of NSCLC and therefore does not allow for EGFR mutation analysis, particularly if histologically inconclusive. Pneumothorax is the most common complication, if suspected, should be evaluated with post procedure chest radiograph. With the development of a new national cancer programme in Ireland, there is a need to establish consistency in the standards for the commonly practiced procedure in the pathway to diagnosis. It is recommended that CT-guided biopsy of bronchoscopically inaccessible lung tumours should be the primary diagnostic procedure to be considered. However CT-FNA can be an alternative in patients deemed not suitable to this approach but the procedure requires expertise from both radiology and cytopathology departments to achieve a high diagnostic performance.

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