DOES GAUGE OF NEEDLE EFFECTS CAUSATION OF PNEUMOTHORAX FOLLOWING ULTRASOUND GUIDED THORACENTESIS?

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ABSTRACT

Objective: To determine the frequency of pneumothorax following ultrasound guided thoracentesis in our department and its association with gauge of needle in causation of pneumothorax.

Methadology: This is descriptive cross sectional study conducted at the Department of Diagnostic and Interventional Radiology, Shifa International Hospital (SIH), Islamabad from January 2010 to April, 2012. A total of 359 ultrasound guided thoracentesis were performed followed by a chest radiograph between January 2010 and April, 2012 fulfilling the inclusion criteria. All procedures were performed by radiology consultants and residents. Generally 18 and 16 G cannulas were used. A few were done with 16 and 18 G spinal needle and 21G syringe needle. Relevant data was collected from hospital data base system on the performa and was analyzed for demographic variables, frequency of pneumothorax, and its association with operator's experience (residents or consultants) and gauge of needle by applying chi square test. P value of < 0.05 was considered significant.

Results: 309 patients had thoracocentesis while performed by residents and 50 by consultants. Pneumothorax occurred in 22 of these 359 cases with an overall frequency of 6 %. In 219 patients 18 G cannula was used and 8 of these developed pneumothorax (3.6%). In 94 patients 16 G cannula was used. Pneumothorax occurred in 11 (11.6%). Statistical analysis confirmed that the frequency of pneumothorax was significantly increased following use of 16G as compared to 18G (p=0.02).

Conclusion: The frequency of pneumothorax following ultrasound guided thoracentesis increases significantly with use of 16G as compared to 18G (p=0.02).

Key Words: Ultrasound, pneumothorax, thoracentesis.

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INTRODUCTION

Aspiration of pleural fluid for diagnostic and therapeutic purpose is performed by thoracocentesis[1]. Technically, this procedure is relatively simple, well tolerated and quite safe; however complications related to thoracocentesis are not uncommon[2]. One of the most common complications is pneumothorax. Thoracentesis represents one of the most frequent causes of iatrogenic pneumothorax[3]. Ultrasound was first described as a technology to guide thoracentesis in 1986[4]. Since then a number of studies have been published showing significant reduction in frequency of pneumothorax as compared to blind procedure[5,6,7,8]. The routine use of ultrasonography during thoracentesis has been shown to reduce the frequency of pneumothorax by 19% in one study[9].

There are certain other factors which have been shown to affect the frequency of pneumothorax in ultrasound guided thoracentesis. Position of the patient during procedure can affect the frequency rate of pneumothorax[10]. Patient's clinical status has also been considered one factor. The risk of pneumothorax increases in patients on mechanical ventilator as compared to stable patients. The amount of pleural fluid aspirated has also been associated with occurrence of pneumothorax i.e. larger the volume aspirated, higher is the chances of pneumothorax[11]. Last but not the least, is gauge of

needle. The smaller the size and gauge of needle, lesser will be chances of pneumothorax[7]. There is no published data from our country regarding the frequency of post-thoracentesis pneumothorax and various factors related to it. Identification of modifiable or preventable factors can help to minimize the risk of development of pneumothorax after thoracentesis. This study was conducted to determine the frequency of pneumothorax following ultrasound guided thoracentesis in our department.

METHODOLOGY

All patients were prepared and draped in standard fashion after marking the skin over the deepest pocket of pleural fluid. Ultrasound with transducer frequency of 3.5 MHz was used for guidance. Local anesthetic was infiltrated into the track. Before procedure it was verified that patient's International Normalization Ratio (INR) was normal. The type of needle used was based on operator's preference. Different needles used were 18G & 16G cannula, 18G & 16G spinal needles and 21G syringe needles. The posture of patient during procedure was dependant on clinical status of patient. Sitting posture was preferred in stable patients while lateral or semi-lateral posture of patient was adopted in clinically unstable patients. After completion of thoracentesis every patient had chest radiograph to look for pneumothorax as part of departmental protocol.

A descriptive cross sectional study was conducted at the Department of Radiology Shifa International Hospital from January to April 2010. A total of 359 patients were included in the study through consecutive non probability sampling.

The record of these patients was reviewed in hospital data base system and their data was collected in performa. The data was entered into SPSS version 16 and analyzed for demographic variables, frequency of pneumothorax, and its association with operators experience as well as gauge of needles with frequency of pneumothorax. Descriptive statistics were calculated. Chi square test was used to determine the association of pneumothorax with the operator's experience and guage of the needles, keeping p value < 0.05 as significant.

RESULTS

Among 359 patients 60.5% (n=217) were males and 39.5% (n=142) were females. The mean age of population was 54.5 years with age range of 8 to 91 years. The pneumothorax rate was 6% (22/359). Eight out of 219 (3.6%) cases were complicated when 18G cannula was used while 11 out of 94 (11.6%) patients suffered pneumothorax when 16G cannula was used. Remaining 3 cases of pneumothorax were seen in a group of 46 patients in whom spinal needles and 21G syringe needles were used. The frequency of pneumothorax was increased significantly with 16G cannula as compared to 18G (p=0.02).

DISCUSSION

Generally the use of ultrasound has significantly decreased the frequency of pneumothorax following thoracentesis. However certain factors have been identified which affect the frequency of pneumothorax in such patients. In a systematic way, these factors can be categorized into those related to the patient, the operator and to the instruments used. Patient related factors include clinical status of patient, spontaneous or mechanical ventilation, amount of pleural fluid and ability of patient to maintain proper posture. Operator related factors include selecting appropriate pleural fluid pocket and direction of needle. Those related to appliances are size and gauge of needle and resolution of ultrasound. Among these factors; gauge of needles was studied and is discussed here.

The overall frequency of pneumothorax varies from centre to centre[12]. Colt et al described pneumothorax frequency of 5.4% in his study on 255 patients[13]. Jones et al observed pneumothorax in 24 thoracentesis out of 941(2.5%)[6]. Raptopoulos et al found 3 cases of pneumothorax out of 188 ultrasound guided thoracocentesis with frequency of 3%[7]. In our study, in 22 out of 359 patients pneumothorax occurred with overall frequency of 6%. This increased frequency in our study is due to use of wider bore needles (16 G associated with 11.6%) used in our patients as opposed to narrow bore needles in the other studies (mostly 20 and 22 G)[13]. Secondly the amount of pleural fluid and its consistency may be a reason as majority of our cases had large pleural effusions. Although the exact amount of fluid aspirated was not entered in every case,the reported aspirated quantities were mostly greater than 500 ml.

An important consideration is the gauge of needle used to aspirate pleural fluid. Different needles can be used in thoracentesis such as spinal needles, intravenous cannulas and 21G syringe needles. We commonly use 18 G and 16G cannula, while spinal needles are used in much selected cases where due to increased skin thickness cannula cannot reach the pleural cavity. 21G syringe needle were mostly used for diagnostic pleural taps where amount of less than 50 ml was aspirated. Since number of patients in which spinal needles and 21G syringes were employed were small. The statistical significance of their role could not be determined.

In our study we found statistically significant high rate of pneumothorax with wide bore cannula i.e 16 G cannula as compared to 18 G cannula (p=0.02). This observation is further strengthened by study of Colt et al[13] who documented the pneumothorax rate of 5.4% using 22 and 20 G needle for thoracentesis as compared to

Table 1: Comparison of frequency of pneumothorax in various studies with needles used.

Study	Sample size	Frequency of Pneumothorax	Gauge of needle/ canula used	P value for pneumothorax versus gauge of needle
Colt et al [13]	255	5.4%	20 and 22 G mostly	-
Jones et al [6]	941	2.5%	-	-
Raptopoulos et al[7]	188	3%	20 and 22G	-
Our Study	359	6%	18 and 16 gauge mostly	0.02

3.6% with 18G and 11.6% with 16G cannula in our study. [Table 1] Furthermore 1 case was with 16G LP, 29 with 18G LP and 16 with 21G syringe with a pneumothorax rate of 0%, 6.9% and 6.3% respectively. In the light of our findings we have now introduced a modification in our department procedure and recommend that only 18 G cannula should be routinely used in ultrasound guided thoracocentesis whereas 16 G cannula and spinal needles should be used only in those cases where due to technical factors thoracocentesis is not possible by 18 G cannula.

Since this was a retrospective study, other factors such as patient's clinical status, position of patient during procedure, amount of fluid aspirated and number of punctures could not be studied. This is a limitation of our study.

CONCLUSION

The frequency of pneumothorax following ultrasound guided thoracocentesis using 16G cannula was significantly greater as compared to that using 18G cannula.

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CONTRIBUTORS

IR conceived the idea, did data collection and wrote the manuscript. SSC and AR helped in data collection. MA helped in the write up of manuscript. AK did the data analysis. AIR supervised the study. All authors contributed significantly to the final manuscript.