Comparison of Pleural Fluid Culture Sensitivity by using Blood Culture bottles and Sterile Syringes in patients having Parapneumonic Effusions and Empyema Thoracis

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MNA KW TM conceived idea, MNK KW drafted the study, MNK MS collected data, MNK MJ AK did statistical analysis and interpretation of data, MNK MJ AK TM critical review manuscript, All approved final version to be published.

Declaration of conflicting interests

The authors declare that there is no conflict of interest.

Abstract

Background: Pleural effusion is a common clinical problem encountered in both the developed as well as in developing countries. They can develop either due to a pulmonary or an extra pulmonary disease. Even use of various medications can lead to development of pleural effusion. Parapneumonic effusions are frequently seen in patients with Complicated pneumonia.

Objective: To compare the frequency of pleural fluid culture sensitivity by using blood culture bottles and sterile syringes in patients having parapneumonic effusions and empyema thoracis.

Methodology: It was a Cross sectional analytical Prospective study conducted at the Department of Pulmonology, Sheikh Zayed Hospital, Lahore. The duration of study was 6 months from July 2016 till December 2016. Pleural fluid was aspirated under ultrasound guidance and was sent to the laboratory. Reports were assessed and pleural fluid culture was labeled as positive or negative and organism isolated along with their antibiogram was also mentioned.

Results: The mean age of our patients was 43.34±11.73 years. The male to female ratio was 1.5:1. Empyema was documented in 27(30%) of our patients whereas 63(70%) had parapneumonic effusion. Positive aerobic infection in blood culture bottle was seen in 48 patients, as compared to 26 patients in the sterile syringes. Statistically significant difference was found between the culture positive rate in aerobic blood culture bottle with sterile syringes(p-value=0.001).

Conclusion: It is concluded that the positivity of pleural fluid culture is higher in blood culture bottles as compared to sterile syringes in patients having parapneumonic effusions and empyema thoracis.

Keywords: Pleural Effusions; Blood Culture Bottles; Sterile Syringes; Parapneumonic Effusions

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Introduction

Pleural effusion is a frequent cause for seeking medical attention in both the developed as well as in developing countries and various pulmonary and extra pulmonary disorders result in the formation of pleural effusions.[1] In cases of transudative pleural effusions the underlying pathology is treated whereas in exudative effusions, the diagnosis and treatment both remain a challenge for the pulmonologist.[2]

An Infective complication of pneumonia, lung abscess or bronchiectasis can result in the formation of parapneumonic effusion.[3] Bacterial pneumonia when treated inadequately, can complicate and result in the development of parapneumonic effusion or empyema thoracis.[4] Invasion of the pleural space with bacteria results in Empyema thoracis, which is basically accumulation of pus within the pleural cavity. Empyema thoracis is one of the severest of diseases ever known. Despite the advancement in the antimicrobial therapy and innovations in various procedures for the drainage of the pleural space, both parapneumonic effusion and empyema thoracis still are a huge cause of morbidity and mortality in the world.[3,4]

Recently, a marked increase of interest in the pathology of pleural diseases and in publications related to them has been witnessed due to advancement in both the antimicrobial therapy and newer evolving procedures both for empyema and pleural infections.[5] Routinely in pleural infections Gram stain and cultures are indicated for confirmation of their etiology.[6] Pleural fluid specimens are obtained with the help of a needle and syringe under aseptic conditions and under ultrasound guidance. For complete analysis, about 20 to 40ml of pleural fluid/pus is required. It includes biochemical analysis, cytological examination and when an infection is suspected microbiological studies are performed.[7] When this aspirated pleural fluid is inoculated into blood culture bottles at the bedside and sent for microbiological studies, its diagnostic yield is thought to increase,[8,9] as the incidence of pleural infections is on the rise in the world so is their associated morbidity and mortality.[10]

For appropriate clinical care, culture of pleural fluid is imperative for the identification of the infecting bacteria so that specific antimicrobial therapy can be prescribed. But as conventional Gram stain and Culture are negative in about 40% of cases, therefore this organism specific approach often becomes unsuccessful. Thus these patients are treated with empirical antibiotics that cover the spectrum of likely pathogens, which has many disadvantages including polypharmacy. Anaerobic antibiotic coverage is given empirically, as anaerobes are often a cause of pleural infections and are mostly not detected by standard laboratory culture.[11]

Rationale of this study is to compare pleural fluid culture sensitivity in blood culture bottles versus sterile syringes in patients having parapneumonic effusions and empyema thoracis. Through international literature, it has been noticed that blood culture bottles show high yield for detection of pathogens as compared to standard 5ml syringes in empyema/parapneumonic effusion. This practice is not universal and is still not recommended in the standard guidelines. In routine we use syringes for sending the pleural fluid cultures in our local setups. Multiple international studies advocate that syringes have a low pathogen detection rate as compared to blood culture bottles, moreover no local evidence is available in this regard. We conducted this study to evaluate the positive pleural fluid cultures observed in both the standard 5ml syringes and blood culture bottles in our local setup, so that a more reliable method for transportation and therefore detection of pathogens and their antibiogram in case of empyema /parapneumonic effusions in our population could be obtained.

Methodology

It was a cross sectional (analytical) prospective study conducted at department of Pulmonology Sheikh Zayed Hospital /FPGMI, Lahore. The duration of study was 6 months from July 2016 till December 2016.

Ninety patients were included in the study by using non probability consecutive sampling. Admitted patients requiring pleural drainage for parapneumonic effusion/empyema thoracis were included in the study. Patients with tuberculous pleural effusion, transudative pleural effusions and malignant pleural effusions were excluded.

After the approval from the Ethical Committee of the Sheikh Zayed hospital the study was conducted in the Department of Pulmonology. Briefing about nature of study was given to each patient and written consent was obtained. Chest radiograph of the patient was utilized to assess the pleural fluid collection and to quantify the volume of pleural fluid collection as small, moderate, large or massive pleural effusion.

Then pleural fluid was aspirated under aseptic measures under ultrasound guidance in the procedure room of Department of Pulmonology, Sheikh Zayed hospital Lahore. The diagnostic pleural fluid was collected in a 50 ml syringe with a fine bore (21G) needle. The pleural fluid sample was divided into two equal parts; one part in sterile syringe and

remaining part in blood culture bottles. All the collected samples were sent to the microbiology laboratory. Strict quality control measures were adopted during transportation of the fluid.

The samples were sent to the laboratory at room temperature within half an hour of pleural aspiration and were inoculated within next one hour. Reports were assessed and pleural fluid culture was labeled as positive or negative and organism isolated along with their antibiogram was mentioned.

All the data was entered and analysis was done by using IBM SPSS 21. Quantitative variables like age and duration of disease were described as using mean±standard deviation. Percentage and frequency were calculated for qualitative variables like gender and pleural fluid culture (positive/ negative). In both the groups, frequency of positive pleural fluid culture was compared by using chi-square test. p-value ≤ 0.05 was considered as significant.

Results

Ninety patients were enrolled in this study. Mean age of the patient was 43.34±11.73 years with minimum age of 17 years and maximum age of 73 years. Out of 90 patients 54 (60%) patients were males and 36 (40%) patients were females and the male to female ratio of was 1.5:1. In this study the mean value of duration of illness of the patients was 14.26±5.69 days with minimum and maximum values of 2 & 21 days respectively. The study results showed that the patients with diagnosis of empyema were 27 (30%) and the patients with diagnosis of parapneumonic effusion were 63 (70%) and the left sided location of the disease was noted in 35 (38.9%) patients and right sided location was noted in 55 (61.1%) patients. In our

Table 3. Comparison of Lipid Profile with age groups

Variable	Frequency (%)
Age (years) Mean ± SD	43.34±11.73
Gender	54 (60%)
Male	36 (40%)
Female	14.26±5.69
Duration of symptoms (days) Mean±SD Diagnosis	
Empyema	27 (30%)
Parapneumonic effusion	63 (70%)
Location	
Left	35 (38.9%)
Right	55 (61.1%)
Size	
Massive	01 (1.1%)
Large	20 (22.2%)
Moderate	56 (62.2%)
Small	13 (14.4%)
Parenchymal infiltrate	
Present	45 (50%)
Absent	45 (50%)
Loculations	
Present	15 (16.7%)
Absent	75 (83.3%)
Specimen in aerobic blood culture bottle	
Culture positive	48 (53.3%)
Culture negative	42 (46.7%)
Specimen in anaerobic blood culture bottle	
Culture positive	02 (2.2%)
Culture negative	88 (97.8%)
Specimen in sterile syringe	
Culture positive	26 (28.9%)
Culture negative	64 (71.1%)

Table 2. Comparison of aerobic culture bottle with sterile syringe

Pleural fluid aerobic culture	Blood Culture Bottle Total 90		Sterile syringe Total 90	
	Positive	Negative	Positive	Negative
	48	42	26	64

P-value=0.001*

Table 3. Comparison of anaerobic culture bottle with sterile syringe

Pleural fluid aerobic culture	Blood Culture Bottle Total 90		Sterile syringe Total 90	
	Positive	Negative	Positive	Negative
	2	88	0	90

P-value=1.000 NS

study large size pleural effusion was found in 20(22.2%) patients, massive pleural effusion in 1 (1.1%) patients, moderate pleural effusion in 56(62.2%) patients and small pleural effusion in 13 (14.4%) patients. Parenchymal infiltrate was present in 45(50%) patients and were absent in 45(50%) patients. Loculations were present in 15(16.7%) patients and were absent in 75(83.3%) patients.

In this study also showed that blood culture bottles with positive aerobic organisms were found in 48(53.3%) patients and it was found negative in 42(46.7%) patients whereas blood culture bottles with positive anaerobic organisms were found in 2(2.2%) patients and it was found negative in 88(97.8%) patients. In comparison pleural fluid samples sent in routine sterile syringes showed positive culture in 26(28.9%) patients and were negative in 64(71.1%) patients (Table 1).

In this study the blood culture bottle positive aerobic organisms were noted in 48 patients of which 26 were also found positive in the sterile syringe. Pleural fluid culture was negative in 42 patients in the blood culture bottles and similarly these 42 samples were also found to be negative in the sterile syringe. Statistically significant difference was found between the aerobic blood culture bottles with sterile syringes. i.e. p-value=0.001 (Table 2).

The blood culture bottle positive anaerobic organisms were noted in 02 patients and both were also negative in sterile syringes, similarly the blood culture bottle negative anaerobic organisms were noted in 88 patients. Statistically insignificant difference was found between the anaerobic blood culture bottles with sterile syringe i.e. p-value=1.000 (Table 3).

Discussion

Infection of the pleural space (either complicated parapneumonic effusion or empyema) is an oldest medical issue, and its first recorded description was found in the medical texts of ancient Greece. Each year approximately four million people are affected by pneumonia, and about half of them develop a parapneumonic pleural effusion which is a common complication of pneumonia. Infection of the pleural space is a major cause of morbidity or mortality, and its incidence is continuously rising in adults and children.

Isolation of the invading bacteria by culture of pleural fluid is important for better clinical care. This often remains unsuccessful because conventional Gram stain and culture are negative in 40% of the cases.[10,11,12] Because of the presence of charcoal-containing medium, better bacterial culture yield for pleural effusion can be obtained by using blood culture bottles, while the standard sterile syringes do not have such medium.[4,13,14]

In our study the blood culture bottle positive aerobic organisms were found in 48(53.3%) patients, the blood culture bottle positive anaerobic organisms were found in 2(2.2%) patients and the culture positive sterile syringes were noted in 26(28.9%) patients. Statistically significant difference was found between the aerobic blood culture bottles with sterile syringe. i.e. p-value=0.001 and insignificant difference was found between the anaerobic blood culture bottles with sterile syringe. i. e p-value=1.000.

Findings of Surapan Charoentunyarak et al are similar to our findings as they concluded that the blood culture bottle method was more effective than the standard sterile syringe method for the isolation of bacterial pathogens in parapneumonic pleural effusion and empyema thoracis. The yield of pleural

fluid culture by using the standard sterile syringe was 14.0%, whereas the yield by using blood culture bottles was 24.0% (P < 0.001) in their study.

The findings of our study are further endorsed by a Canadian study, Menzies et al who found that when the pleural fluid culture was sent in blood culture bottles positive pleural fluid cultures was obtained in 58.5% of the patients in comparison to standard 5ml syringes which revealed a positive results in 37.7% of patients. Moreover study findings of Ferrer A are consistent with previously described studies as they also reported blood culture bottle to increase the culture positivity from 44% to 64%.[15] However organisms of pneumonia and the causes of parapneumonic pleural effusion may be slightly different between Asian and the Western countries.[16,17]

Conclusion

It is concluded that the positivity of pleural fluid culture is higher in blood culture bottles as compared to sterile syringes in patients having parapneumonic effusions and empyema thoracis.

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