Etiology of pleural effusion among adults in the State of Qatar: a 1-year hospital-based study

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أسباب الانصباب الجنبي بين البالغين في قطر: دراسة استطلاعية أجريَت في المستشفيات على مدى عام كامل

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الخلاصة: لم يتم إجراء أي دراسات منهجية للأمراض التي تسبب الانصباب الجنبي في قَطَر. وقد شملت هذه الدراسة الاستطلاعية التي أجريَت في المستشفى جميع المرضى البالغين (> 15 عاماً) الذين يعانون من الانصباب الجنبي، وتم قَبُولُهم في مستشفيات الإحالة على مدى عام كامل، وتم تحديد ما مجموعه مِئَتَا (200) حالة تعاني من الانصباب الجنبي (152 من الذكور و48 من الإناث)، وكان متوسط أعمارهم 45.1 سنة (انحراف معياري ± 18.5)، ومعظمهم (73.5٪) من غير القَطَرِيِّين، حيث إن غالبيتهم من القارة الآسيوية. وكان أكثر أسباب الانصباب الجنبي شيوعاً هو السل (32.5٪) يليه الالتهاب الرئوي (19٪) والسرطان (15.5٪) ثم الفشل القلبي (13٪). أما السبب الرئيسي لحدوث الانصباب الجنبي جرّاءَ مرض خبيث فقد تمثَّل في السَّرَطانة القصبية المنشأ (38.7٪)، في حين أن الجراثيم الإيجابية الغرام كانت أكثر المستفرَدات وجوداً في السائل الدُّبَيْلي (الانصباب القيحي) (62.5٪). وقد تبيَّن أن الفحص الهيستولوجي ومزرعة الخزعة الجنبية هي من أنفع الوسائل في تشخيص الانصبابات السُّلِّيَّة المنشأ، في حين أن الفحص السيتولوجي المتكرر للسائل الجنبي والخزعة الجنبية هما الأكثر جدوى في حالات الانصباب الجنبي الخبيث.

ABSTRACT There have been no systematic studies of diseases causing pleural effusion in Qatar. This prospective, hospital-based study involved all adult patients (> 15 years) with pleural effusions who were admitted to referral hospitals over a 1-year period. A total of 200 cases of pleural effusion were identified (152 males and 48 females); mean age 45.1 (SD 18.5) years. A majority of patients (73.5%) were non-Qataris, mostly from the Asian subcontinent. The most frequent cause of pleural effusions was tuberculosis (32.5%), followed by pneumonia (19%), cancer (15.5%) and cardiac failure (13%). The most frequent cause of malignant effusion was bronchogenic carcinoma (38.7%), whereas Gram-positive organisms were the most frequent isolates from empyema fluid (62.5%). Histological examination and culture of pleural biopsy were the most useful diagnostic workup for tuberculosis effusions, whereas repeated cytological examination of pleural fluid and pleural biopsy were most useful for malignant effusions.

Étiologie de l'épanchement pleural chez des adultes dans l'État du Qatar : étude hospitalière sur un an

RÉSUMÉ Il n'existe pas d'étude systématique des maladies à l'origine d'un épanchement pleural au Qatar. La présente étude prospective hospitalière portait sur tous les patients adultes (âgés de plus de 15 ans) atteints d'un épanchement pleural et admis dans des hôpitaux de recours pendant un an. Au total, 200 cas d'épanchement pleural ont été identifiés chez 152 hommes et 48 femmes, âgés de 45,1 ans en moyenne (E.T. 18,5). La majorité des patients (73,5 %) n'étaient pas qatariens, mais originaires principalement du sous-continent asiatique. Les causes les plus fréquentes d'épanchement pleural étaient la tuberculose (32,5 %), la pneumonie (19 %), le cancer (15,5 %) et l'insuffisance cardiaque (13 %). La cause la plus fréquente d'un épanchement pleural malin était un carcinome pulmonaire (38,7 %), et les bacilles à Gram positif étaient les isolats les plus fréquemment observés dans le liquide de l'empyème (62,5 %). Un examen histologique et la culture de la biopsie pleurale étaient les éléments les plus utiles pour l'élaboration du diagnostic d'épanchement tuberculeux, alors qu'un examen cytologique répété du liquide pleural et de la biopsie pleurale convenait mieux pour le diagnostic des épanchements malins.

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Received: 10/06/09; accepted: 16/12/09

Introduction

Pleural effusion is an abnormal collection of fluid in the pleural space. The etiologic spectrum of pleural effusion depends on the geographical region and the local incidence of different diseases that cause pleural effusions. In developed countries the common causes of pleural effusions in adults are cardiac failure, malignancy and pneumonia [1,2], whereas in developing countries tuberculosis and parapneumonic effusions are more prevalent [3–6]. There is a lack of information about the etiology of pleural effusions in most Arab countries including Qatar. Only a few studies have been conducted, in Saudi Arabia, Lebanon and Iraq. Tuberculosis was the most frequent cause of pleural effusions in these countries [5–7].

Although pleural effusion is a common clinical problem confronting physicians in Qatar, there has never been a systematic study of the diseases causing pleural effusion in this country. This prompted us to conduct this study to define the etiology of pleural effusions in the state of Qatar and to evaluate the roles of pleural fluid analysis and pleural biopsy in the diagnosis of malignant and tuberculous effusions.

Methods

Setting

A free national health care service for all nationals is the cornerstone of the health care programme in Qatar. In addition, free medical services are provided for expatriates and visitors examined at the accident and emergency department, without requiring any referral from a health centre. This prospective observational study was conducted at Hamad Medical Corporation, which serves as a tertiary referral centre. Hamad general hospital in Doha city and Alkhor hospital in the north area of the country are the 2 main hospitals within the Hamad Medical Corporation that are assigned to admit patients with pleural effusions.

Sample

This study involved all adult patients (> 15 years) with pleural effusions who were admitted to Hamad Medical Corporation from 1 January 2005 to 31 December 2005. Pleural effusions were diagnosed by clinical and radiological examination.

The study was approved by the research committee of Hamad Medical Corporation. Informed consent was obtained from each participant before any interview or clinical examination was conducted.

Diagnostic workup

Patients underwent thoracentesis in the first 24 hours after admission. Under aseptic conditions, a 16-gauge needle was used, and 100 mL samples of pleural fluid were collected and immediately sent to the biochemical, cytological and microbiological laboratories for analysis. At the same time, blood samples were taken for simultaneous pleural fluid and blood determination of the levels of total protein, albumin, lactate dehydrogenase and glucose.

Smears of pleural fluid were fixed and stained with haematoxylin and eosin and Papanicolaou stains, and microscopically examined for their cellular content. The sediment from pleural fluid was cultured for *Mycobacteria* spp. Pleural biopsy (with Cope needle) was sent to the microbiology and histopathology laboratories for the diagnosis of tuberculous and malignant pleural effusions. Three sputum samples were obtained from the patients and studied by Ziehl–Neelsen staining and Lowenstein culture. A tuberculin skin test with induration size ≥ 10 mm was considered to be a significant positive reaction.

Additional examinations were performed according to the clinical findings, including bronchoscopy, mammography, gynaecological examination, digestive tract endoscopy, abdominal ultrasonography, abdominal computerized tomography (CT) scan, bone scan, bone-marrow biopsy, fine-needle aspiration of the pulmonary mass, liver or lymph nodes and lung scintigraphy.

The following variables were collected on standard proformas: demographic data, pleural fluid analysis and etiology of pleural effusion.

Definitions

The criteria for the classification of the different types of effusions were as follows:

Tuberculous pleurisy

Pleural effusions were diagnosed as tuberculous if at least one of the following criteria were fulfilled: (1) caseous necrotic granulomas were found in pleural biopsy tissue samples, (2) Ziehl–Neelsen stains or Lowenstein cultures of pleural fluid or biopsy tissue samples were positive, or (3) histological findings of non-caseating granuloma were found with positive sputum for acid-fast bacilli (AFB) and/or positive tuberculin skin test, (4) there was clinical and radiological response to anti-tuberculosis treatment in the absence of bacteriological and histological confirmation of tuberculosis.

Parapneumonic effusion

Parapneumonic effusions were defined as pleural effusions associated with an acute febrile illness and cough, in which chest radiographs revealed pulmonary infiltrates and the patient responded to antibiotic treatment.

Empyema

Empyema was diagnosed when pus was present or microorganisms were isolated from the pleural aspirate.

Malignant effusion

Malignant and paramalignant effusion was diagnosed from malignant cells in the pleural fluid and/or pleura as demonstrated by cytological and/or histological studies. Paramalignant effusions were diagnosed when pleural biopsy specimens or pleural fluid

cytology specimens were negative and other known causes of pleural effusions were excluded in patients with a histologically-proven malignancy elsewhere.

Cardiac effusion

The diagnosis of cardiac effusion was suspected when the patient developed pleural effusion in the setting of clinical congestive heart failure with an enlarged heart, distended neck veins and cardiac gallop that improved with therapy for congestive heart failure. Cardiac failure was diagnosed clinically as well as by echocardiography.

Cirrhotic effusion

The diagnosis of cirrhotic effusion was suspected when the patient developed pleural effusion in the setting of clinical hepatic failure due to liver cirrhosis.

Nephrotic effusion & uraemic effusion

The diagnosis of nephrotic syndrome effusion was suspected when the patient developed pleural effusion in the presence of nephrotic syndrome (urine protein excretion rate of > 3.5 g/1.73 m^2 per 24 hours), while uraemic effusions occurred in a patient with uraemia for which there was no other explanation.

Lupus effusion

This was an effusion that occurred in a patient with systemic lupus erythematosus and negative bacterial cultures.

Idiopathic effusion

Pleural effusions whose causes were not established by any of the diagnostic tests (including 3 pleural biopsies) were classified as idiopathic.

Transudative and exudative effusions

Transudative and exudative effusions were defined according to Light's criteria.

Data analysis

Quantitative variables were expressed as mean, standard deviation (SD) and range. Student *t*-test was used for continuous variables and Mann–Whitney U test if quantitative variables were not normally distributed. Fisher exact or chi-squared tests were used when appropriate to compare data in different groups. Results were considered significant if the *P* value < 0.05. Statistical analysis was carried out using *Epi-Info 2000* software.

Results

Demographic data

During the study period, 200 cases of pleural effusion were identified. The mean age of the patients was 45.1 (SD 18.5) years (range: 16–99 years). There were 152 (76.0%) males with mean age 44.4 (SD 18.6) years and 48 (24.0%) females with mean age 47.4 (SD 18.2) years (M:F ratio was 3:1). Three-quarters of cases (147, 73.5%) occurred in non-Qatari residents, whereas 53 cases (26.5%) occurred in Qatari residents. Non-Qatari patients comprised 33 Indian (16.5%), 33 Nepali (16.5%), 14 Philippine (7.0%), 12 Bangladeshi (6.0%) and 9 Pakistani (4.5%), while the rest were from several other nationalities.

Etiology of pleural effusion

The most frequent cause of pleural effusion was tuberculosis in 32.5% of patients, followed by pneumonia (19.0%), cancer (15.5%) and cardiac failure (13.0%) (Table 1). In 3 cases (1.5%) we were unable to identify the cause of the effusion despite pleural fluid analysis, pleural biopsy, CT of the thorax and abdomen, and other investigations.

The mean age of Qatari residents was significantly higher than non-Qatari residents: 56.8 (SD 20.3) versus 40.9 (SD 15.9) years ($P < 0.001$). There were significant differences between Qatari and non-Qatari residents with respect to the cause of pleural effusion (Table 2). Cardiac failure was observed with a higher frequency in Qatari patients compared with non-Qataris ($P = 0.002$), whereas tuberculosis was observed more in non-Qatari than in Qatari patients ($P = 0.002$). Moreover, renal failure was observed with a higher frequency in Qatari patients compared with non-Qataris ($P = 0.043$).

Cardiac failure was observed with a higher frequency in elderly patients compared with younger patients, whereas tuberculosis was observed more in young than in elderly patients ($P < 0.001$) (Table 3).

Radiological test results showed effusions on the right side in 109 patients (54.5%), on the left side in 63 patients (31.5%) and on both sides in 28 patients (14.0%) (Table 4).

Table 1 Etiology of pleural effusions in patients attending tertiary referral centres in Qatar (*n* = 200)

Etiology or type of pleural effusion	No.	%	Age (years) Mean (SD)
Tuberculosis	65	32.5	33.7 (12.8)
Parapneumonic	38	19.0	43.3 (17.1)
Malignancy	31	15.5	53.4 (15.6)
Cardiac failure	26	13.0	65.0 (15.8)
Empyema	17	8.5	39.9 (9.8)
Liver cirrhosis	7	3.5	53.9 (9.8)
Chronic renal failure	6	3.0	60.3 (24.5)
Nephrotic syndrome	3	1.5	44.7 (28.5)
Paramalignant	3	1.5	51.7 (25.4)
Systemic lupus erythematosus	1	0.5	–
Unknown	3	1.5	53.7 (28.1)

SD = standard deviation.

Table 2 Comparison between Qatari and non-Qatari residents in relation to sex ratio, age group and etiology of pleural effusions (*n* = 200)

Variable	Non-Qatari (*n* = 147)		Qatari (*n* = 53)		*P*-value
	No.	%	No.	%	
Sex					
Male/female ratio	124/23	–	28/25		< 0.001
Age group (years)					
≥ 65	14	9.5	18	34.0	< 0.001
< 65	133	90.5	35	36.0	
Etiology					
Tuberculosis	59	40.1	6	11.3	0.002
Parapneumonic	27	18.4	11	20.8	0.860
Malignancy	23	15.6	8	15.1	0.890
Cardiac failure	11	7.5	15	28.3	0.002
Renal failure	2	1.4	4	7.5	0.043

Exudative and transudative pleural effusions

Most effusions were exudates (79.0%). The most common cause of exudative pleural effusion was tuberculosis (41.1%), whereas the most common cause of transudative pleural effusion was cardiac failure (62.0%) (Table 5).

Among exudative pleural effusions, tuberculous effusions were most frequent among younger patients, whereas malignant pleural effusions were most common among elderly patients (P = 0.003) (Table 6).

Tuberculous pleurisy was the cause of pleural effusions in 32.5% of our patients. Only 1 patient in our study was HIV-positive. Table 7 shows the sensitivity of each of the criteria used for the definitive diagnosis of tuberculous pleurisy. Pleural fluid direct smear for AFB was negative in all 65 patients while pleural fluid mycobacterial culture was positive in 24/65 patients (36.9%). In 2 patients (3.1%) the diagnosis of tuberculous effusion was based almost entirely on clinical judgement and the response to anti-tuberculous chemotherapy.

The most frequent cause of malignant effusion was bronchogenic carcinoma, followed by breast cancer, lymphoma and mesothelioma (Table 8). The primary lung carcinomas comprised adenocarcinomas 6/12 (50%), squamous cell carcinomas 5/12 (41.7%) and small-cell carcinoma 1/12 (8.3%).

Malignant pleural effusions were confirmed by positive pleural fluid cytology in 17/31 patients (54.8%), positive pleural biopsy in 6/31 (19.4%) and positive pleural biopsy and positive pleural fluid cytology in 7/31 (22.6%). With the first thoracocentesis, pleural fluid cytological examination was positive for malignant cells in 13/31 (42%). With the second thoracocentesis, pleural fluid cytological examination was positive for malignant cells in 24 (77.4%), whereas pleural biopsy was performed in only 18 patients and was positive in 13 (72.2%) (Table 8).

Of the 38 patients with parapneumonic effusion, blood cultures were positive in 9/38 patients (23.7%), which included the following isolates: *Strep. pneumoniae* isolated from 6/9 (66.7%) patients, *K. pneumoniae* from 2/9 patients (22.2%) and *Staph. aureus* from 1/9 (11.1%). On the other hand, of the17 patients with empyema, cultures of empyema fluid yielded bacterial isolates in only 8/17 patients (47.0%), which were mostly Gram-positive cocci: *Strep. melleri* 4/17 (23.5%), *K. pneumoniae* 2/17 (11.8%), *Escherichia coli* 1/17 (5.9%), *Staph. aureus* 1/17 (5.9%).

Cardiac failure was the common cause of transudative effusions, accounting for 62.0% of transudative effusions. Ischaemic heart disease was the most common cause of cardiac failure 21/26 (80.8%), followed by hypertension 3/26 (11.5%), and valvular heart diseases 2/26 (7.7%).

Discussion

The mean age of the patients in this study (45.1 years) was lower than those described in other studies [2,5,8–10]. Furthermore male patients predominated regardless of their nationality, which can be explained by the fact that Qatar and other Gulf countries have large working community composed mainly of young males.

Table 3 Type of pleural effusions by age group (*n* = 200)

Age group (years)	Tuberculosis (*n* = 65)		Pneumonia (*n* = 38)		Malignancy (*n* = 31)		Cardiac failure (*n* = 26)		*P*-value[a]
	No.	%	No.	%	No.	%	No.	%	
15–64	63	96.9	34	89.5	23	74.2	15	57.7	< 0.001
≥ 65	2	3.1	4	10.5	8	25.8	11	42.3	

[a] *Tuberculosis vs pneumonia vs malignancy vs cardiac failure.*

Table 4 Site of pleural effusions (n = 200)

Etiology or type of pleural effusion	Right-sided effusion		Left-sided effusion		Bilateral effusion		Total
	No.	%	No.	%	No.	%	No.
Tuberculosis	37	56.9	25	38.5	3	4.6	65
Parapneumonic	21	55.3	16	42.1	1	2.6	38
Malignancy	17	54.9	9	29.0	5	16.1	31
Cardiac failure	12	46.2	2	7.6	12	46.2	26
Empyema	10	58.8	7	41.2	0	0.0	17
Others	12	52.2	4	17.4	7	30.4	23
Total	109	54.5	63	31.5	28	14.0	200

Tuberculosis was the most common cause of effusions in our study which is comparable with reports from Saudi Arabia, India, Malaysia, Lebanon, Iraq, Ghana and Spain [3–10] but different from those reported in other developed countries and the Islamic Republic of Iran [1,2,11].

This could be explained by the fact that tuberculosis is still endemic in Qatar. It has an incidence rate of 60/100 000, and an average of 491 cases are diagnosed annually. In our study 90.8% of all patients with tuberculous effusions were expatriates, mainly from the Indian subcontinent. Poor socioeconomic conditions and stress were other contributing factors to the high incidence of tuberculosis among expatriates. The mean age of patients with tuberculous effusions (33.7 years) was lower than that of patients with other types of effusions, in agreement with previous reports [5–10].

Tuberculous pleurisy is either a primary disease or a reactivation of previous parenchymal lung tuberculosis. In developed countries, these effusions have been increasingly associated with reactivation of tuberculosis [12–14], whereas in developing countries tuberculous effusions are classically associated with primary tuberculous infection [15].

Although this study was not designed to classify tuberculous pleurisy as primary or reactivated tuberculosis, the low mean patient age together with the low association with pulmonary lesions in our study suggests that tuberculous pleurisy is still a primary disease, which is similar to that reported by Ibrahim et al. [15]

Table 5 Etiology of exudative versus transudative effusions

Etiology	No.	%
Exudative effusions		
Tuberculosis	65	41.1
Parapneumonic	38	24.0
Malignancy	31	19.6
Empyema	17	10.8
Paramalignant	3	1.9
Systemic lupus erythematosus	1	0.7
Unknown	3	1.9
Total	158	79.0
Transudative effusions		
Cardiac failure	26	62.0
Liver cirrhosis	7	16.7
Chronic renal failure	6	14.3
Nephrotic syndrome	3	7.0
Total	42	21.0

Pleural fluid mycobacterial culture had a higher sensitivity than direct smear for AFB, in agreement with many reports worldwide [3,5,6,9,10,16,17]. This could be explained by the fact that direct examination requires bacilli concentration of 10 000 /mL, whereas the culture only requires the presence of 10–100 organisms /mL [16]. Closed pleural biopsy using Cope needle was positive for caseating granulomas in 73.3% of our patients, which falls within the range of 51% to 83% described in many studies [14–18]. Pleural biopsy study for AFB was positive in 28.3% of our patients which is different from the rates reported in Lebanon, Malaysia and Spain [9,10,15,16], while pleural biopsy mycobacterial culture was positive in 81.7% of the cases, higher than the range of 40% to 76% described in the literature [13–20].

There was right-sided dominance of tuberculous effusions in our series which is comparable with many reports [2–15].

Parapneumonic effusion was the second most common cause of pleural effusions in our series; it had a tendency to afflict both older and younger age groups in agreement with many reports worldwide [8–11]. Parapneumonic effusions occur in about 40% of cases of bacterial pneumonias. Although these effusions have no tendency to affect any

Table 6 Type of exudative effusions by age group

Age group (years)	Tuberculosis (*n* = 65)	Pneumonia (*n* = 38)	Malignancy (*n* = 31)	*P*-value
15–64	63/2	34/4	23/8	0.003
≥ 65	2/63	4/34	8/23	

Table 7 Sensitivity of each of the criteria used for the definitive diagnosis of tuberculous pleurisy

Criterion	No. of positive/total cases	%
Pleural fluid		
Stain[a]	0/65	0.0
Culture[b]	24/65	36.9
Biopsy tissue		
Stain[a]	17/60	28.3
Culture[b]	49/60	81.7
Pleural biopsy		
Caseating granulomas	44/60	73.3
Non-caseating granulomas	9/60	15.0
Sputum		
Stain[a]	6/65	9.2
Culture[b]	15/65	23.0
Tuberculin skin test		
Positive	48/65	73.8

[a]*Ziehl–Neelsen;* [b]*Lowenstein.*

Table 8 Primary tumour associated with malignant effusions and sensitivity of each of the criteria used for the definitive diagnosis of malignant effusions

Variable	No.	%
Primary tumour		
Cancer of lung	12	38.7
Cancer of breast	5	16.2
Lymphomas	3	9.7
Mesothelioma	3	9.7
Cancer of ovary	2	6.5
Cancer of colon	1	3.2
Cancer of oesophagus	1	3.2
Cancer of uterus	1	3.2
Cancer of thyroid	1	3.2
Synovial sarcoma	1	3.2
Unknown	1	3.2
Total	31	100.0
Sensitivity of the diagnostic criteria		
Pleural fluid cytology positive	24/31	77.4
Needle pleural biopsy positive	13/18	72.2

particular side of the pleural cavity, our patients tended to have effusions on the right side.

Malignant pleural effusion was the third most common cause of effusions in this series, accounting for approximately 15.5% of all cases, which falls within the range of 14.7% to 48% described in the literature [21]. A majority of these patients were over 50 years of age, which is comparable with many reports from both developed and developing countries [1–11]. In agreement with previous reports, the most common place of origin of the tumour was the lung [2,5,8–11,22]. Direct tumour involvement of the pleura is most effectively diagnosed by pleural fluid cytology and/or pleural biopsy (open or closed). A single pleural fluid cytological study can detect 54% to 63% of malignancies; the yield increases to 77% when serial samples are processed [23–25]. In our study, serial cytological examination of pleural fluid for malignant cells was positive in 77.4% of patients, which is similar to previously reported results. When pleural fluid cytology is non-diagnostic for a suspected malignant effusion, pleural biopsy is recommended. Although the specificity of closed needle biopsy (Abrams or Cope needles) for malignant effusion is high, reported sensitivities range widely between 7% and 72% [26]. However, if it is available, medical thoracoscopy has been shown to have a higher sensitivity (approaching 100%) in a prospective trial comparing the 2 techniques [27]. In our series, closed pleural biopsy (via Cope needle) confirmed the diagnosis in 13/18 (72.2%) patients, which falls within the above mentioned range. No patient underwent thoracoscopy, because this facility was not available in our hospital during the period of study. There was right-sided dominance of malignant pleural effusion in our patients in agreement with the observations by others [5,10].

A total of 13% of our patients had cardiac failure, which is comparable with

reports from Saudi Arabia [5] but different from other reports from the Czech Republic, Spain, the United States of America and the Islamic Republic of Iran [1,2,8,11].

Cultures of empyema fluid in this series yielded bacterial isolates in 47.0% of cases, which falls within the range of 11% to 82% previously reported [28–32]. The spectra of the most common organisms isolated from empyema fluid have varied depending on the patient populations studied by other investigators. In contrast to recent reports [30–32] Gram-positive organisms were the most frequent isolates in our study accounting for 62.5% of all isolates. These results are consistent with previously reported figures [33–35]. *Streptococci melleri* was the most commonly encountered aerobic Gram-positive organism, which is similar to some reports in the literature [33].

There were significant differences between Qatari and non-Qatari patients with respect to the age and etiology of effusions. Qatari patients had a significantly higher mean age than did non-Qataris. This difference most likely reflects the demographic structure in Qatar, since the majority of non-Qatari residents were mainly young males. On the other hand, among Qatari patients, the most common cause of effusions was cardiac failure, which is comparable with reports from developed countries. Among non-Qatari patients who were mainly south Asians the most common cause of pleural effusion was tuberculosis, a finding which is comparable with reports from many developing countries and highlights the effect of lifestyle and socioeconomic status on determining the cause of effusions in the 2 groups.

Some limitations can be noted in our study. First, the study was hospital-based rather than population-based. However, our centre is the only referral centre in Qatar and therefore is likely to provide a true reflection of the actual burden of pleural effusion in the country. Secondly, the number of cases was small.

In conclusion, pleural effusion is a common clinical problem confronting physicians in Qatar. The most frequent cause of pleural exudates was tuberculosis, followed by pneumonic and malignancy causes, particularly lung cancer, whereas the most common cause of pleural transudate was cardiac failure. Histological examination and culture of pleural biopsy were the most useful diagnostic workup for tuberculosis effusions, whereas repeated cytological examination of pleural fluid and pleural biopsy were most useful for malignant effusions.

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