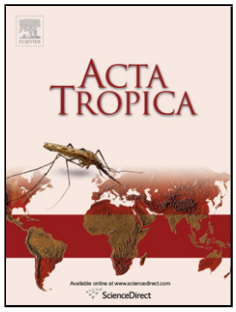

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A Retrospective Study of Human Cystic Echinococcosis in Basrah Province, Iraq

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Running Title: Human Hydatidosis in Iraq

Highlights

- Cystic echinococcosis (CE) continues to pose a threat to public health in Basrah, Iraq.
- Hospital recodes show higher incidences of CE cases in females and in in the age group between 21 to 30 years old.
- Liver and lung were the most affected organs.
- Reported solitary organ involvement was common in females' ovaries.
- Hospital data in Iraq suffer from quality and validity issues.

ABSTRACT

Human cystic echinococcosis (CE) is a parasitic zoonosis with serious clinical burden and constitutes a challenge to public health in endemic areas worldwide. We performed a retrospective study to investigate the occurrence of CE in patients at six hospitals in Basrah province, Iraq. In the current study setting, data retrieval and validation of the quality of hospital records was very challenging considering the difficult situation Iraq is unfortunately facing. Hospitalization records were reviewed from January 2005 to December 2015. A total of 748 cases of human with CE were diagnosed and operated in Basrah hospitals, equivalent to an annual clinical incidence of approximately 4.5 cases per 100 000 people. Hospital records show that, cystic echinococcosis affected more females (61.2%) than males (38.8%). Descriptive review of recorded CE cases in the surveyed hospitals revealed that more cases were reported in the age group of 21-30 years than in the other age groups. Based on the reviewed recorded clinical reports, cysts were mainly found in the liver (46.3%) and lungs (28.1%) of the patients. Hospital reports demonstrate that females had more hepatic cysts (63.9%) than males (36.1%). This study found that CE continues to pose a threat to public health in Basrah, and there is a need for more epidemiological investigations of CE in humans in order to determine risk factors and the economic impact of the disease in this province of Iraq.

KEYWORDS

Cystic echinococcosis; *Echinococcus granulosus*; Humans; Iraq; Basrah

1. INTRODUCTION

Human cystic echinococcosis (CE) is caused by the larval stage of *Echinococcus granulosus*, a helminth belonging to the cestode group. A number of herbivorous and omnivorous animals act as intermediate hosts of Echinococcus. They become infected by ingesting the parasite eggs in contaminated food and water, and the parasite then develops into larval stages in the viscera. Carnivores act as definitive hosts for the parasite, and host the mature tapeworm in their intestine. They are infected through the consumption of viscera of intermediate hosts that harbor the parasite (Budke et al., 2006). CE is principally maintained in a dog–sheep–dog cycle. Humans are an accidental intermediate host for this parasite, and are infected through ingestion of eggs released from dogs or other canids (Eckert and Deplazes, 2004). CE demonstrates a high predilection for the liver and lung. Clinical symptoms vary depending on the size and position of the cysts in the organ (Eckert et al., 2001; McManus et al., 2003). In the liver, the pressure effect of the cyst can produce symptoms of obstructive jaundice and abdominal pain. Involvement of the lungs produces chronic cough, dyspnea, pleuritic chest pain, and hemoptysis (Larrieu and Frider, 2001; Schantz, 2006).

The World Health Organization identifies human CE as one of the most important neglected zoonoses, as the disease continues to pose a serious socio-economic problem in many parts of the world (Budke et al., 2006). CE is highly endemic in most of the countries of the Mediterranean basin, including North Africa and the Middle East. The high endemicity of echinococcosis in the Mediterranean region has been attributed to many risk factors, such as a lack of adequate public health education, insufficient application of control programs, and the common practice of home slaughter of small ruminants (Dakkak, 2010).

The zoonotic nature and the serious clinical burden of CE make it important from public health and economic perspectives worldwide. High annual incidences of CE have been reported in Levant, the Persian Gulf, and Middle East countries (Sadjjadi, 2006) and the costs associated with the disease have a great impact on affected individuals, their families, and the community as a whole (McManus et al., 2003). For example, in Morocco, 1700 human surgical cases of CE (5.5 cases per 100 000 inhabitants) were recorded in 2003 and the average cost for surgical intervention was US $1500 per case (Azlaf and Dakkak, 2006). The overall annual cost of CE in Iran was estimated at US$232.3 million (95% CI US$103.1–397.8 million), including both direct and indirect costs (Rokni, 2008).

Human CE is endemic in Iraq, and the disease has been recognized from the number of patients that were admitted to the hospitals and treated surgically (Faraj and Muhsin, 2013; Jarjees and Al-Bakeri, 2012; Maktoof and Abu Tabeekh, 2015; Saida and Nouraddin, 2011). Higher number of cases of human CE have been recorded in the southern provinces of Iraq (Abdul Ameer et al., 2013; Thweni and Yassen, 2015), and in particular Basrah province (Thamir et al., 2015). Despite the substantial burden of the disease, national surveillance programs for CE do not exist in Iraq. The fragile health services in Iraq, after years of international economic sanctions and ongoing political and ethnic conflicts, are challenging for any organized efforts to combat endemic tropical and zoonotic diseases (Barnett-Vanes et al., 2016).

In common with several other neglected zoonoses, little is known on the prevalence and incidence of human CE in Iraq, and the resulting lack of awareness generates little interest for developing and implementing appropriate control programs. The aim of this study was to compile data from hospital records on human CE in Basrah province, as an attempt to characterize aspects of the disease in an endemic setting in southern Iraq.

2. MATERIALS AND METHODS

2.1. Study area and population

Basrah is the third largest province in Iraq and lies in the south of the country and borders Iran, Kuwait, and Saudi-Arabia. Its economy is largely dependent on the oil industry with some of Iraq's largest oil fields located in the province, and most of Iraq's oil exports leave from there. Basrah province has a desert climate with great temperature variations between the seasons and maximum temperatures of 50°C in summer. Basrah is in a fertile agricultural region, with major products including rice, maize corn, barley, pearl millet, wheat, dates, and livestock. The province had an estimated population of 1.5 million in 2012, with 20.1% of this rural (The NGO Coordination Committee for Iraq, 2013).

In Basrah province, there are 14 public and 5 private hospitals primarily located in urban areas. Only 8 of these hospitals offer surgical services, and of these 6 (5 public and 1 private) are equipped with the technical facilities and skilled surgeons to perform operations on human cases of CE. The study outlined in this manuscript was conducted at these 6 hospitals (Al-Sadar general hospital, Al-Basrah general hospital, Al-Faihaa general hospital, Al-Shifa general hospital, Al-Mawana general hospital, and Abin-Albaitar private hospital).

2.2. Data collection

Clinical records were reviewed for the 11 year period from 2005 to 2015 at the 6 hospitals. Data retrieval was very challenging; the majority was handwritten paper-based reports, there was no harmonized data collection style or forms, and there was not system in place to validate the quality of the kept hospital clinical records. The following data were extracted from the records and entered into excel sheets; age, gender, occupation, residency (urban vs. rural), and localization of cysts. Descriptive data analysis was performed using the

software STATA Ver.11 for Windows (Stata Press, College Station, TX, USA). Categorical variables were analyzed using the chi-square test for independence at a critical probability of $P < 0.05$.

2.3. Ethics statement

This research study was approved by the Human Ethics Review Committee of Murdoch University, Perth, Australia (Permission number: 2016/034). Official written approval forms the Ministry of Health in Iraq and from Basrah Health Directorate were obtained before commencement of the field work.

3. RESULTS

Reviewing the available clinical records revealed that a total of 748 human patients with CE were diagnosed and surgically operated at the 6 hospitals in the 11-year period from 2005 to 2015 (Table 1) giving an average of 68 cases per year. Using 2012 population data for Basrah (United Nations Development Program (Iraq Country Office), 2013) as an estimate of the hospitals catchment area, an annual clinical incidence of 4.5 cases/100 000/year was calculated. The highest number of CE cases (12.7%, 95% confidence interval (CI): 10.4, 15.3) was recorded in hospital reports of the year 2014, while the lowest (4.3%, 95% CI: 2.9, 5.9) was in 2005.

The age and gender distributions of patients with CE are summarized in Table 1. The largest share of patients with CE (26.9%) was in the 21-30 year-age-group. Based on our data, cystic echinococcosis was recorded more in females (61.2%) than males (38.8%). Housewife was the most frequently reported occupation listed for cases revealed from the hospitals records, and represented 53.9% of CE cases. The average age of patients with CE was 34.6 years (SD

16.6 years) (Table 2). The youngest patient operated on was only 6 months of age and the oldest 85 years.

The distribution of cysts in the body is summarized in Table 3. The two anatomical sites most commonly affected were the liver (46.3%) and lung (28.1%). Surprisingly, the reviewed hospital data indicate that 15.7% of CE cases among female patients were recorded in ovaries. Recorded cases in females had more hepatic cysts (63.9%) than males (36.1%), and both genders were equally affected by pulmonary cysts (Table 3). Our data show that the majority of CE cases featured with single organ involvement and with solitary cysts. Cysts were found in multiple organs of only 3.2% of patients and livers of male patients was commonly (7/24) involved (Table 3). Involvement of various atypical organs was evident, for instance 6 patients received surgery in the neck and 4 patients in vertebral column. Three patients received surgery due to cyst in brain, spinal cord, legs, thigh and pelvic region. Two cases were reported with cysts in testicles, scrotum, pancreas, shoulders, and thorax vertebrae.

4. DISCUSSION

Cystic echinococcosis is a cosmopolitan zoonosis, with highly endemic areas in regions of South America, China, the Middle East and North Africa (Dar and Alkarmi, 1997). Iraq is an important endemic focus of CE where several species of intermediate host (e.g. sheep, goats, camels, cattle and buffalo) are commonly infected with *E. granulosus* (Thweni and Yassen, 2015). This study demonstrated that CE poses an important threat to human health in south of Iraq, with a high incidence of hospitalized cases (4.5 cases/100 000/year). Such incidence estimate should be treated with caution, as data retrieval and quality validation of clinical records was very challenging in the surveyed 6 hospitals in Basrah, considering the difficult situation Iraq is unfortunately facing. The physical infrastructure of the health system in Iraq has deteriorated as a result of over 20 years of under-investment, poor management, war and conflict. There is no effective health information system, and reliable and high-quality epidemiological data is generally scarce in Iraq (Alwan, 2004). Compared to our results, a lower incidence of CE was reported in neighboring Iran with 1.18-3 cases per 100 000 population in different regions of the country (Rokni, 2008). Also lower annual incidence rates have been reported in some Arab countries including Jordan (2.3/100 000/ year) (Al-Qaoud et al., 2013), Libya (4.2/100 000/ year) (Shambesh et al., 1999), and in different governorates in Egypt (0.80–2.60 per 100 000/ year) (Kandeel et al., 2004). Although the data obtained from the hospital records are the most dependable source of information on human hydatidosis in many countries, it is likely that the true incidence of infection is higher due to underdiagnosing and underreporting of cases (Craig et al., 2007). In future work, it is important also to consider the impact of health-care migration in the study area, i.e. that a number of patients with CE going to other hospitals in nearby regions to be operated, and the vice versa where patients come from neighboring regions to be operated in Basrah hospitals. The presented information in this research on the rate of surgically operated

patients illustrates the magnitude of the public health burden of human CE in Basrah and provides evidence of the high infection pressure with *E. granulosus* in the environment in southern Iraq.

Many potential risk factors for human CE may be prevalent in Basrah governorate. A high prevalence (22%) of hydatid cysts has been reported in domestic sheep slaughtered in Basrah abattoirs (during 2006-2007), in addition 14.7% of stray dogs in Basrah city were infected with *E. granulosus* (Maktoof and Abu Tabeekh, 2015). Dogs with little or no veterinary attention and especially those found to be free-roaming and living in close proximity to people and their livestock are a crucial factor for maintaining the CE infection cycle (Acosta-Jamett et al., 2010; Buishi et al., 2005). Interestingly, a high infestation rate of 80% was found in dogs roaming around Basrah abattoir, which is hypothesized to be due to the frequent access of stray dogs to hydatid cysts discarded during meat inspection (Maktoof and Abu Tabeekh, 2015).

Although environmental conditions in Basrah province include a hot and arid climate, its location within the Persian Gulf, results in high humidity and rainfall. The province receives an average of 152mm of rainfall between the months of October and May (Hadeel et al., 2010). Less than half of the people connected to the public water network have water available for the full day. Covered canals are the source of waste water disposal for 26.7% of Basrah's inhabitants (The NGO Coordination Committee for Iraq, 2013). In the absence of plentiful potable water and widespread environmental contamination with dog feces, it is highly possible that drinking water is contaminated with *Echinococcus* eggs. A study in Jordan indicated that contaminated open source drinking water was an important risk factor for human CE infection (Dowling et al., 2000). In Iraq, the provision of clean water supplies declined in quantity and quality over the last two decades. Water supply and sewage

treatment plants were damaged during the wars, and raw sewage is released into the rivers directly (Alwan, 2004). Water accessibility challenge and unhygienic domestic waste disposal might be hypothesized as among the causes of higher number of CE recorded in Basrah.

Before discussing the key descriptive findings of the present retrospective study, it is important to state that there were some key limitations and challenges with respect to data retrieval, management, integration, and, most importantly, data quality issues that are present in the surveyed hospitals in Basrah. Our study was not designed to evaluate the information system quality in the surveyed hospitals, but we think it is important to highlight this experience from a challenging field work in Iraq as it might impact the validity of other investigations for endemic diseases, beyond CE. We noted, absence of an up to date and detailed data dictionaries, data models, and there was no available information on how data and process flows within each hospital structure. In all of the surveyed hospitals there were no regular data audits and controls. Variation in data collection elements was evident in some hospitals records over multiple years. Iraq faces enormous challenges in rebuilding the infrastructure, strengthening management; there is virtually no information technology nor an effective health information system tackling the main causes of the rise in communicable and non-communicable diseases (Alwan, 2004).

Based on the hospitalization data summarized in this study, the age distribution of human CE cases showed that higher infection rate was recorded in individuals aged between 21-30 years. The age groups with the highest proportion of cases varies between regions: in Turkey most cases appeared in 41–50 (22.7%) year age group (Gulsun et al., 2010), and in Tunisia most CE cases were aged 30–44 years (Lahmar et al., 2009), while in Egypt about one-third of the cases were ≤ 20 years of age (Kandeel et al., 2004).

In the analysis of gender distribution of CE recorded cases in the present study; females had a higher occurrence of CE (61.2%) than males. Similar findings were reported in Tunisia (Bchir et al., 1991), Jordan (Dowling et al., 2000), Iran (Hajipirlooand et al., 2013), and China (Zhang et al., 2015). This may arise from the fact that females may appear more affected due to possible increased exposure, but also the result may derive from a bias on females accessing more the health services.

In the present retrospective analysis, hospital records show that the anatomical distribution of cysts was highest in the liver (46.26%) followed by lungs (28.07%). The result was similar to previous findings that the majority of cases presented as isolated liver cysts (AL-Barwari et al., 1991; Pawlowski et al., 2001; Zhang et al., 2015). In the present study, most of the patients with primary CE have single organ involvement and harbor a solitary cyst, and this is in accordance with findings of other research (Aribas et al., 2002; Talaiezadeh and Maraghi 2006). A very questionable finding in the present study was the high reporting of CE in ovary. On paper, it is obvious that the hospital reports indicate that the female patients went through surgery; but in reality it was difficult to retrieve past data on the differential diagnostic conditions for these cases. Existing literature indicates that the incidence of hydatid cyst in the female reproductive system is rare and constitutes less than 0.5% of all hydatid cysts (Abike et al., 2011; Vural et al., 2001; Sharma et al., 2012). It is very difficult to differentiate hydatid cysts from other ovarian lesions that may appear to be mostly cystic (cystadenoma, cystadenocarcinoma) on the basis of imaging findings alone (Sharma et al., 2012). This finding warrants further investigations through active clinical surveillance, in order to rule out any possibility of imperfect differential diagnosis, or bad reporting on paper.

5. CONCLUSION

This is the first retrospective analysis of human CE cases in Basrah. In view of our findings, human CE is prevalent and presents a public health burden in Basrah. Quality of health care has progressively deteriorated in Iraq over the last two decades; there is virtually no effective hospitals information system tackling endemic diseases as CE. Added to that, there is a shortage of diagnostic supplies, equipment, and training of staff, there has also been a continuing depletion of experienced professionals at all levels. This might have impacted the differential diagnostics skills for some neglected zoonotic diseases, and might be a hidden reason behind the very questionable finding in the present study on the high reporting of CE in ovary. The findings of this study highlight the need for more extensive epidemiological investigations of CE in human to determine the prevalence and economic impact of the disease in Basrah Province and Iraq.

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Figures and table

Table 1
Age and gender of patients with CE in Basrah, Iraq, between 2005-2015.

Age (years)	**Female (%)**	**Male (%)**	**Total (%)**
> 10	17 (42.50)	23 (57.50)	40 (5.3)
11-20	75 (62.50)	45 (37.50)	120 (16.04)
21-30	120 (59.70)	81 (40.30)	201 (26.87)
31-40	88 (61.1)	56 (38.9)	144 (19.25)

41-50	73 (68.87)	33 (31.13)	106 (14.17)
51-60	51 (64.56)	28 (35.44)	79 (10.56)
61-70	32 (64.00)	18 (36.00)	50 (6.68)
>70	2 (25.0)	6 (75.0)	8 (1.07)
Total	**458 (61.23)**	**290 (38.77)**	**748 (100.00)**

Table 2
Occupation, gender and age distribution of patients with CE in Basrah, Iraq, between 2005-2015.

Occupation	Number (%)	Female (no.)	Male (no.)	Age (Mean ± SD)
Child	22 (2.94)	9	13	4.26 ± 1.68
Employee*	49 (6.55)	11	38	37.93 ± 11.26
Housewife	403 (53.88)	403	0	37.90 ± 15.25
Retired	10 (1.34)	0	10	59.6 ± 10.27
Student	70 (9.36)	33	37	14.52 ± 5.60
Teacher	2 (0.27)	2	0	34.00 ± 5.65
Unemployed	192 (25.67)	0	192	36.23 ± 15.15
Total	**748 (100.00)**	**458**	**290**	**34.58 ± 16.64**

* Employee referred to people working as public servant.

Table 3
Distribution of single and multiple cysts in different organs in 748 human patients with CE in Basrah, Iraq, between 2005-2015.

Organ	**Number of CE cases (%)***	**Sex**	**Frequency (%)‡**	**Number of multiple cysts**
Liver	346 (46.26)	Female	221 (63.87)	2
		Male	125 (36.13)	7
Lungs	210 (28.07)	Female	105 (50.00)	1
		Male	105 (50.00)	3
Ovary	72 (9.63)	Female	72 (100.00)	1
		Male	0 (0.0)	0
Kidney	32 (4.27)	Female	18 (56.25)	1
		Male	14 (43.75)	0
Abdominal cavity	17 (2.27)	Female	8 (47.06)	2
		Male	9 (52.94)	2
Spleen	10 (1.34)	Female	5 (50.00)	1
		Male	5 (50.00)	0
Chest cavity	9 (1.20)	Female	5 (55.56)	0
		Male	4 (44.44)	0
Others	41 (5.48%)	Female	16 (39.02)	4
		Male	25 (60.97)	0
Total	**748 (100.00)**			**24 (3.2%)**

* The denominator is the total number of human CE cases; ǂ the denominator is the number of CE cases per organ.