

Outbreak of pertussis in Basra, Iraq

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فاشية من الشاهوق في البصرة، بالعراق

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خلاصة: تمت دراسة عدد مجموعته 133 من المصابين بالشاهوق (السعال الديكي)، أثناء فاشية حدثت في البصرة في المدة من حزيران/يونيو إلى كانون الأول/ديسمبر 1996. وكان معظم الحالات إناثاً مطعّمت. وتم استفراد (عزل) أنواع البورديتيلة في 48.1% من الحالات. كما كانت معدلات الاستفراد أكثر ما تكون ارتفاعاً بين الرضع، وأخذت تنخفض مع زيادة العمر، كما كانت أعلى ما تكون أثناء المرحلة النزلية للشاهوق. وكانت البورديتيلة الشاهوقية هي أكثر الأنواع شيوعاً وإن كانت البورديتيلة شبه الشاهوقية قد وجدت كذلك. وشهدت حالات ونخيمة من الشاهوق بين الرضع سببها البورديتيلة الشاهوقية أو عدوى مزدوجة بنوعي البورديتيلة. وكانت العدوى تنتقل عن طريق الاتصال المباشر بأحد المصابين بالشاهوق.

ABSTRACT A total of 133 pertussis cases were studied during an outbreak in Basra from June to December 1996. Most were females and were immunized. *Bordetella* spp. was isolated in 48.1% of the cases. The isolation rate was highest among infants and decreased with increasing age, and was highest during the catarrhal stage. *B. pertussis* was the most common species; however, *B. parapertussis* infection did occur. There were some severe cases of pertussis among infants caused mainly by *B. pertussis* and dual *Bordetella* infection. Infection was transmitted by close contact with a pertussis case.

Flambée épidémique de coqueluche à Bassora (Iraq)

RESUME Au total, 133 cas de coqueluche ont été étudiés pendant une flambée épidémique à Bassora de juin à décembre 1996. La plupart étaient des sujets de sexe féminin et avaient été vaccinés. *Bordetella* spp. a été isolé dans 48,1% des cas. Le taux d'isolement était le plus élevé chez les nourrissons et diminuait avec l'âge; il était le plus élevé à la phase catarrhale. *B. pertussis* était l'espèce la plus courante. Cependant, l'infection à *B. parapertussis* s'est produite. Il y a eu quelques cas de coqueluche grave chez les nouveau-nés causés principalement par *B. pertussis* et une double infection à *B. pertussis* et *B. parapertussis*. L'infection était transmise par contact proche avec un cas de coqueluche.

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Received: 21/10/97; accepted: 01/11/98

Introduction

Routine mass immunization of infants and children against pertussis has markedly decreased the morbidity and mortality attributed to this disease throughout the world [1]. However, without natural reinfection with *Bordetella pertussis* or repeated booster vaccinations, older children and adults are susceptible to the disease if exposed and mothers provide little if any passive protection to young infants [2,3].

The incidence of pertussis is high in developing and industrialized countries where vaccine coverage is low [4]. In the United States (US), lax implementation of vaccination policy is partially responsible for the rise in annual pertussis incidence to 1.2 cases per 100 000 from 1980 to 1989 and epidemic pertussis in many states in the US in 1989–1990 and 1993 [5].

Immunity to pertussis wanes after 5–10 years. However, whole cell vaccine boosters are not recommended for people older than 7 years because of concerns about adverse reactions [1,6]. The acellular pertussis vaccine provokes fewer local and systemic reactions in children than the whole cell vaccine and this may also be true for the adult vaccine [6,7].

B. pertussis is the sole cause of epidemic pertussis and the usual cause of sporadic pertussis [2,8]. *B. parapertussis* is an occasional cause of pertussis accounting for less than 5% of isolates of *Bordetella* species [2]. However, one study has suggested that *B. parapertussis* causes 22% of pertussis cases [9]. In addition, some European studies have suggested that this organism causes 20%–30% of cases of pertussis syndrome [10].

Nasopharyngeal cultures are positive for *Bordetella* during the catarrhal stage and early paroxysmal stage of the disease, but are less likely to be positive in partially

immune individuals and those who have received amoxicillin or erythromycin [2]. As a rule, *Bordetella* spp. can be isolated in 70%–90% of cases in the catarrhal stage, in 40%–60% in the second week; and in only a negligible number of cases after 4–5 weeks [11].

There are few studies regarding the extent of the disease in Iraq. Therefore, this study was conducted during an outbreak of pertussis in Basra in 1996 in order to provide baseline data for laboratory diagnosis and the extent of pertussis in Iraq. The objectives of the study were to estimate the distribution of pertussis cases among those infected and to determine the isolation rate of *Bordetella* spp. from patients with clinical pertussis in relation to age, sex, duration and severity of illness and other factors.

Materials and methods

Study design and patients

The study was conducted in Basra southern Iraq and involved patients with whooping cough (pertussis). It was conducted from June 1996 to December 1996. During this period there was an outbreak of pertussis in the population in various age groups, but primarily among infants and adults.

Diagnosis of each case was based on the following clinical criteria [2,12]: patients with a cough lasting at least 2 weeks with one of the following:

- paroxysmal cough
- inspiratory whoop
- post-tussive vomiting
- early diagnosis of an epidemiological link to a pertussis case.

Samples from any case with a clinical diagnosis of pertussis were sent to the laboratory of the Department of Microbiology,

College of Medicine Teaching Hospital. The patients were referred from outpatient clinics or were inpatients at the Paediatric Hospital and Teaching Hospital in Basra or were from private clinics. For each patient, a complete form indicating age, sex, duration of illness, antibiotic used, immunization status, history of close contact with a pertussis case within or external to the family and hospital admission during the illness period was collected. Accordingly, 133 patients were included in the study. However, this number may represent only a small portion of the outbreak as there were many patients during the outbreak who were not included in the study.

Laboratory diagnosis

Posterior nasopharyngeal swabs were taken in the laboratory and immediately inoculated onto Bordet-Gengou medium. The medium was prepared each week and contained 10% blood and 0.04 mg/ml cephalixin. The cultures were incubated at 37 °C in humidified sealed jars and examined daily for 7 days. Colonies with the characteristics of *Bordetella* microorganisms were Gram-stained.

Two species of *Bordetella* were isolated and differentiated. *B. pertussis* appears as small colonies within 2–3 days; the colonies are citrate- and urease-negative and do not grow on MacConkey or peptone media. *B. parapertussis* grows as slightly larger colonies which appear in 1–2 days, are citrate- and urease-positive and grow on MacConkey and peptone media [8].

Results

A total of 133 patients presented with pertussis and 53 (39.8%) were children under 5 years of age. Of the 53 children under 5 years, 10 (18.9%) infants under 2 months of age were not immunized and only 5 (19.4%) children aged more than 1 year had no pertussis immunization (Tables 1 and 3).

Table 1 shows the isolation rates of *Bordetella* spp. according to age. The incidence of pertussis was highest in infants < 1 year (26.3%), followed by adults aged 30 years and older (22.6%). Children aged 5–9 years were not affected by the disease.

Bordetella spp. was isolated in 64 patients (48.1%) with pertussis (Table 1). The

Table 1 Isolation rates of *Bordetella* spp. among pertussis patients according to age

Age (years)	Patients		<i>B. pertussis</i>		<i>B. parapertussis</i>		Total	
	No.	%	No.	%	No.	%	No.	%
<1	35 ^a	26.3	18	51.4	12	34.3	27 ^b	77.1
1–4	18	13.5	5	27.8	7	38.9	12	66.7
5–9	0	0.0	0	0.0	0	0.0	0	0.0
10–19	25	18.8	8	32.0	3	12.0	11	44.0
20–29	25	18.8	6	24.0	0	0.0	6	24.0
30–	30	22.6	5	16.7	3	10.0	8	26.7
Total	133	100.0	42	31.6	25	18.8	64	48.1

^a16/35 (45.7%) of infants with pertussis were admitted to hospital.

^bThere were three infants with both *B. pertussis* and *B. parapertussis* infection.

isolation rate was highest among infants (77.1%). The rate decreased with increasing age. *B. pertussis* was isolated in 42 patients (31.6%) with pertussis while *B. parapertussis* was isolated in 25 patients (18.8%). This difference was statistically significant ($\chi^2 = 5.771$, $P = 0.0163$). *B. pertussis* was most frequently isolated in infants (51.4%) and the isolation rate decreased with increasing age. The isolation

rate of *B. parapertussis* was also high in children under 5 years of age and decreased in older patients.

The outbreak of pertussis occurred in Basra from June to December 1996 (Figure 1). The number of pertussis cases and confirmed *Bordetella* infections were high in the first months, particularly in July. However, these cases represent only referred cases and there were many cases not included in our study. This was because of difficulties in referring patients to the laboratory, lack of cooperation from patients and the fact that many cases were diagnosed as pertussis with an epidemiological link to the outbreak and were treated in outpatient departments and health care centres without laboratory confirmation.

Patients were in various stages of illness when the nasopharyngeal swab was collected. Accordingly, the isolation rate of *Bordetella* was highest in week 1 (the catarrhal stage) of the illness (62.9%), decreased in week 2 (50.0%) and was lowest in week 3 and later (37.9%) (Table 2). *B. pertussis* was isolated in 40% of pertussis cases during the catarrhal stage of the illness. However, *B. parapertussis* was also isolated in week 1 (22.9%) and week 2 (30.0%) of the illness. *B. pertussis* infection was isolated in 34.5% of patients in week 3.

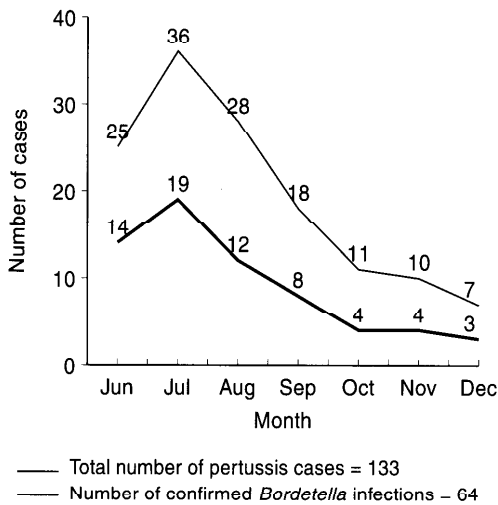


Figure 1 Distribution of pertussis cases during the outbreak in Basra (June–December 1996)

Table 2 Isolation rate of *Bordetella* spp. according to duration of illness at the time of nasopharyngeal swab collection

Duration of illness	Patients No.	<i>B. pertussis</i>		<i>B. parapertussis</i>		Total	
		No.	%	No.	%	No.	%
Week 1	35	14	40.0	8	22.9	22	62.9
Week 2	40	8	20.0	12	30.0	20	50.0
Week 3	58	20	34.5	5	8.6	22 ^a	37.9

^aThere were three patients with both *B. pertussis* and *B. parapertussis* infection.

Table 3 Features of patients with pertussis and those with confirmed *Bordetella* spp. infection

Pertussis cases	Patients		Male/ female ratio	Close contact with pertussis case		Immunization		Erythromycin treatment	
	No.	%		No.	%	No.	%	No.	%
Pertussis cases with <i>Bordetella</i> spp. isolation	64	100.0	1:2.4	48	75.0	49	76.6	16	25.0
<i>B. pertussis</i>	39	60.9	1:5.5	26	66.7	34	87.2	11	28.2
<i>B. parapertussis</i>	22	34.4	1:0.7	19	86.4	15	68.2	5	22.7
Dual infection	3	4.7	0:3	3	100.0	0	0.0	0	0.0
Pertussis cases without <i>Bordetella</i> spp. isolation	69	—	1:3.3	38	55.1	46	66.7	15	21.7
Total pertussis cases	133	—	1:2.8	86	64.7	95 ^a	71.4	31	23.3

^a48/53 (90.6%) of children under 5 years had pertussis immunization.

Table 3 shows some features of patients and those with confirmed *Bordetella* infection. The male:female ratio for pertussis cases was 2:8 and 71.4% had been immunized. There were 64 bacteriologically proven pertussis cases. *B. pertussis* was the most common isolate and comprised 39 of the 64 cases (60.9%), while *B. parapertussis* comprised 22 of the 64 cases (34.4%) (Table 3). Both *B. pertussis* and *B. parapertussis* were isolated in three patients (4.7%) with severe pertussis which necessitated hospitalization. These three patients were female infants under 2 months of age with no pertussis immunization; they presented with severe, prolonged cough. Most of the patients in whom *Bordetella* infection was confirmed were females, particularly with *B. pertussis* infections; the male:female ratio was 1:5.5 (Table 3).

Most of pertussis cases were mild but patients with severe pertussis were admitted to the hospital. All of the patients ad-

Table 4 Hospitalization rates for infants with demonstrated *Bordetella* spp. infection

Infection	Patients		Hospital admission	
	No.	%	No.	%
<i>B. pertussis</i>	15	46.7	7	46.7
<i>B. parapertussis</i>	9	22.2	2	22.2
Dual infection	3	100.0	3	100.0
Total	27	44.4 ^a	12	44.4 ^a

^a12/16 (75.0%) of hospitalized infants had *Bordetella* spp. infections.

mitted were infants under 1 year of age. A total of 16 out of 35 infants (45.7%) with pertussis were admitted to hospital (Table 1) and 12 of these 16 infants (75.0%) had *Bordetella* infections (Table 4). Also, 46.7% of infants with *B. pertussis* and 22.2% with *B. parapertussis* infection were admitted. This difference was not statistically significant ($\chi^2 = 3.68$, $P = 0.055$). All

infants with both *B. pertussis* and *B. parapertussis* infections were admitted to hospital.

In all, 87.2% of *B. pertussis* isolates were recovered from immunized patients (Table 3). However, there were 10 infants under 2 months of age with no immunization, 3 of whom were infected with both *B. pertussis* and *B. parapertussis* and 7 had *B. parapertussis* infection. In addition, 5 out of 53 children (9.4%) over 1 year of age had no immunization but they had taken erythromycin for more than 1 week before swab collection and showed negative culture for *Bordetella* spp. However, 25.0% of patients with confirmed *Bordetella* infection had taken erythromycin for less than 3 days and the results of culture were not affected (Table 3).

With regard to contact with pertussis cases, 75.0% of patients with confirmed *Bordetella* infection had had previous close contact with pertussis cases within the home, family or, less commonly, outside the home (Table 3).

Discussion

Pertussis remains a major problem in Arab countries during infancy and early childhood and has a high case fatality rate among infants who develop the disease in the first 6 months of life [13]. In the Eastern Mediterranean Region of the WHO the annual incidence rate between 1974 and 1982 varied from 26.2 to 50.2 per 100 000 population [13]. However, the incidence has decreased to 0.0 to 6.9 per 100 000 population in recent years [14].

In the present study, the highest incidence of pertussis was among infants and adults while young children aged 1–4 years had lower incidence rates. Children aged 5–9 years were not affected by the disease.

The proportion of those affected increased for adolescents and adults. Similar age patterns were observed in the US during a 1993 epidemic; 44% were infants, 21% were aged 1–4 years, 11% were aged 5–9 years and 24% were 12 years of age or older [3]. In contrast, in the pre-vaccine era the peak incidence of pertussis was among children 1–5 years of age and infants younger than 1 year accounted for less than 15% of cases [2,5].

In this study, pertussis immunization coverage for children under 5 years of age was approximately 90%. This high immunization coverage concurs with the immunization rate recorded in 1995 in Iraq. The reported incidence of pertussis in that year was 2.4 per 100 000 population [14], but this incidence rate might have been underestimated because of poor reporting.

Pertussis in adolescents and adults is mild or atypical and is difficult to diagnose unless the doctor is alerted to it as he/she may not hear the characteristic cough, which may be the only symptom [15–18]. In our study adolescents and adults represented a high percentage of patients with pertussis, which was usually mild.

The incidence of pertussis is still higher in Iraq than in other countries of the Eastern Mediterranean Region of WHO. There were more than 5000 reported pertussis cases in Iraq during 1990–1993 [19]. The high incidence of pertussis found in our study, despite high vaccination coverage, can be attributed to three important factors. First, the disease primarily affected infants, most of whom were under 6 months of age and had not yet received the full benefit of immunization [2,6]. Immunization protection was obvious among children 5–9 years of age who had taken four or five doses of the diphtheria, pertussis and tetanus (DPT) immunization. Very few of these children contracted the disease. Second, the disease

was common among the adolescent and adult population. This could be attributed to the fact that the effectiveness of the vaccine diminishes after 5–10 years [1,6,12,16]. Therefore, booster doses of acellular pertussis vaccine are recommended for adolescents and adults [2,7,16]. Third and most importantly, poor nutrition, especially among infants, as a result of the sanctions on Iraq has led to severe malnutrition in more than 12% of children under 5 years of age [20].

Improvements in nutrition and social conditions are partially responsible for the decline in the incidence of pertussis in developing and industrialized countries [11]. A recent study in London emphasized the importance of an adequate nutrition level in combating pertussis in developing countries where pertussis remains a lethal disease in children because of immunodeficiency linked to severe malnutrition [21].

One of the main purposes of this study was to confirm the infection by isolation of *Bordetella* spp. from the patients. All current methods for confirmation of infection with *Bordetella* spp. have limitations in sensitivity, specificity or practicality [2]. Isolation of the bacteria in culture is the gold standard and if careful attention is paid to specimen collection, transport and isolation techniques, is a more sensitive and specific method of diagnosis than direct fluorescent antibody testing of nasopharyngeal secretions [2]. This was taken into consideration in our study in order to obtain the best possible culture results.

From June to December 1996, *Bordetella* spp. was isolated in 48.1% of patients with pertussis. It has been suggested that during this period an outbreak of pertussis occurred. The isolation rate of *Bordetella* spp. was high among infants and decreased

with increasing age and a low rate of isolation was seen among adults. The isolation of *B. pertussis* was higher than *B. parapertussis* which is the most common cause of epidemic pertussis [2,11,12]. However, *B. parapertussis* infection was nearly as common as *B. pertussis* infection in children under 5 years of age. In addition, overall 39% of confirmed *Bordetella* infections were caused by *B. parapertussis*. This is a very high rate of *B. parapertussis* infection in comparison to previous observations in which this species caused 20%–30% of cases of pertussis [9,10]. Thus, the results indicate that an epidemic of *B. pertussis* and *B. parapertussis* occurred in Basra. In addition, dual *Bordetella* infection was seen in 4.7% of patients with confirmed *Bordetella* infection and caused severe pertussis, especially in infants. *B. pertussis* was more frequently isolated in female patients, which is in contrast to most other febrile diseases [2,11,22].

Pertussis cases tended to be mild among the adolescent and adult population, but the disease tended to be severe in infants. About half of the infants presented with severe pertussis and were admitted to hospital. In most of them (75%) *Bordetella* infection was confirmed; this pattern has been observed previously [22]. The incidence of hospitalization emphasized the seriousness of the illness in infants. In infants with confirmed *Bordetella* infection, the hospitalization rate was high for *B. pertussis* infection because of the seriousness of the illness caused by this organism. However, the highest rate of hospitalization occurred in infants with both *B. pertussis* and *B. parapertussis* infection, which reflects the severity of the illness caused in infants under 2 months with no immunization. This pattern has also been observed previously [9,23]. Therefore, pertussis immunization is recommended at birth, month 1

and month 2 to reduce the risk of severe infection [1,2].

B. parapertussis usually causes mild illness [2,11], but severe cases with *B. parapertussis* infection may actually represent dual infections with *B. pertussis* [9,10]. However, in this study *B. parapertussis* caused severe illness which required hospitalization. Approximately 22% of infants with confirmed *B. parapertussis* infection were admitted to hospital because of the seriousness of the disease.

The majority of patients with confirmed *Bordetella* infection had previous close contact with a pertussis case, generally a

household contact or less commonly other close contact. This indicates that the infection is transmitted from person to person through close contact [2,11,24].

Although most of the patients with confirmed *Bordetella* infection were immunized, non-immunized female infants under 2 months of age had higher isolation rates of *Bordetella* spp. [2,25]. In a few non-immunized children, *Bordetella* infection was not found because they had taken erythromycin for more than 1 week before culture. Therefore, immunization and erythromycin intake partially affected the isolation rate of *Bordetella* spp.

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