The Epidemiological profiles of hospitalized pertussis patients in Babylon province

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Abstract: The epidemiological features of 75 serologically confirmed hospitalized pertussis cases were analyzed. This study aimed to describe the epidemiological features of hospitalized pertussis patients in Babylon – Iraq, in order to determine the epidemiological factors that affect the severity of this disease in this country.

Methods and patients: Serum samples obtained from 136 hospitalized suspected pertussis patients admitted to Babylon Maternity and Children hospital in Hilla-Babylon province – Iraq in the period between February 2004
to January 2005. Anti-Bordetella pertussis IgG and IgA were measured by ELISA technique for all those patients.

Results: Only 75 (55%) (Age range 56 days to 10 years) cases of the 136 hospitalized suspected pertussis patients, fulfilled the diagnostic criteria in this study. 53% of all cases were reported in patients younger than 1 year. The male to female ratio was (1.14:1). A significant rise of hospitalized pertussis cases were observed in the period between March and July. 83% of patients reported as a rural area resident of Babylon province compared with 17% lived in urban area. 60% of the patients were unvaccinated, while 29% and 5% cases were received 1 and 2 doses of DTP vaccine respectively. 96% the unvaccinated patients were old enough to be vaccinated. Apnea, pneumonia, seizures and death cases were reported in 88%, 29%, 18% and 1.3% of all pertussis cases respectively. Most of the complications were occurred in unvaccinated rural area residents and less than 1 year patients.

Conclusion: Pertussis continues to cause a significant morbidity and occasional mortality in Iraq, with a higher incidence of pertussis complications compared with other countries. DTP vaccine and its booster doses should be given at proper time in order to prevent sever cases of pertussis, and special attention should be given to DTP vaccination coverage in rural area to control the spread of this disease and it's complications in Babylon province.

Introduction:

Pertussis is an acute disease of respiratory tract infection that was well described initially in the 1500s. Sydenham 1st used the term pertussis, meaning intense cough, in 1670, it is preferable to whooping cough because most infected individuals do not ((whoop)) [1]. Classically, pertussis is a prolonged disease, divided into catarrhal, paroxysmal, and convalescent stages. Bordetella pertussis is the sole cause of epidemic pertussis and the usual cause of sporadic pertussis but Bordetella parapertussis is an occasional cause of sporadic pertussis which account to <5% of Bordetella isolates in the united states. Bordetella pertussis and B. parapertussis are exclusive pathogens of humans and some primates. B. bronchiseptica is a common animal pathogen, that occasionally infects humans and typically occurs in immunocompromised persons or young children with intense exposure to animals. There are 60 million cases of pertussis each year worldwide resulting in >500000 deaths [1]. The incidence of pertussis has been greatly reduced by mass vaccination; however, even in countries with high vaccination coverage, the disease is reemerging [2]. In the United State, the incidence of pertussis steadily declined since 1951, when the pertussis vaccine was first introduced, but then showed a steady rise since early 1980 [3]. In 1993 pertussis became the most commonly reported vaccine-preventable disease among children younger than 5 years of age in the United State, with cases reported primarily in non-immunized or under-immunized populations [4-6].

The principal pertussis complication includes: apnea, secondary infections (Otitis media and pneumonia), hemorrhages, seizures, encephalopathy and death [1]. The goals of hospitalization included are: 1) assess progression of disease and like hood of life-threatening events 2) prevent or treat complications 3) educate parents in the natural history of the disease and the care that will be given at home. The indications of hospital admission of pertussis patients is: infants less than 3 months, infants between 3 to 6 months with severe paroxysms, and patients with complications at any age [1]. There are many laboratory diagnostic tests to pertussis, they include: culture, direct fluorescent antibody, PCR, serology. Serologic tests for detection of variety of antibodies
to components of *Bordetella pertussis* in acute and convalescent samples are the most sensitive and are useful in epidemiological studies[1]. Determination of antibody titer IgA and IgG to various virulent factors of *Bordetella pertussis* is the most sensitive diagnostic test [7].

In Iraq pertussis continue to occur throughout the country with high incidence (2312 reported cases in 2001) [8]. In 1996, an epidemic occurred in Basra from June – December with 40% of those affected under 5 years [9].

**Patients and Methods:**

From the period between February 2004 to January 2005, total of 136 blood samples were obtained from hospitalized patients with suspected pertussis infection admitted to the Babylon Maternity and Children Hospital in Hilla – Babylon province, which is the only infectious disease unit in the Babylon province, but the epidemiological profiles of pertussis was studded only in the serologically confirmed 75 samples (positive levels of anti bordetella pertussis IgG and IgA) of the total 136 samples.

A clinical case of pertussis was defined as an acute cough illness last at least 14 days in a person with at least 1 pertussis-associated symptoms (i.e. paroxysmal cough, post-tussive vomiting, inspiratory whoop) according to case definition for pertussis recommended by Center for Disease Control of USA [10]. A serological confirmed pertussis case was defined as a case that met the clinical definition of suspected pertussis and confirmed by serological methods.

The IgG and IgA (provided by IBL Immuno-Biological Laboratories GmbH-Hamburg-Germany) positive antibody levels to *Bordetella pertussis* antigens were determined by ELISA technique. Sera from patients with clinical pertussis were stored at – 10 °C in the laboratory of Babylon Maternity and Children Hospital. ELISA assay procedure was done according to the manufacturer instructions (IBL. Cat. No. RE 56131 & 56141). ELISA assay was done in the Public Health Laboratory in Hilla-Babylon. Levels of > 24 and > 12 U/ml were considered a positive levels of anti-*Bordetella pertussis* IgG and IgA respectively, while a levels of ≤ 24 and ≤ 12 U/ml were be considered as a negative levels.

The medical records for each suspected pertussis case were reviewed and the following data were analyzed: age, sex, duration of illness, signs and symptoms, residency and complications. Immunization status was determined by using the immunization records of each patient.

The analysis were carried out by using Microsoft excel (XP), chi-square, analysis of variance (ANOVA) and correlation coefficient between data. A difference was considered significant difference, if the P value was less than 0.01, and it considered highly significant difference if the P value was less than 0.001. The P value equal or more than 0.01 was considered non significant difference.

**Results:**

The serological tests of 136 suspected pertussis patients showed that, 103 (76%) and 82 (60%) of samples were positive for anti-*Bordetella pertussis* IgG and IgA respectively and seventy five 75 (55%) of the pertussis cases fulfilled the diagnostic criteria in this study (positive levels of both anti Bordetella pertussis IgG and IgA).

Out of the 75 serologically confirmed pertussis cases, 40 (53%) were male, 35 (47%) were female. The male to female ratio was (1.14: 1). There were no significant differences between male and female in all age groups (Figure 1). The age range was (56 day to 10 years). Forty 40 (53%) of all cases were reported in less than 1 years of age (P < 0.001) and seven 7 (9%) of cases were reported in patients older than 5 years.
During the study period (February 2004-January 2005), pertussis cases were reported throughout the year (Figure 2), although a highly significant raise ($P < 0.001$) in hospitalized pertussis cases were occurred in the period between March and July (spring and summer months).

There was a highly significant difference ($P < 0.001$) between number of patients who lived in rural area and those who lived in urban area of Babylon province. Of the 75 pertussis cases, 62 (83%) lived in rural area compared with 13 (17%) were lived in urban area (Figure 3).

Forty five 45 (60%) of the serologically confirmed hospitalized pertussis patients were not vaccinated by DTP vaccine (Figure 3), while there were 22 (29%) and 4 (5%) patients received 1, 2 doses of DTP vaccine respectively. Only 4 (5%) patients were received the full 3 doses of DTP vaccine during their first year of life ($P < 0.001$). Most of the unvaccinated patients (43 out of 45 or 96%) although they were old enough to be vaccinated. Most of the unvaccinated patients (38 out 45 or 84%) were lived in rural area (Figure 3). Out of the 22 patients who had 1 dose of DTP vaccine, there were 19 (86%) lived in rural area and 3 (14%) lived in urban area ($P < 0.01$).

Several pertussis complications were noticed in the hospitalized patients (figure 4). Apnea was the most common. Out of 75 patients, there were 66 (88%) suffering from apnea, followed by pneumonia and seizures in 22(29%) and 18 (24%) patients, respectively. There was 1(1.3%) death case in 2 months girl as a consequence of sever pneumonia.

Figure 7 show the age distribution of the patients with apnea. The incidence of apnea was highly significant higher ($P <0.001$) in patients less than 1 year compared with other age groups. There is no significant difference between numbers of males and females with apnea. Out of the 66 patients with apnea, there were 56 (85%) lived in rural area (figure 5). Out of the 66 patients with apnea, there were 41 (62%) cases of apnea unvaccinated patients compared with 18 (27%), 3 (5%) and 4(6%) apnea cases in 1, 2 and 3 DTP vaccinated patients, respectively (figure 6).

Figure7 show the age distribution of pertussis patients with pneumonia. Pneumonia incidence was significantly higher ($P < 0.01$) in patients less than 1 year. There was no significant difference between pneumonic males and females patients. Out of the 22 pneumonic patients, there were 12 (55%) in patients aged less than 1 year. The incidence of pneumonia was highly significant ($P < 0.001$) higher in unvaccinated patients as compared with vaccinated patients. Out of 22 pneumonic patients, There were 17 (77%) unvaccinated compared with 3 (14%), 1 (5%) and 1 (5%) had 1, 2 and 3 doses of DTP vaccine, respectively (figure 8). The incidence of pneumonia was highly significant ($P < 0.001$) higher in rural area patients as compared with urban area patients. Out of 22 pneumonic patients, there were 21 (95%) lived in rural area compared with only 1 pneumonia case in urban area patient (figure 5).

Figure 7 show the age distribution of patients with seizures as a complication of pertussis infection. Seizures incidence were highly significant ($p < 0.001$) higher in less than 1 year patients compared with other age groups. Out of the 18 patients with seizures, there were 10 (55%) patients aged less than 1 year . There were no significant difference between males and females who had seizures. Seizures were significantly ($P < 0.01$) noticed in unvaccinated patients as compared with vaccinated patients. Out of the 18 seizure cases, there were 11 (61%) seizures cases in unvaccinated patients compared with 3 (16%), 2(11%) and 2 (11%) seizures cases were reported in 1,2 and 3 doses of DTP vaccinated patients (figure 6). The incidence of seizures was significantly ($P < 0.01$) higher in rural patients compared with urban patients. Out of 18 seizures cases, there were 16 (89%) seizures cases in rural patients compared with only 2(11%) seizure cases in urban patients (Figure 5).
Figure 1: Age and sex distribution of hospitalized pertussis patients.

* P < 0.001

Figure 2: Seasonal variation of hospitalized pertussis cases.

* P < 0.001

Figure 3: Residential and DTP vaccination status of the hospitalized pertussis patients.

* P < 0.001

No. of patients

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Figure 5: Residential distribution of the pertussis patients with complications

Figure 6: Vaccination status of the complicated pertussis cases

* P < 0.001
Discussion:
This study analyzed the epidemiological characteristics of 75 hospitalized patients with a serologically confirmed pertussis. The results showed that 53% of these severe cases of pertussis were under 1 year. These findings were similar to the findings of some Iraqi studies in pertussis infection. In Al-Marzoki et al study in 2004, 60% of the pertussis patients were below one year[11]. Another Iraqi study in Basra, patients with pertussis aged less than 1 year represented 26.3% of all cases 0[9]. Many other studies in the world agree with findings in this study. In Taiwan the pertussis cases less than 1 year represents 52.2% of all cases[12]. In Australian study, 65% of patients were less than 2 months[13]. The incidence of pertussis has dramatically changed after presentation of DTP vaccine. In the prevaccine era, pertussis primarily affected children between 1 to 5 years of age, at least in part because of passive protection during first year of life through maternal antibody. For example, in a study from 1937, 60.2% of pertussis patients were 1 to 5 years of age[14]. In that setting with most adult having had pertussis as children and being repeatedly exposed in the population, there was high level of adult immunity. Whole cell vaccine, pertussis vaccine has clearly been the major cause of overall reduction in the incidence of disease, yet it has probably also affected a shift in the United States to children younger than 1 year of age[15]. According to this study, there is no significant difference in pertussis incidence between males and females. The male to female ratio was (1.14 : 1). In other two Iraqi studies, the incidence of pertussis was higher in females than in males[9,11]. Other studies mentions that there is no significant difference in incidence of pertussis between males and females[16-17].

![Figure 7: Age distribution of complicated pertussis cases](image-url)
This study indicates that, 60% of the hospitalized pertussis patients were unvaccinated, although most of them (84%) were old enough to be vaccinated by DTP vaccine. Most (84%) of the unvaccinated patients lived in rural area of Babylon province. These findings indicate a defect in vaccination coverage in rural area of Babylon province, and that may be explain the high incidence of pertussis in the rural area as compared with urban area patients. Many other researchers showed a high pertussis incidence in low vaccine coverage rural areas, in Iraq [11], in Sudan [18], in India [19] and in Chile [20]. UNICIF reports indicate that since 1990s, Iraq's immunization services were interrupted, and the expanded program on immunization coverage was affected, with disruption of vaccine supply, of the cold chain and the health services. This compromised protection against vaccine preventable childhood diseases and their incidence increased, especially for measles and pertussis [21]. According to this study, there were 40% of pertussis cases which occurred in vaccinated patients. Pertussis occurred among children, who had been appropriately immunized [22]. These results may be explained by following: Lessened potency of the pertussis vaccine [23] or Waning of vaccine-induced immunity [24] or a mismatch between the vaccine and the circulating strains of Bordetella pertussis [25].

The distribution of pertussis cases during the study period is shown that a high incidence of pertussis cases between March and July, and the peak rate was in May. These findings agree with the other Iraqi studies [9,11].

In this study, apnea was reported in 88%, pneumonia (29%) and seizures in (24%) of the cases. These findings were higher than that reported in other studies of hospitalized pertussis cases in the world [27-29] This study showed that, a high incidence of pertussis complications in patients less than 1 year. Pertussis complications were directly related to age, the disease being most severe in children under 1 year, especially those under 6 months [30]. Halperin et al in a study of 1082 pertussis cases showed that pneumonia was reported in 9.4%, seizures in 2.3% and death in 0.9, all children ≤ 6 months [29]. In a study by Nielsen and Larsen, pneumonia developed in 12%, seizures in 2% under one year and 5% over year, apnea occurred in 10% under one year and 2% over one year [27].

The results of this study were shown a high incidence of pertussis complications in rural area resident patients compared with urban area patients. These findings may be explained by low socioeconomic level and the low vaccination coverage in rural area of Babylon province. High rates of complications were generally higher among unvaccinated children than among those who had received three or more doses of DPT vaccine [3]. There was increasing evidence that previously vaccination reduces the complication of the disease but the vaccination program does not cover very young children 0[30].

**Conclusion:**

Pertussis continues to cause a significant morbidity and occasional mortality in Iraq. Most of the severe cases were reported in less than 1 year patients. Many cases were reported in patients in school or preschool age. This study reported a defect in DTP vaccine coverage to children less than 1 year in rural area of Babylon province. Higher incidences of pertussis complication were reported in this study compared with other places in the world, and this due to poor vaccination status of patients in rural area in Iraq. The study recommends that, more attention should be giving to DTP vaccination in Babylon province in order to prevent of this disease and it's sever complications and there is a need to a laboratory diagnosis to assess accurate clinical diagnosis of pertussis.
References: