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# The effect of the immune system and vaccination against Bordetella pertussis among children at Al-Semawa Teaching Hospital for maternity and childhood /Al-Muthanna governorate – IRAQ

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***Abstract**:*
***Background**: Pertussis"whooping cough"constitutes a very serious health problem particularly among children in developing countries like Iraq.It is the main cause of whooping cough like Syndrome which is caused bythe gram negative pleomorphic bacillus "Bordetella Pertussis" bacteria.*
***Objectives**: The aims of this study are to understand the immune profile and identify vaccination as the triggering factor. Moreover, this study aims to throw light on an important health problem which is very infectiousdisease among children in Iraq.*
***Materials and Methods**: This study was conducted at Al-Semawa teaching hospital for maternity and childhood in south of Iraq, during the period of 1st of Feb. 2016 to 29th of June 2017.*
*Eighty-eight patients aged between early infancy to15 years,46 of them were boys (52.3%) and 42 were girls (47.7%). I depended on clinical history of cough for at least 2 weeks and the total leukocytes count (TLC) anddifferential count in addition to immunization schedule in Al-Muthannagovernorate.All children with doubtful pictures were excluded.*
***Results:** Eighty-eight patientswereincluded in this study and met the criteria of the case definition of the world health organization for pertussis while other patients were distributed among hyper sensitive air way disease,bronchopneumonia and bronchial asthma. Mostparticipants involved weremales (28 cases) (60.9%),1-5 years of age and most cases were never vaccinated with (DPT) vaccine (54cases)(61.4%).*
***Conclusions:** Paroxysmal attacks of cough and bronchopneumonia were the most persistent recognized clinical feature in pertussis".*
*Antibiotics and vaccinations play an important role for treatment and prevention of this disease. Vaccination of pregnant women in 3rd trimester is very important for prevention against pertussis" whooping cough"of babies after delivery.*
***Key words:** Clinical history, total leukocytes count (TLC) and differential count, chest x-ray ( CXR) and immunization schedule.*

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## I. Introduction

The pertussis syndrome "whooping cough " includes disease caused by Bordetella pertussis, a gram negative pleomorphic bacillus[1].

This disease is an airborne disease which spreads easily through the droplets of an infected person[1,2]. Pertussis is also known as whooping cough or one hundred-daycough[3,]and is a highly contagious bacterial disease. The clinical features are usually like those of the coryza with a runny nose, fever and mild cough, followed by a characteristicparoxysmal or whoop attacks of cough.The spasms of cough are often worse at night and may be associated with vomiting and the symptoms may persist for 10 to 12weeks[4,5].

Patients are highly infectious to others from the start of symptoms until about 3 wks.Those treated with antibiotics are no longer infectious after 5 days [6]. Antibiotics are important for eliminating Bordetella pertussis and the best one is Erythromycin for 10-14 days [7,8]. Infants may not show the typical signs and symptoms of pertussis, the first sign in the neonate may be an episode of apnea[2].

Complications like pneumonia,convulsion, pneumothorax, emphysema, epistaxis, rectal prolapse, otitis media, sinusitis, bronchiectasis and hernias may occur[9].The incubation period of the disease is an average 7-14 days " range 6-20 days "[10], rarely as long as 42 days [11].

A cellular pertussis vaccine gives 71-85% effective protection against pertussis for 5-10 ys[13,16], The effector molecules of innate and acquired immunity against infection is interleukin 17. Th17 cells are at the cross roads of innate and adaptive immunity against infectious disease at the mucosa [17].

The adaptive immunity is induced by vaccination and the cell mediated immunity is responded to antigens of Bordetella pertussis and gives protection against pertussis in school children[19] and the effective immunization against Bordetella pertussis respiratory infection in mice is depended on induction of cell mediated immunity[20].

Active immunity is induced by acellular pertussis components given in combination with tetanus and diphtheria toxoids (DTaP), this vaccine is recommended as preventive measures which is given in 3 doses in the first 6 months of life ($2^{nd}$ month, 4th month and 6th month)and followed by booster dose 1 at 18 months then booster dose 2 at 4-6 years of life.

IgM immunity against pertussis plays an important role for the protection in the first 6 months of life, so IgM regarded as a natural immunity against pertussis, but it does not cross the placenta to the fetus during pregnancy [21.22.23], so that the prevention of pertussis is mainly by vaccination with pertussis vaccine[3,12,13]and thus recommended routinely in Iraq according to the world health organization (WHO)[15].

It is important to protect our babies from pertussis by giving the" Tdap vaccine" as a single shot to pregnant mothers between the $27^{th}$ and $30^{th}$wk of each pregnancy (i.e. $3^{rd}$ trimester).This will create protective antibodies and will pass some of them to the fetus before birth. This offers some short protection against whooping cough in early life when the baby is too young to get vaccinated, those antibodies protect the baby from serious complications like pneumonia and encephalopathy[24].

The diagnosis of pertussis on clinical history of paroxysmal attacks of cough followed by inspiratory whoop may be associated with other complications,[9] in addition to TLC and lymphocytes which is a diagnostic clue for pertussis[26].

The organism can be identified early in the disease from a per-nasal swab and culture of nasopharyngeal swab on Bordet-Gengoumedium.Other investigations include polymerase chain reaction (PCR), direct fluorescent antibody (DFA), and serological methods,including a complement fixation test (CFT)for example, can be used for confirmation of the diagnosis .[25,26]

## II. Methods

Eighty-eight patientswereincluded in this study, all patients includedin the study had the following criteria: to be a child less than 15 years of age and to have a highly suggestive history and clinical findings of whoopy cough, the cough lasting for at least 15 days and most of them had paroxysmal attack in nature.Whoopy cough was not mandatory for the diagnosis.

The doubtful cases were excluded.Other criteria used for the diagnosis of pertussis includes total leukocytes count (TLC) and lymphocytes count, in addition to history and vaccination status of patients " complete or incomplete or never vaccinated cases" and also I depended on the age and sex of patients and chest x-ray (CXR) findings in those patients because of high involvement of respiratory system with pertussis , there are other tests used for confirmation of pertussis like culture of nasopharyngeal swab on Bordet-Gengou medium or polymerase chain reaction (PCR ) , direct fluorescent antibody (DFA) in addition to serological methods for example complement fixation test (CFT) , which are not available in our hospitals. All these data are presented in tables below, with a significant level of 5% (P. value: 0.05).

## III. Results

Eighty-eight patients with pertussis involved in this study, 46 of them males (52.3%) and 42 patients were females (47.7%) with male: female ratio of 1.14:1 as in Table 1.

**Table I: shows distribution of pertussis cases among children according to age and sex:**

| Age | Sex | | Total |
|---|---|---|---|
| | Male | Female | |
| <1 year | 8(17.4%) | 24(57%) | 32(36.4) |
| 6ys | 28(60.9%) | 16(30%) | 44(50%) |
| >6 ys -15ys | 10(21-7%) | 2(4-8%) | 12(13.7%) |
| Total | 46(52.3%) | 42(47.7%) | 88(100%) |

**Table II: Shows pertussis cases with DPT vaccine:**

| DPT vaccine: | Number of cases: |
|---|---|
| Complete vaccination | 20(22.7%) |
| Incomplete vaccination | 14(15.9%) |
| Never vaccinated | 54(61.4%) |
| Total cases | 88(100%) |

***Table III: Shows the total and differential leukocytes count among pertussis case according to age groups and number of cases: -***

| *Age* | *TLC/mcl* | *Lymphocytes %* | *Cases* |
|---|---|---|---|
| ≥ 6 years | Upto 10000 | >60% | 14(16%) |
| 6 ys -12ys | 10000→20000 | 60→ 80% | 66(75%) |
| >12 ys | >12000 | >80% | 8 (9-1%) |
| Range | 4000 → 30000 | Range : 50→88% | Total cases :88 |

**Table IV:Shows the normal TLC according to age groups, taken from illustrated textbook of pediatrics, UK-London, Tom Lissauer andGrahanClayden / printed in 1997-1998 by Mosby International,page: 323:**

| **Age:** | **TLC/mcl** |
|---|---|
| Birth | 10000→26000 |
| 2 wks | 6000→ 21000 |
| 2 months | 6000→ 18000 |
| 1 to <6 years | 6000→17500 |
| 6 - 12ys | 4500→14500 |
| 12 ys- 18ys<br>Male<br>Female | <br>4500→13000<br>Same |

**Table V: CXR findings in pertussis cases:**

| **Patients:** | **CXR finding:** |
|---|---|
| 53 | Bronchopneumonia |
| 15 | Lobar pneumonia |
| 3 | A atelectasis |
| 17 | Normal finding |
| Total cases : 88 | |

**Table VI: Shows vaccinations schedule used in Al-Semawa teaching hospital for maternity and childhood:**

| **Age:** | **Vaccine ( immunization Program )** |
|---|---|
| At birth | BCG , OPV-O , HBV-1 |
| 2 months | DPT-1, OPV-1, HBV-2,H.influenza B ,Rota-1. |
| 4 months | DPT-2 , OPV-2 , H-influenza B, Rota-2 |
| 6 month s | DPT-3 , OPV-3 , HBV-3 ,H. influenza B ,Rota-3. |
| 9 months | Measles + Vit A ( 100000 U) |
| 15 months | MMR |
| 18 months | DPT: booster -1 ,OPV: booster -1<br>H- influenza B, Vit A ( 200000 U), |
| 4→ 6 ys | DPT: booster -2, OPV: booster -2,<br>MMR |

## IV. Discussion

Eighty-eight patients were studied, from table I, we found that 46 out of them were males ( 52.3% ) and 42 patients were female (47.7% ) with male female ration 1.14:1 , female patients aged less than one year are mostly involved and account 24 cases ( 57% ) , while male patients aged from 1to 5 `years account 28 cases ( 60.9%) and after5 years of age , the incidence of pertussis declined to 12 cases ( 13.7%) as 10 cases male (21.7%) and 2 cases female(4.8%).While in other studies, females accounted 54% of pertussis cases in the United states[27] and23% of cases were younger than 1 year ,12% were aged 1 to 9 years, 33% aged 10 to 19 years and 23% were older than 20 years[27,28].Because of the lack of maternal immunity transfer, 10-15 % of all cases of pertussis occur in infants younger than 6 months and more than 90% of all deaths occur in this same group[27,28]

In table II: wefound that 54 cases(61.4)contracted pertussis and were never vaccinated by DPT vaccine while 20 cases (22.7%) contracted the disease andwerecompletely vaccinated and 14 cases (15.9%) contracted the disease andwereincompletely vaccinated. This suggeststhat ahigh percentage of never vaccinated patients contracted the disease, while the completely vaccinated patients account 20 cases ( 22.7% ) , so the differences were of great significant ( P. Value =0.015).This study was correlated with other studies in which this disease is common in pre-vaccination status and it may be higher in developing countries when vaccination rates increase [26].

Table VI shows the vaccination schedule which is used in Al-Semawa teaching hospital for maternity and childhood.

Regarding thetotal leukocytes count (TLC) and lymphocytes count , the results in table III compared with normal values in table IV show that in younger aged group patients less than 6 years of age , the TLC are up to 10000/mcl with lymphocytes count < 60% in 16 cases (16%) , in older aged group > 12 ys , there is

marked leukocytosis > 20000/mcl with lymphocytosis >80% in 8 cases (9.1%) , while patients aged ranged from 6 to 12 ys are slightly increased in the area of 10000 to 20000/mcl with lymphocytosis 60 to 80% in 66 cases ( 75%).

So this study is corrected with other studies of the classic Bordetella pertussis, lymphocytosis is present in 75 – 85% of patients,although in young infants, the rate is much lower[26].

Table V shows the chest X-ray (CXR) findings in pertussis cases , 53 cases (60.2%) presented with bronchopneumonia while 15 cases (17%) suffered from lobarpneumonia and 3 case ( 3.4%) with atelectasis , only 17 cases ( 19.31%) out of 88 cases were normal.This means that high percentage of pertussis cases contracted respiratory system problems and account 71 cases (80.68%) , and this correlated with other studies in which pneumonia from either Bordetella pertussis infection or from secondary infectionwith other pathogens is a relatively common complication among pertussis cases [28].

## V. Conclusions

Bordetella pertussis bacteria is a common cause of pertussis (whooping cough) which is very infectious disease among children in developing countries, which spread easily through the droplets(coughs and sneezes), so we recommend usingantibioticslikeErythromycinto eradicate the organism, and its early uses may reduce family spread.There is no specific treatment that reduces the duration of the disease in addition to vaccination (DPT) as preventive measures which is given in 3 doses in the first 6 months of life (2nd month, 4th month and 6th month)and followed by booster dose 1 at 18 months then booster dose 2 at 4-6 years of life.

The adaptive and innate immunity play a role against Bordetella pertussis microorganism, IgM plays an important role for protection of this disease, but it does not cross the placenta to the fetus during pregnancy, so the baby should be vaccinated in early infancy.

Nowadays vaccination of pregnant mother is done to allow activation of immune system of the fetus, so the baby has some protection against Bordetella pertussismicroorganism. Vaccination against pertussis" whooping cough "does not give 100% protection, so it gives about 70→80% and those babies who received the vaccination may have the disease but in modified form and the cough may not be followed by whoop attack.

From this study,we conclude that this disease is common among children in the developing countries because most of them are unvaccinated or incompletelyvaccinated with DPT vaccine.Hence, we should encourage the vaccination of all children according to the WHO (World health organization) vaccination schedule to avoid this disease and its serious complications.

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