

Revision of Meningitis Surveillance System in Jordan during 2001 and 2014 Years

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Abstract

Background: Since 2002 a specific categorization of meningitis cases was initiated in Directorate of Communicable Diseases (DCD). Analyzing data reveals severe underreporting of meningitis cases from some reporting sites (up to zero), therefore it is important to conduct a study that measures sensitivity of the system (data quality, predictive value positive and representativeness).

Objective: To determine proportion of cases that fit adopted case definition (by WHO) and to determine completeness of data received by DCD from hospitals.

Methodology: The researcher adopted a case definition based on WHO criteria for suspected and probable cases and applied it to viral meningitis in order to determine what proportion of cases fits case definition.

To calculate the sensitivity of the surveillance system, clinical records of all meningitis cases admitted to four major hospitals from different health sectors were reviewed during the study period and compared to reported cases to the DDC.

Results: The researcher identified and evaluated all meningitis cases in 2001 and 2014 years, 7% fit the suspected WHO case definition for viral meningitis in ages <2 years and 1.3% fit the probable.

For ages ≥2 years 76% fit the suspected cases and 26.8% fit probable. The sensitivity for all types for hospital A=10%, hospital B=50%, hospital C=63% and hospital D=99%. Hospital A is the largest referral hospital in Jordan.

Conclusions: Non-standardized case definition by clinicians plagues the meningitis surveillance system. Targeted efforts to strengthen the system should be adopted by the Ministry of Health (National Clinical Guidelines, Active System Versus Passive).

Keywords: Meningitis; Sensitivity; Incidence rate; Evaluation

Introduction

Meningitis may be defined as an inflammatory response to infection (bacterial, viral) of the pia-arachnoid and the cerebrospinal fluid (CSF) of the sub arachnoid space. It is characterized by sudden onset of febrile illness with signs and symptoms of meningeal involvement.

The incidence rate of bacterial meningitis is between 3 and 5 per 100,000 people per year in USA. The disease is even more common in developing countries.

In Jordan since 1988 meningitis is reported either as non-meningococcal meningitis (which including viral, Hib meningitis and other bacterial meningitis) or meningococcal.

Based on annual report of infectious diseases at the Jordanian Ministry Of Health the incidence rate for the year 2000 for meningococcal meningitis is 0.7/100000 and IR for non-meningococcal is 22/100000 according to the national surveillance data.

Considering that there is severe underreporting in meningitis cases, which make numbers that received by Directorate of Disease Control and Prevention (DDC) doubtful, it was important to start meningitis database in the DDC to enable the surveillance system to determine the sensitivity of the system and to distinguish different types of meningitis.

In Jordan the Expanded program of Immunization introduced MMR (2000) and *H. influenza* (2001) vaccines which considered the main causative agents for meningitis in children under 2 years old.

A more specific categorization of non-meningococcal meningitis is initiated to identify the incidence of different types since 2001 (including viral, *H. influenza* meningitis and other bacterial)

Considering that initiating MMR vaccine and Hib Vaccine in our national immunization program for children in the first two years of life could be the main cause for reduction in numbers of cases in non-meningococcal meningitis in Jordan.

Regardless the possibility of severe underreporting in meningitis cases from reporting sites (hospitals), which make numbers that received by Directorate of Disease Control and Prevention (DDC)

doubtful, the missing data would not affect the credibility of IR of both meningococcal and non-meningococcal meningitis in Jordan.

Objectives

- To analyze the database using descriptive epidemiology (person, time, place)
- To define a case definition of meningitis based on WHO criteria for public health surveillance
- To apply the case definition for meningitis to the MoH data in order to classify different types of meningitis (bacterial vs. viral)
- To determine the incidence of each type of meningitis in Jordan
- To evaluate the sensitivity of the meningitis surveillance system
- To identify the most common laboratory test that was used in diagnosing these cases in Jordan

Methodology

A new form for meningitis surveillance was developed in the year 2000; this form allowed 4 categories of meningitis to be reported: meningococcal, Hib meningitis, other bacterial and viral meningitis. This form is currently only used in Irbid, but it is planned to have it distributed to all directorates, so that it becomes the main reporting form for meningitis cases [1].

All case reports of meningitis obtained at DDC will be entered into an Epi Info database. These data were analyzed to describe the epidemiology of meningitis in Jordan, based on the current descriptive data [2].

Next in collaboration with physicians at selected hospitals, the researcher assessed sensitivity of the current system.

Hospitals will be selected to be representative of the major sectors in Jordan: e.g. the university hospital, the Basheer hospital from the public sector, the Islamic hospital from the private sector and Rahma hospital which has the majority reported cases.

Review was performed for all discharge records in these selected hospitals to identify all cases of meningitis at these hospitals. Comparing these data to the national surveillance data in DDC will allow calculation of the sensitivity of the current meningitis surveillance system.

Information was collected and analyzed on demographic, clinical and laboratory characteristics, as well as outcome. Then a case definition was adopted based on WHO criteria to analyze these data to determine what proportion of cases fits this case definition, and therefore to identify the sensitivity of our surveillance data.

In addition, we will be able to determine the proportion of the different types of bacterial meningitis as well as proportion of viral meningitis. Since isolation of a bacterial causative organism may not always be possible either because of partially treated meningitis or inadequate laboratory methods, we may need to adapt a case definition for bacterial vs. viral meningitis based on clinical and laboratory criteria [3].

To determine what proportion of cases is compatible with viral meningitis case definition that meets the criteria of WHO (Appendix) and can be applied to the dataset (which already has been created by records from DDC) two case definitions were applied according the

age group, which was divided into under 2 years old and equal or greater than 2 years old.

For children under 2 years old the viral meningitis case definition was: each case with fever and irritability or bulging fontanel considered as suspected case, if the case fit the suspected case definition and accompanied with CSF laboratory test, which unfortunately didn't include glucose and protein of CSF, and by reviewing the WHO criteria it was acceptable to include WBC (white blood cells) and percent of lymphocytes, so the case considered as probable case.

For cases that were equal or greater than 2 years old the case definition was: each case with fever and neck rigidity or headache will be considered as suspected viral meningitis and if it is accompanied with wbc <500 and predominance >50% of lymphocytes, the case will be considered as probable case [4].

Study design

Prospective cohort study was conducted from the beginning of 2001 year. Data was collected from records and received by DDC from all MOH directorates.

A more developed questionnaire was used in collecting data from the directorates and data entered on Epi Info program and be analyzed.

Results

Starting analyzing data received from all directorates in the year 2014, the overall numbers of cases were 566 cases including meningococcal, Hib meningitis, and other bacterial and viral meningitis as shown in Table 1.

The number of Meningitis infected patients according to 2001 and 2014 survey based on gender are shown in Table 2.

Final diagnosis	2001	2014
Meningococcal	22	2
Hib meningitis	26	0
Other bacterial	44	0
Viral	474	463
Total	566	465

Table 1: Number of meningitis cases in Jordan in 2001 and 2014 years.

According to above Table 1 the majority of cases are diagnosed as viral meningitis (83.7%), other bacterial consist 7.8% of cases in 2001 and zero in 2014, Hib meningitis consist 4.6% in 2001 and zero in 2014 and meningococcal is about 3.9% in 2001 while constitutes 0.4 in 2014.

Sex	2001	2014
Male	371	274
Female	195	191
Total	566	465

Table 2: Number of meningitis cases in Jordan by sex in 2001 and 2014 years.

Age group	2001	2014
<2 years	224	184
3-5 years	104	98
6-10 y	165	89
11-15 y	53	31
16-20 y	7	15
>20 years	13	53
Total	566	465

Table 3: Number of meningitis cases during January-September in Jordan in 2001 year and 2014 by age group.

According to Table 3, it reveals that the majority of cases are less than 15 years old (96.5%).

District	2001	2014
Ajloon	6	5
Amman	79	101
Balka	9	23
Banekenana	25	4
Deiralla	7	0
East amman	8	7
Irbid	296	228
Jarash	10	20

Karak	1	0
Kura	23	0
Maan	1	0
Madaba	3	5
Mafrak	6	3
North agwar	24	3
North badia	3	2
South shona	5	2
Tafleleh	3	1
Zarka	57	53
Total	566	465

Table 4: Distribution of meningitis cases by districts in Jordan in 2001 and 2014 years.

Looking at Table 4 it shows that the majority of cases are from Irbid, Amman and Zarka. Analyzing data to determine which laboratory test is mostly used in meningitis, the analysis revealed that 91% had CSF culture, while 41.5% had latex test and 15% had gram stain test.

Under 2 years old 7% from fit the suspected case definition based on WHO criteria, while 93.0% don't. 1.3% only fit with the probable case definition based on WHO criteria, while 98.7% cases don't. For the other age category (≥ 2 years old) 76.0% fit with the WHO suspected case definition, while 24% don't. 26.8% fit with WHO probable case definition, while 73.2% don't.

Positive predictive value in 2001			
	Disease (number)	No disease (number)	Total (number)
Test result Positive (number)	74 (true positive)	418 (false positive)	492 (test positive)
Test result Negative (number)	9 (false negative)	65 (true negative)	74 (test negative)
Total	83 (disease)	483 (non-disease)	566
Prevalence=13 Positive predictive value= $74/492 \times 100=15\%$ Negative predictive value $65/74 \times 100=88\%$			
Positive predictive value in 2014			
	Disease (number)	No disease (number)	Total (number)
Test result Positive (number)	37 (true positive)	381 (false positive)	418 (test positive)
Test result Negative (number)	4 (false negative)	43 (true negative)	47 (test negative)
Total	41 (disease)	424 (non-disease)	465
Prevalence=9 Positive predictive value= $37/418 \times 100=9\%$ Negative predictive value $43/47 \times 100=91\%$			

Table 5: Positive predictive value for meningitis surveillance system in Jordan in 2001 and 2014.

According to Table 5 the sensitivity of meningitis surveillance system a visit was planned to Al-Basheer hospital, it revealed severe underreporting. By reviewing the records it was found that 160 cases of meningitis cases were entered the hospital, while the DDC received only 22 cases from the hospital. The physician who was met in the pediatric ward confirmed the underreporting and explained it by the overload of work in their ward, because it considered as a referral hospital and there is no time or a specialized person to report the cases to the DDC.

The visit to the other hospital which reported the majority of cases - Rahma Hospital - revealed the accuracy in their reporting of cases and it was found that the number of cases that were reported to the DDC fit the actual number of cases that were entered and discharged from the pediatric ward and also the final diagnosis fit the records in DDC.

In the university hospital also was found underreporting in meningitis cases. The number of cases that were received by DDC was 60 cases, while the actual number was more than 130 cases (50% underreporting). According the last hospital which represent the private sector it revealed that 160 cases were the actual number of meningitis cases while only 100 cases were received by DDC which consist 63% sensitivity of the surveillance system

Discussion

Analyzing the previous tables it is already seen that the majority number of cases is under the 15 years old (96.5 % of the whole cases), while the most cases were among males (65.6%). The majority of cases were reported from Irbid district (especially from Rahma hospital which constitutes 50.3% of cases). There is a sharp decrease in Meningitis Incidence Rate as a result of Hib and MMR vaccine introduction into the expanded immunization program.

By looking at the cases by laboratory diagnosis it revealed that most cases were diagnosed by CSF culture, while the others were diagnosed either by latex culture (41.5%) or by gram stain (15%). So the CSF culture is the most common test that used for meningitis cases.

Accordingly the basic way in diagnosing meningitis in Jordan is only the clinical picture of the patient and because children are the vulnerable group, so clinicians are more likely diagnose the majority of fever cases as meningitis, trying not to miss any serious case of meningitis, regardless the case definition. According the case definition that is applicable in the Ministry of Health (MOH) in Jordan it takes more broad approach (Appendix).

Limitations of study

- Cases were reported mainly by clinical picture
- Underreporting of meningitis cases from reporting sites
- Broad case definition adopted by clinicians for meningitis
- Viral meningitis prevalence is affected with partially treated bacterial meningitis by laboratory
- Restricted ability of laboratory to diagnose viral causative agent (no kits to perform viral tests)
- Electronic data base still in progress

Advantages of the study

- Determine the importance to adopt national clinical guideline for meningitis
- Improve diagnostic methods for meningitis, especially viral
- Set reporting data base for meningitis in Ministry of Health

Conclusions

- The severe underreporting in meningitis cases all over Jordan excluding Rahma hospital, which revealed the individual efforts in reporting cases by districts.
- The sharp decrease in incidence rate of meningitis as Hib and complicated mumps cases.
- The inability of the laboratory to diagnose the causative agent for the majority of cases, especially viral cases.
- The case definition that used by physicians according MOH criteria is very broad.

Recommendations and directions for future studies

- To adopt standardized national clinical guideline for meningitis management by Ministry of Health.
- To substitute active meningitis surveillance system instead of current passive meningitis surveillance system.
- To improve the ability of laboratories in diagnosing meningitis cases, especially viral meningitis.
- Perform cost effectiveness study to introduce meningococcal vaccine in national immunization program.

References

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Appendix

Operational case definition for different types of meningitis based on WHO criteria that was applied in this project analysis

Meningococcal meningitis: An illness with sudden onset of fever (> 38.5 and one or more of the following:

- Neck stiffness
- Altered consciousness

Other meningeal sign or petechial or purperal rash

In patients <1 year, suspect meningitis when fever accompanied by bulging fontanel.

Laboratory criteria for diagnosis:

- Positive CSF antigen detection or
- Positive culture

Case classification:

Suspected: A case that meets the clinical case definition

Probable: A suspected case as defined above and turbid CSF (with or without positive Gram stain) or ongoing epidemic and epidemiological link to a confirmed case

Confirmed: A suspected or probable case with laboratory confirmation

Haemophilus influenzae type b meningitis and bacterial meningitis

Bacterial meningitis is characterized by fever of acute onset, headache and stiff neck. Meningitis is not a specific sign for Hib disease and Hib disease cannot be diagnosed on clinical grounds.

Laboratory criteria for diagnosis

Culture: Isolation of Hib from a normally sterile clinical specimen, such as CSF or blood.

Antigen detection: Identification of Hib antigen in normally sterile fluids.

Case classification

Potential: (bacterial meningitis case): a child with a clinical syndrome consistent with bacterial meningitis.

Probable: not applicable

Confirmed: a case that is laboratory –confirmed (growth or identification of Hib in CSF or blood.

Viral meningitis

Clinical case definition

A case with fever and one or more of the following:

- Neck stiffness
- Severe unexplained headache
- Neck pain and 2 or more of the following
- Photophobia
- Nausea
- Vomiting
- Abdominal pain
- Pharyngitis with exudates

For children <2 years of age a case definition is defined as a case with fever 38.5 c and one or more of the following

- Irritability
- Bulging fontanel

Laboratory criteria for confirmation

The specific virus confirmed on cell culture

Case classification

Suspected: A case that meets the clinical case definition.

Probable: A suspected case with one or more of the following

- Normal CSF glucose and normal or mild increase in CSF protein (>50 mg/dl) moderate increase CSF cells (<500/mm³) and lymphocyte predominance (>50%).
- CSF positive for viral genomic sequences using PCR (Polymerase Chain Reaction).
- Epidemiological link to a confirmed case.

Confirmed: A suspected or probable case with laboratory confirmation.

Suspected meningitis case definition based on MOH criteria

For patients > 1 year old

Sudden complain with fever >38.5°C accompanied with three symptoms from the following:

Headache/vomiting/neck rigidity/echimosis/systolic hypotension/seizures or coma/epidemic or outbreak.

For children <1 year old

Sudden increase in fever \irritability/seizures/bulging fontanel Echimosis. or one sign from the previous with one sign of:

Vomiting, drowsiness, neck rigidity, epidemic or outbreak.

Confirmed meningitis case definition by MOH criteria

It is the suspected case in addition to the following:

- Isolation of the causative agent by culture of CSF or blood.
- Appearance of the causative agent in gram stain test of CSF or blood.
- Latex test positive of CSF.

By analyzing the data by the MOH case definition first the cases were divided into cases under or equal one year old and cases with age greater than one year old. Cases <1 year old were 122 cases while cases over 1 year old were 349 cases.

For cases over 1-year-old 315 cases (90.3%) fit the MOH suspected case definition, while 34 cases (9.7%) don't. For cases less than one year old 86 (70.5%) cases fit the case definition while 36 cases (29.5%) don't. In case definition of the MOH no probable cases and there is only either suspected cases either confirmed.