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Management of an outbreak of meningococcal meningitis in a Sudanese refugee camp in Northern Uganda

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SUMMARY

We describe an outbreak of meningitis at a Sudanese refugee camp in Northern Uganda that lasted over a year from February 1994. Some 291 cases occurred in a refugee population of 96 860 (averaged over the year), an attack rate of 0·30%. The case fatality rate was 13·3%. From a small number of samples taken for culture *N. meningitidis* serogroup A, serotype 21:P1·9, clone III-1 was identified as the causative organism. The outbreak started in the camp's reception centre which had the highest attack rate. Spread from the reception centre was rapid and the epidemic reached its peak within 3 weeks. All of the cases amongst residents of the reception centre reported having had meningococcal vaccine before arriving at the camp and so were not immunized on arrival as would normally have been the case. Some 37 547 doses of meningococcal vaccine were used in a mass immunization campaign in February and March 1994. Following this the outbreak was declared over in August 1994 when no cases were registered for 2 consecutive weeks. However, following a massive and sudden influx of refugees a new epidemic peak occurred during February 1995. Many of these new refugees were also not immunized on arrival due to pressures of numbers. A follow-up immunization campaign then brought an end to the outbreak. Our experience confirms the effectiveness of timely and high-coverage immunization campaigns in controlling group A meningitis outbreaks amongst refugees in Africa.

INTRODUCTION

Bacterial meningitis is a major problem in Africa where large epidemics of meningococcal disease occur every 5–10 years in the so-called meningitis belt [1]. However, epidemics are also common in countries outside the belt [2]. These epidemics usually start at the peak of the dry season and end with the arrival of the rainy season [2, 3]. The factors which initiate and propagate these epidemics are still not fully understood [3, 4]. Most of these epidemics are caused by *Neisseria meningitidis*, serogroup A. Attack rates are often as high as 1% and case fatality rates may exceed 30% [5, 6].

Prevention of meningitis by the inclusion of meningococcal A+C vaccine in childhood immunization schedules is hampered by its limited immunogenicity and duration of protection in children aged under 4 years. Mass immunization campaigns appear to be effective in controlling outbreaks if carried out early in the course of the outbreak [7–10], though their value in refugee settings has recently been questioned [6].

If vaccination is to be effective in controlling epidemics of serogroup A meningococcal meningitis such epidemics need to be detected early. This is problematic because existing surveillance systems are often poor and there may be uncertainty about the number of cases requiring to be ascertained before declaring an outbreak. While the appearance of two or more related cases of meningitis may be sufficient to signal the start of a potential outbreak when these are the first cases to have occurred for some time, such

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a small number will not be obvious against a background of endemic disease. Furthermore it can be difficult to distinguish between cases occurring during a post-epidemic endemic period and the start of a new epidemic wave. In these situations, several thresholds have been proposed such as the doubling of weekly cases or more than 1 case/1000 population/week [12]. The most widely used measure of some 15 cases/100000 population/week averaged over 2 weeks was proposed by Moore and colleagues [13]. However, as most of the available evidence for the use of Moore's epidemic threshold for early detection of outbreaks comes from indigenous settings in countries within the meningitis belt, it has been suggested that this level may be inappropriate for refugee populations [6].

In this paper we describe a meningitis outbreak that occurred between February 1994 and March 1995 amongst Sudanese refugees in Northern Uganda; we describe and evaluate the epidemiological criteria used to identify the outbreak and the measures taken to control it.

MATERIALS AND METHODS

Study population

East Moyo sub-district is part of Moyo District in Northern Uganda on the border with Sudan. West and East Moyo are divided by the Albert Nile. The eastern part of the district contains two thirds of the population of which the large majority are Sudanese refugees. The climate is more similar to that of Southern Sudan, which is part of the meningitis belt, than to that of Southern Uganda.

The first consistent influx of Sudanese refugees into East Moyo was registered in 1988. By 1989 the refugee population of East Moyo amounted to about 30000 people mainly from the Madi, Acholi and Kuku tribes. A transit camp for the refugees was opened by the United Nations High Commissioner for Refugees (UNHCR) in Ogujebe on the East bank of the Nile. Médécins Sans Frontières Switzerland (MSF-CH) was the main implementing Agency being in charge of the provision of health and sanitation services. MSF-CH was running a large 150 beds health centre, with tuberculosis, maternity, paediatric, general and malnutrition wards in the transit camp and five dispensaries located in the settlements. The health centre was not classified as a hospital as it did not have an operating theatre. Routine meningococcal A+C immunization of all new arrivals aged 2–25 years had been part of the initial health screening in the camps since their opening in 1989.

In February 1994 when the meningitis outbreak described in this article started, the total UNHCR official refugee population was around 100000 persons of whom 71317 were living in the transit camp and the remaining 34098 in the seven settlements. These settlements had been opened in the early 1990s to allow more space and to encourage self-sufficiency. By March 1995 UNHCR official figures were 106205 for the transit camp and 42099 for the settlements. MSF-CH estimates of the population were identical to those of UNHCR for the settlements, but were some 30000 less for the transit camp. For all calculations the MSF-CH population figures have been used because they were felt to be more accurate as they were based on constantly updated counting of the population made by the MSF-CH community health workers. The average of the February 1994 and March 1995 population estimates were used for calculations of attack rates.

Overcrowding was a problem in the transit camp and especially in the reception centre of Pachara. At the reception centre some 2000 refugees occupied an area of less than 20000 m^2, giving less than 10 m^2 per person.

Epidemiological surveillance and case definitions

Case definitions used were:

(1) A case, adult or child, was defined as having meningitis, if at least three of the following were present: fever, headache, vomiting, convulsions, mental confusion, stiff neck, positive Kernig's sign.

(2) For infants of one year and below, a case was defined as having meningitis if at least three of the following were present: fever, refusal to feed, irritability or excessive crying, convulsions and a tense anterior fontanelle.

An outbreak was declared 3 days after the index case had been diagnosed in Pachara Reception Centre on 22 February 1994 when there were just four cases. Factors supporting the declaration at that time were the proximity of cases in time and space and the knowledge that no cases had ever been registered in the camps since their opening in 1991, other than two sporadic cases in September and December 1991.

The case definitions, instructions on referrals and advice on early management (treatment with intravenous or intramuscular penicillin and referral to the health centre), were sent to all medical assistants and dispensary personnel. At the health centre, adults and children were treated with intravenous chloramphenicol, and infants up to 2 months old with ampicillin. Community health workers were trained to recognize the signs and symptoms of the disease and refer patients to the nearest dispensary or to the health centre. Routine information collected on each patient, when possible, included age, gender, residence, date of arrival into the camps, date of diagnosis, immunization status and disease outcome.

Laboratory investigations

Routine lumbar puncture (LP) was performed on the first six patients during the first 5 days of the outbreak, then LP was performed only when differential diagnosis, mainly of cerebral malaria, was required. Four samples of cerebrospinal fluid (CSF) were sent to Epicentre in Paris at the end of March 1994, and from there to Oslo to the National Institute of Public Health, for typing.

RESULTS

The outbreak

The outbreak started in the reception centre at Pachara on 22 February 1994, when the first case in a 26 year old male was identified. During the following 3 days another 3 cases were diagnosed, 1 more in Pachara and 2 in the nearby transit camp. The outbreak started amongst a group of 2000 Acholi refugees, who had been transferred in November 1993 to Pachara reception centre in Moyo from the neighbouring district of Kitgum, where they had arrived a few days before from Sudan. Kitgum District, like the rest of Northern Uganda, sees meningitis cases regularly during each dry season. During the 1994 dry season, several cases of meningitis were registered in Kitgum, both among the local population and the few refugees still living there.

The outbreak was officially declared within 4 days of the identification of the index case. A total of 321 cases satisfying the case definition was reported during the following 58 weeks (Fig. 1). The outbreak was initially declared over on 15 August 1994 as no new cases had been identified during a 2 consecutive week period. However in the following week a further two cases were identified and additional cases were ascertained until the end of March 1995, when the outbreak finally ended. The epidemic threshold of 15 cases per 100000 population over 2 consecutive weeks was breached again in the 52nd week of the outbreak, 2nd–3rd week of February 1995.

Of the 321 cases registered, 30 were amongst Ugandan citizens living in villages close to the camps and using the refugee health service facilities. These cases were mostly concentrated towards the end of the second epidemic wave in February-March 1995. Of the 291 refugee cases, full information was available for 199 of them; some information, eg residence, was available for some further 38 cases, while no other information but the number and the period, eg March 1995, was available for the remaining 54 cases. Of the 237 cases for whom residence was documented, 17 were in the reception centre, 147 were in the rest of the transit camp and 73 were resident in the settlements. Gender and age were documented for 199 of the 291 cases; of these, 101 were males and 98 were females.

The age distribution, the attack rate and the case fatality rate of the 199 for whom this information was available, is shown in Table 1. The overall attack rate was 0·30%. The attack rate was highest in the reception centre of Pachara, moderate in the rest of the transit camp and lowest in the settlements (χ^2 for trend = 14·54, $P < 0{\cdot}00014$, Table 2).

A total of 43 deaths was registered during the outbreak; of these, full information was available for only 25. There was no significant difference in the case fatality rates for residence (χ^2 for trend = 1·017, $P =$ 0·3133, Table 2).

Lumbar puncture was performed on 50 (16% of clinically diagnosed cases). Of these, 41 (82%) were positive for pus cells on direct microscopy. From the four samples sent to the Oslo Public Health Laboratory in March 1994, the diagnosis of *N. meningitidis* serogroup A, serotype 21:P1.9, clone III-1 was confirmed.

Previous vaccination status

The response to the enquiry about vaccination history was available for 199 cases, 166 until August 1994 and 33 between January and February 1995. Because many people did not have vaccination records with them, self-reported previous vaccination was accepted as evidence if the patient or his/her relatives were able to specify the period and the place where the patient

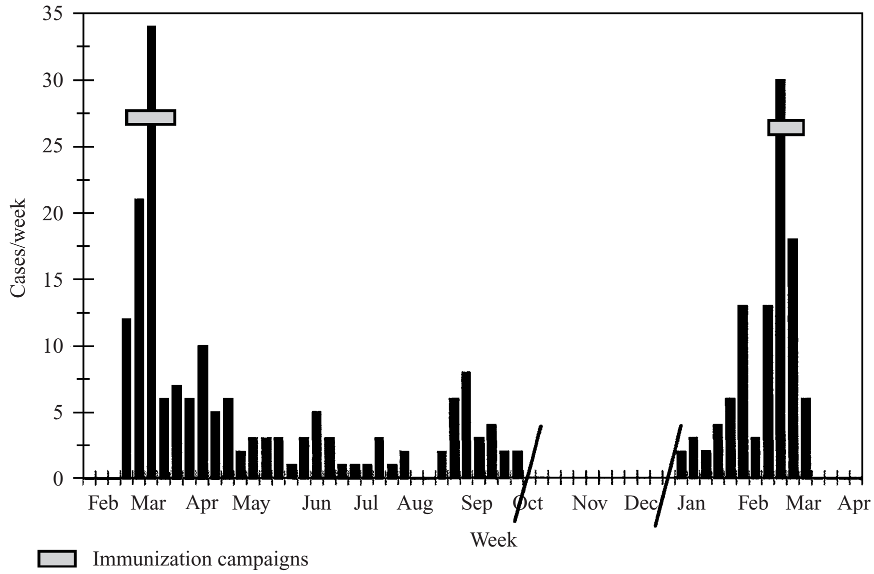

Fig. 1. Epidemic curve of outbreak of meningitis in a refugee camp in Northern Uganda. Date of onset (and other demographic data) not available between slanted lines as data collection failed during a period of severe famine.

Table 1. *Age specific attack rates and case fatality rates*

Age group	Population	Number of cases	Attack rate (%)	Number of dead	Case-fatality rate (%)
< 1	3874	18	0·46	3	16·7
1–4	14045	24	0·17	0	0
5–9	13948	17	0·12	2	11·8
10–14	11623	26	0·22	2	7·7
15–19	9880	39	0·39	7	17·9
20–29	15498	35	0·23	2	5·7
30–44	15110	26	0·17	6	23·1
45+	12882	14	0·11	3	21·4
Unknown		92		18	19·6
Totals	96860	291	0·30	42	14·4

Table 2. *Attack rates and case-fatality rates by residence for refugees only*

Residence	Population	No. cases	Attack rate (%)	Deaths	Case fatality rate (%)
Pachara	2000	17	0·85	2	11·7
Transit	58762	147	0·25	17	11·5
Settlements	38098	73	0·19	5	6·8
Unknown		54		18	33·3
Total	96860	291	0·30	42	14·4

had received the vaccination. Of these 199 cases, 70 did not know their vaccination status. Of the remaining 129, 41 stated they had not been vaccinated (of whom 4 were children under 1 year), 9 had been vaccinated more than 3 years before and 85 stated they had been vaccinated in the previous 3 years. Of these 85, a total of 67 had been vaccinated in Moyo, either during the mass campaign of February–March 1994 or on arrival, 6 had been vaccinated in Sudan and 12 in Kitgum district before their transfer to Moyo in November 1993. Of the 67 who had been vaccinated in Moyo by MSF-CH, 26 had received the vaccine less than 7 days before being diagnosed with meningitis. This leaves 41 cases (for age distribution,

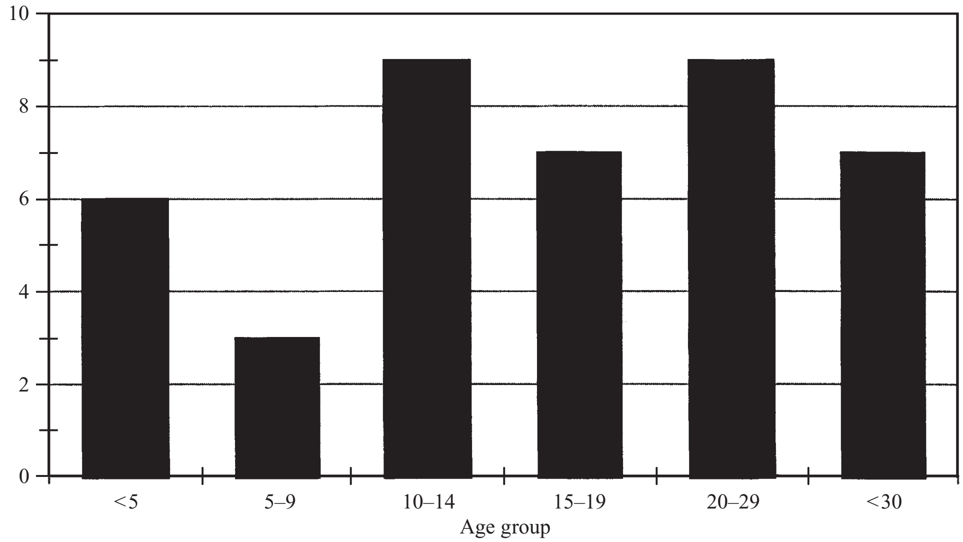

Fig. 2. Age distribution of cases who had received immunization in Moyo more than 7 days before onset of illness.

Table 3. *Calculations of vaccine effectiveness in the 1–30 year age group*

	Population	Person weeks	
Non-vaccinated or < 7 days post vaccine			
Estimated population in weeks 1–4	51 000	204 000	
Estimated population unvaccinated weeks 5–57	13 500	715 500	
Estimated population of new influx unvaccinated weeks 20–57	11 000	418 000	
Total unvaccinated weeks		1 337 500	
Number of cases in unvaccinated			107
Attack rate/10 000 person weeks			0·80
Vaccinated > 7 days			
Estimated population in weeks 5–57	37 500	1 987 500	
Estimated number of new population influx weeks 20–57	18 000	684 000	
Total vaccinated weeks		2 671 500	
Number of cases in vaccinated > 7 d			34
Attack rate/10 000 person weeks			0·13
Protective effect of immunization			83·8 %

see Fig. 2) who had been vaccinated in Moyo more than 7 days before developing meningitis and thus did not respond to the vaccine. In particular, 14 of these 41 non-responders were vaccinated during the mass campaign of February–March 1994 when a total of 37 547 doses were given. Twelve cases, including the index case, were among the 2000 Acholi tribes people who had not been immunized on their arrival in Pachara because they had written records of meningitis vaccination from a few days earlier in Kitgum.

From the available data, it was not possible to calculate the precise protective effect of vaccine. Table 3 show the calculation for an estimate of the protective effect of immunization. However, there was a high level of uncertainty regarding both case and denominator numbers and so this value must be taken as indicative only.

Control measures

An isolation ward for the treatment of meningitis cases was opened in the Health Centre at Ogujebe as soon as the first cases were identified.

Eight days after the identification of the index case, a mass immunization campaign was started in the reception centre of Pachara, where the outbreak had started. A single dose of 0·5 ml of bivalent (A+C) polysaccharide vaccine, provided by the Ugandan National Expanded Immunisation Program (UNEIP) was injected subcutaneously in the deltoid muscle region of each person between the ages of 1 year and 30 years, irrespective of previous vaccination status. Single use material was used and an immunization card was issued to each person.

A total of 37 547 doses of vaccine was given to persons in the target age group during the 3 weeks between 28 February and 17 March 1994. Based on the MSF-CH population figure and estimating that about 65% of the population was contained in the target age group [16], the following coverage rates were obtained: overall coverage 77%, transit camp and reception centre 73%, settlements 82%.

Cases of meningitis peaked again with the arrival of the dry season in January 1995, with the epidemic threshold of 15 cases per 100 000 population (averaged over 2 consecutive weeks) being crossed in the third week of February 1995. Further 'one day' immunization campaigns were undertaken during February and March 1995 in those areas, the transit camp and some nearby settlements where the recent cases had occurred. A total of 5002 doses of vaccine was administered in February, and 2365 doses in March 1995.

DISCUSSION

The overall attack rate registered during this outbreak was high compared to many, but not all other reported outbreaks amongst refugees. For example, compared to the attack rate in this epidemic of 0·30%, that of an outbreak in Kibumba and Kitale–Zaire 1994 was 0·094–0·134% [6], 0·130% amongst Khmer refugees in Thailand during 1980, and over 0·50% amongst Ethiopian refugees in Eastern Sudan during 1985 [15]. However caution must be used when trying to compare these rates with each other because of the different case definitions employed. In Moyo district a clinical case definition was used, whereas in others the case definition was based on laboratory diagnosis.

The epidemic in Moyo district had an early peak during the third week. This is very similar to the outbreak in Katale, Zaire during 1994 and contributes to evidence that the epidemiology of meningococcal disease in refugee populations is distinctive [6]. Refugee populations are at high risk of rapid spread of infection due to overcrowding, malnutrition and generally poor living conditions [3]. Overcrowding was a problem in the transit camp and even more in Pachara reception centre where each refugee had less than the 10 m^2 available as recommended by UNHCR [6].

It was not clear whether the reduced incidence of disease in the settlements was solely due to less overcrowding or was because of their distance from the reception centre at Pachara. Although new arrivals were not supposed to leave the reception centre for the first few months, to avoid the potential spread of communicable diseases, the transit camp with its large market was too enticing for the newly arrived. Furthermore, delays in the distribution of food and water to the Pachara residents were further reasons for them to leave the reception centre and walk to the transit camp where water pumps and food depots were located. This may have been the route for the rapid dissemination of the disease to the population of the transit camp.

A major issue during the first epidemic period was the apparent failure of vaccination amongst the 2000 Acholi refugees at Pachara who reported having recently received bivalent meningococcal vaccine in Kitgum. Whether this was because of inappropriate administration was not clear. The bivalent vaccine in use in Uganda has to be administered subcutaneously to be effective; when erroneously given intramuscularly, it is rapidly eliminated from the body without production of protective antibodies [15].

Although the age-band recommended as the target for mass immunization amongst refugees during an epidemic is that of 1–25 years old [15], the upper age limit was extended to 30 because recent experience indicated high attack rates among people in this age group [17]. The effectiveness of the mass vaccination campaign was shown by the sharp drop in cases that followed (Fig. 1). However between May and July 1994, a massive influx of over 30 000 refugees was registered. Both the MSF-CH screening service and the UNHCR registration service had great difficulty in coping with this sudden increase in workload compared to the normal average of between 1000 and 2000 newcomers a month. These difficulties were compounded by epidemics of measles and malnutrition amongst the refugees at this time. This sudden influx resulted in an estimated 11 000 refugees not being screened at their arrival and immunization not being given to the target age groups. This may have led to the subsequent cases which peaked again during the second and third weeks of February 1995. Further evidence for the effectiveness of the vaccine in this epidemiological setting was provided by the ending of the outbreak following the 'mopping-up' operations of February–March 1995 (Fig. 1). These operations allowed catch-up immunization of those new arrivals who had slipped through the screening net in May–July 1994 and were then at risk from the second epidemic wave.

Mass immunization campaigns are an effective method in controlling outbreaks of serogroup A meningococcal meningitis in refugee settings in Africa. To be effective campaigns need to be started early, carried out properly and achieve a high vaccine coverage amongst target groups. Early detection of outbreaks is of vital importance and this can be done through the use of sensitive epidemiological criteria such as the appearance of two or more related cases, or the use of Moore's threshold, depending on the circumstances. Moore's threshold is also useful in identifying a new epidemic during a post-epidemic period. These and other epidemiological criteria can only be employed when an appropriate surveillance system is in place, with prompt and accurate diagnosis of cases. This outbreak demonstrated the difficulties in maintaining such a system in a refugee setting when other demands on the health care system (as in dealing with the impact of a severe famine) may take precedence.

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