Outbreak of Meningococcal Infection amongst Soldiers Deployed in Operations

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Abstract

Background: Meningococcal infection may lead to life threatening meningitis and fulminant meningococcal sepsis. Sporadic cases of meningococcal infection have been reported in soldiers but no outbreak in soldiers has been reported earlier from India. This outbreak in soldiers serving in counter insurgency role under field setting was effectively controlled without compromising their operational commitment.

Methods: This is an epidemiological investigation and control of an outbreak of meningococcal infection, bringing out the predisposing factors and highlighting the role of early diagnosis and management of cases. Mass chemoprophylaxis in contacts was used as an effective control measure in the absence of vaccine in this institution based outbreak.

Result: Out of a total of 17 cases reported, 14 presented as meningitis and three as meningococemia. Two cases of meningococemia ended fatally. Serogroup A of *Neisseria meningitidis* was responsible for this outbreak. Gross over-crowding was the predisposing factor.

Conclusion: An outbreak of meningococcal infection in soldiers deployed in counter-insurgency role was effectively contained using mass chemoprophylaxis in the absence of meningococcal vaccine.

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Key Words : Meningitis; Meningococcal infection; Outbreak; Soldier

Introduction

Meningococcal disease occurs worldwide as isolated (sporadic) cases, institution or community-based outbreaks and in the form of large epidemics. Meningococcal infection can lead to two life threatening conditions i.e. meningitis and fulminant meningococcal sepsis (FMS). Without epidemics, one million cases of bacterial meningitis are estimated to occur with at least two lakh deaths globally every year. About three lakh cases and 30,000 deaths are estimated to occur due to meningococcal infection. In India, outbreaks have been reported from different parts in 1985, 2000 and 2005-2006 [1-4]. Between 01 Feb and 26 May 2006, 17 cases of meningococcal infection were reported amongst soldiers deployed in Kashmir.

Material and Methods

This is an observational, epidemiological study amongst soldiers deployed in field setting. The index case was reported from a training institute on 01 Feb 2006. A suspicion of an impending outbreak of meningococcal meningitis was considered, awaiting lab confirmation. When the second case occurred on 03 Feb, the outbreak was confirmed. The case definitions adopted were as given by WHO [5]. A “suspected” case as one with fever with stiff neck or petechial or purpur

rash or both. “Probable” case was defined as a suspected case with turbid cerebro-spinal fluid (CSF) with or without positive Gram stain in ongoing epidemic. A “confirmed” case was any suspected or probable case and either positive CSF antigen or positive culture. Ongoing passive surveillance using case definition for a suspect case was established and instructions for early institution of antibiotics were issued to all units. Epidemiological case sheets were developed and data collected on all cases. The cases were studied for their distribution in time, place and person; data collected and analyzed. A detailed study of their living conditions was done and a list of close contacts prepared. Data on prevailing meteorological conditions was collected. On 04 Feb 06, a team comprising of a community medicine specialist, health assistant, laboratory assistant and an ENT operating room assistant visited the training institute to carry out investigation. A portable incubator was also carried to ensure safe transport of the specimen as ambient temperature was low. All the contacts of two cases were segregated, examined, and throat swabs collected. They were administered chemoprophylaxis after collecting throat swab samples. Chemoprophylaxis was done by using rifampicin 600 mg twice a day for two days to close contacts. Others in the unit or subunit were administered ciprofloxacin 500 mg stat. A close contact was defined as any person who stayed in the same room, bunker or was in contact with the case being his

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buddy or friend and health care workers.

Previous morbidity data was reviewed from the records available. A health awareness drive was also organised highlighting the signs and symptoms of disease with preventive measures to be taken by the troops. On occurrence of any case, all the contacts were identified, segregated, administered chemoprophylaxis and put under medical surveillance for ten days. All units reporting suspected / probable case were visited by health staff of concerned formation and necessary instructions on preventive measures instituted, including chemoprophylaxis.

Over crowding was tackled by dispersal and head to foot arrangement of beds. Ventilation was improved by keeping doors and windows open during day. The barracks reporting cases were mopped with 2.5 % cresol and fumigation was done. All healthcare providers were also given chemoprophylaxis besides adopting standard precautions as applicable in preventing droplet infections. The laboratory investigation of the cases included routine blood count, examination of CSF for cytology, biochemistry, Gram stain and culture. Examination of skin smear from purpuric spots to demonstrate Gram negative diplococci was done in one case and was positive. The throat swabs were inoculated on blood and chocolate agar media and incubated at 35°C in presence of 5 to 10% CO₂. The gram negative colonies were then subjected to oxidase test and further confirmed by testing for biochemical utilization of sugar. Three samples of culture isolate were sent to All India Institute of Medical Sciences, Delhi for serotyping. All admitted cases were discharged only after throat swab cultures tested negative for *Neisseria meningitidis*.

Results

All the cases were from locations at an altitude of around 3000- 5000 feet. The weather conditions were late winters to early spring. The relative humidity was recorded from 74 % to 85 %. There were no reports of a similar outbreak amongst army personnel in the past in the same geographical area or amongst the civil population during the same period.

There was considerable overcrowding in the training institute where focal outbreak occurred. A total of 2976 troops were accommodated whereas the living accommodation was designed to cater for only 2227 troops. The deficiency was limited to trainee accommodation (Tables 1, 2). Moreover the use of double bunk beds reduced the available per capita air space and air volume. Lack of any heating appliances led to huddling up by the soldiers. Amongst sporadic cases in field setting, gross overcrowding and poor ventilation was noted in most cases. There was an overall deficiency of 34% in living accommodation and cots were deficient by 50% (Table 1). This was further aggravated due to poor and inadequate ventilation. On study of a barrack, it was revealed that per capita floor space was 30-36 sq ft as against recommended 50 -100 sq ft and air space available was 300- 350 cubic ft as against minimum laid down air space 500-1000 cubic ft per capita. The bed to bed distance was 0 to 3.4 feet as against a minimum of 6 feet. Windows and doors were kept closed due

to cold weather, further compromising ventilation. Window space was much below desired standard of minimum of 10% of floor space. The available window space was only 48 square feet against a desired minimum of 86 square feet in a room of 864 square feet.

Distribution of Cases

The entire outbreak lasted for about four months, from 01 Feb to 26 May 2006 (Fig. 1). The focal outbreak lasted for 19 days only while sporadic cases continued upto 26 May 06. The first ten cases were clustered in time and space, probably forming a part of the initial outbreak. Out of total 17 cases reported, a cluster of six were from a training establishment and 11 were sporadic coming from different locations. In the focal outbreak at training establishment, all six cases were from adjacent barracks. Sporadic cases did not give history of contact with cases or their contacts from the site of focal outbreak. However, four cases reported from a general area lying along a common axis, shared distribution in time and space with the focal outbreak. Out of 17 reported cases, 15 were young trained soldiers (21- 26 years of age).

Clinical Profile

Out of 17 cases reported, 14 (82.3%) presented as meningitis and three had features of meningococcal septicemia (fulminant meningococcal sepsis). All cases of meningitis had headache, fever and signs of meningeal irritation (Table 3). Three cases presenting as meningococemia had features of coma, hypotension, seizures and petechial rashes (Fig.2). One case developed features of Waterhouse-Friderichsen Syndrome and died (Fig.3). Late reporting in another case of fulminant meningococemia led to fatal outcome. Timely reporting in one case of meningococemia,

Table 1

Summary of accommodation state and bed deficiency in the Training Institute

Course	Accommodation		Bed	
	Available	Deficient	Available	Deficient
CTC (RR)	948	312	672	588
CTC (OA & S)	280	70	300	50
UTT	40	14	50	04
GARUD & MARCOS	54	06	60	0
PIT Units	576	324	70	830
Adm & Staff	329	23	352	0
Total	2227	749 (34%)	1504	1472 (50%)

Table 2

Accommodation and deficiency in Barracks reporting cases (Focal outbreak)

Barrack No.	Capacity	Accommodated	Available beds	Remarks
T-68	112	152	112	I st case
T-70	112	160	32	II nd case
T-69	112	135	32	III rd case
T-116	112	112	112	V th case
T-49	96	130	70	IV th &VI th case

due to its proximity to the hospital and efficient management resulted in complete recovery. The meningitis cases recovered without any sequelae.

Laboratory Findings

The laboratory profile of all cases was studied (Table 4). There was polymorphonuclear leucocytosis. CSF had turbid appearance, elevated proteins and reduced sugar level. Gram stain of CSF revealed presence of Gram- negative diplococci (Fig.4) in 16 cases. The CSF culture grew *Neisseria* organism in only three cases. One sample from skin, in a case of meningococemia revealed presence of intracellular diplococci. Out of 97 samples of throat swab collected from

trainees selected at random for detecting carriers, only 14 (14.4%) could be confirmed as carriers. The samples of CSF, serum and culture isolates were sent to AIIMS, New Delhi. These were similar to the Delhi outbreak i.e. Group A *Neisseria meningitidis*. Post-mortem was conducted on the two fatal cases to establish the diagnosis.

Discussion

Meningococcal meningitis is an acute communicable disease caused by *N meningitidis*. It is a gram negative diplococcus found in the nasopharynx of 5- 30 % of normal population during inter-epidemic period. Jha et al [6] reported a carrier rate of 11.94 % amongst recruits of a military training centre and recorded 14.4% carrier rate amongst trained soldiers. Groups A and C, and to lesser extent Group B organism, are capable of causing major epidemics. Group A is responsible for majority of infections in developing countries and India [3,4,7]. Group A serotype was also found to be responsible for this outbreak. An organization or community based outbreak is defined as the occurrence of three or more cases within three months in persons who have a common affiliation or reside in the same area but who are not close contacts of each other; in addition the primary disease attack rate must exceed ten cases per 100,000 persons [8]. No outbreak of this

Table 3
Clinical Profile

Symptoms/Signs	Frequency (%)
Headache	17/17 (100)
Neck stiffness	16/17 (94.1)
Fever	16/17 (94.1)
Vomiting	13/17 (76.4)
Altered sensorium	04/17 (23.52)
Seizure	03/17 (17.6)
Petechial rashes*	03/17 (17.6)
Coma*	03/17 (17.6)

* Three cases of fulminant meningococcal sepsis

Fig. 1 : Epidemic curve

Note : Epidemic curve has an initial peak of focal outbreak followed by occurrence of sporadic secondary cases due to person to person transmission following dispersal of soldiers from the training institute where the outbreak began.

Fig. 2 : Petechial rashes

Fig. 3 : Post mortem findings in a case of Waterhouse Friedrichsen Syndrome- Bilateral adrenal hemorrhage

Fig. 4 : Turbid CSF showing intracellular Gram negative bacilli

Table 4

Laboratory profile of cases of meningococcal infection

Parameter	Average	Minimum	Maximum	Remarks
Total leucocyte count	13,470/ cmm	7300/ cmm	20,250/cmm	Leucocytosis in 11/17 (67.7%)
Polymorph count	72.8%	27%	90%	Polymorphocytosis in 7/17 (41%)
CSF cell count	7886/cumm	20/cumm	41,600/cumm	Increased in all
CSF sugar	23.5 mg/dl	nil	84 mg/dl	Reduced in 11/17 (67.7%)
CSF protein	466.4 mg/dl	20 mg/dl	1500 mg/dl	Increased in 13/17 (76.5%)
CSF turbidity	CSF was turbid in all the cases			
Gram stain	Gram negative diplococci were seen in 16/17 cases			
CSF culture	Culture was positive in three cases			

magnitude amongst soldiers has been reported earlier [7]. Mass vaccination should be considered when such outbreaks occur and mass chemoprophylaxis may be used to control institution-based outbreaks [3,7,8]. The United Kingdom has taken an important step in becoming the world's first country to implement routine immunization with meningococcal conjugate vaccines [9]. In US, all recruits receive the quadrivalent A, C, Y, W-135 meningococcal vaccine and routine vaccination of all children 11-12 years has been recommended [10].

Meningococci can cause inapparent infections to severe disease like meningitis or meningococemia, depending on the immunity of the host and severity of infection. Carriers are the most important source of infection [3]. This is predominantly a disease of older children and young adults. All, except two cases in this outbreak, were aged between 21 to 26 years. The clinical presentation was mainly as meningitis and three cases (17%) presented as meningococemia. Case fatality rate reported in this outbreak was 11.76% which is lower than that reported in other studies [1,11-13].

Outbreaks occur more frequently in dry and cold months of the year as seen in this outbreak. Over crowding, as occurs in schools, barracks, refugee and other camps is an important predisposing factor. Gross overcrowding and inadequate ventilation was seen in this outbreak. Close contacts of persons with confirmed meningococcal disease are at an increased risk of developing meningococcal illness (about 1000 times the general population). Chemoprophylaxis with rifampicin 600 mg orally every 12 hour for two days or ciprofloxacin 500 mg orally single dose or ofloxacin 400 mg single dose or intramuscular injection of ceftriaxone 250 mg is recommended for close contacts. In the present outbreak, occurrence of a case of pyogenic meningitis in the absence of any previous such incidence from a training institution had raised the suspicion of a meningococcal outbreak [4].

Ongoing surveillance of troops and their contacts was carried out. On occurrence of any suspected case, complete details of movement of the case and contacts

were recorded. Early treatment of cases with rifampicin chemoprophylaxis of all contacts was done under supervision and cases were put under medical surveillance. Vaccination could not be used as a control measures due to non-availability of desired quantity of vaccine in time. Vaccine is recommended as an important measure in the control of epidemic. Besides, the vaccine is routinely recommended in adults with anatomic or functional asplenia or terminal complement component deficiencies. Other indications are first-year college students living in dormitories, microbiologists who are routinely exposed to isolates of *Neisseria meningitidis*, military recruits, and persons who travel to or reside in countries in which meningococcal disease is hyperendemic or epidemic (e.g., the "meningitis belt" of sub-Saharan Africa during the dry season), particularly if contact with local populations will be prolonged [14].

Conclusion

The outbreak of meningococcal infection in the soldiers deployed under field conditions in counter insurgency operations was effectively investigated, monitored and controlled using mass chemoprophylaxis. Occurrence of sporadic cases points to the fact that probably high carrier rate generated after the outbreak holds a potential threat in the coming season. We need to remain vigilant and alert. Avoiding overcrowding is an important preventive measure at all training institutes. Vaccination of recruits in training centers is recommended to be introduced as is practiced routinely in the United States [15].

Conflicts of Interest

None identified

Intellectual Contribution of Authors

Study Concept : Lt Col AS Kushwaha

Drafting & Manuscript Revision : Lt Col AS Kushwaha

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