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Original Article

Outbreak control of community acquired pneumonia in a large military training institution

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ABSTRACT

Background: Between 09 Jan 2011 to 25 Mar 2011 an outbreak of respiratory illness was reported from a Military Training institution. 52 cases of respiratory tract infection were admitted from this institution. All the cases were trainees between 18 and 21 years of age. Aggressive control measures were instituted along with the investigation of the outbreak to determine the nature of the disease and the causative organism.

Methods: The investigation of the outbreak was initiated on 08 Mar 2011 when a sudden rise in number of hospital admissions due to respiratory illness was noticed. Epidemiological information was collected from the cases. Routine blood investigations, sputum examination and chest radiograph of suspected cases were done.

Results: Total of 52 cases of respiratory illness were reported during the period of outbreak giving an attack rate of 25.8 per 1000. Out of these 52 cases 23 (44.2%) were radiologically confirmed. Streptococcus pneumoniae was grown in 8 (25.85) out of 31 sputum samples. The outbreak was controlled by administration of 'supervised mass chemoprophylaxis' of all susceptible individuals in the institution with Tablet Azithromycin orally. Last suspected case was admitted to the military hospital on 25 Mar 2011.

Conclusion: The study highlights the importance of Streptococcus pneumoniae as a causative organism for outbreaks of community acquired pneumonia (CAP) in large residential training institutions and reiterates the need for formulating a policy for continuous surveillance. It also highlights the importance of the novel method of using chemoprophylaxis for control of an ongoing outbreak of CAP.

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Introduction

Community acquired pneumonia (CAP) is known to have high rate of mortality despite development of better antibiotics.¹ Closed living conditions, environmental challenges and harsh physical training among military trainees increase their risk of acquiring respiratory infections. Major pathogens causing these infections are Group A streptococcus, adenovirus, influenza A, Streptococcus pneumoniae, rhinovirus, Bordetella pertussis, Mycoplasma pneumoniae and atypical agents.² A study done in Turkey has also found that 62.8% of cases of CAP are due to Streptococcus pneumoniae, 13.8% due to Mycoplasma pneumoniae and 10% due to respiratory syncytial virus.³ Outbreaks of pneumococcal disease have been reported from various military institutes all over the world.^{4,5} The aim of the article is to describe the investigation and control of an outbreak of pneumonia that occurred in a large military training institute in winter of 2011 and to give recommendations based on the experience gained during the outbreak control. This military institute trains approximately 2000 trainees at any point of time. There were 2015 trainees aged between 18 and 21 years in the institute during the period of investigation. In January 2011 fresh trainees were joining the institution in first term and other trainees from second to sixth terms were reporting back at the end of term break. Between 06 January 2011 to 08 March 2011, 18 cases of respiratory illness varying between pneumonia/bronchitis/upper respiratory tract infections were admitted to different hospitals for treatment.

Materials and methods

The diagnosis of pneumonia/bronchitis in these cases was established based on clinical presentation, lab reports and chest radiograph findings. An increase in the number of cases of pneumonia/bronchitis being admitted to the hospital compared to last two years was noticed and an investigation into the cause of this apparent outbreak was initiated on 08 March 2011.

Case definition: A case definition was developed as any trainee present in the training institution from 01 January 2011 onwards and presenting with fever with cough whether productive or non productive was defined as a 'probable case' of pneumonia for the purpose of investigation. All cases fitting the probable case definition were treated as cases of pneumonia for the purpose of investigation of the outbreak. 'Confirmed case' was defined as any probable case with chest radiograph PA view showing lobar consolidation.

Epidemiological case sheet and line listing of cases: An epidemiological case sheet was developed and information recorded from all affected cases admitted; domains included personal particulars, date of onset, presenting complaints, date of reporting, date of admission, history of contact with a known case, history of any collective activities, clinical details, lab investigation reports. All probable and confirmed cases were line listed and analysed in time/place/person. In addition following actions were taken to identify the possible source of infection:

- Interview and clinical examination of cases of pneumonia at the training establishment including both admitted cases at the hospital and those which had reported back after sick leave.
- Collection of sputum samples from the affected trainees for microbiological examination.
- Throat swabs were collected from a random sample of healthy trainees.
- Visit to living accommodations, class rooms and training areas to assess environmental factors.
- Interaction with administrative authorities
- Interview of all civilian support staff interacting with trainees who had taken sick leave from January to March 2011

Surveillance: As the investigation progressed, cases continued to be reported on a daily basis. Daily medical inspection of trainees from all terms and subunits was done by medical officer and any trainee suffering from respiratory symptoms like cough with or without sputum, chest pain, breathing difficulty, other symptoms like fever, body aches and weakness was segregated and admitted to the hospital.

Blood culture and sputum culture was carried out for all cases reported after 10 March 2011. Samples were tested for IgM for Mycoplasma pneumoniae at microbiology referral laboratory at local medical college. In addition 54 samples (throat swabs) were collected from healthy trainees to look for carrier rate of Streptococcus pneumoniae and Mycoplasma pneumoniae. These were also sent to National Institute of Virology (NIV) Pune for a viral screen.

Results

Total of 52 cases of respiratory illness were reported from the training Institution between 06 January 2011 to 25 March 2011 giving the attack rate of 25.8 per 1000 for the respiratory illness. The common symptoms for hospitalization were running nose, sore throat, cough and fever. Out of these 52 cases of respiratory illness, 23 (44.2%) were confirmed radiologically (lobar consolidation in one or more lobes on radio-graph chest PA view) (Table 1). There was no fatality.

Out of the 31 sputum samples collected from the affected trainees, 8 (25.8%) showed growth of Streptococcus pneumoniae. None tested positive for IgM for Mycoplasma. Sputum samples were collected for cases in the later part of the outbreak only, hence these samples could not be collected for all 52 cases. None of the blood cultures of the hospitalized cases showed any positive results.

In addition, out of 54 throat swabs that were randomly collected from healthy trainees only 2 (3.7%) samples showed a growth of Streptococcus pneumoniae, 2 (3.7%) were positive for Mycoplasma pneumoniae and 2 (3.7%) were positive for parainfluenza virus. No sample was positive for Influenza A H1N1.

The training institution has 15 subunits to which the trainees are distributed in various terms from first to sixth term. The subunit wise breakdown of cases is given in Table 2 and term wise breakdown of cases is given in Table 3.

Table 1 – Breakdown as per diagnosis of cases of respiratory illness.

Diagnosis	Numbers
Pneumonia (radiologically confirmed)	23
Acute bronchitis	14
Upper respiratory tract infection	15
Total	52

Maximum number of cases (total 15 cases) were reported from subunit 'XII' and from trainees of first term (total 17 cases).

All cases in this out break were admitted between 06 January 2011 to 25 March 2011. The index case was a third term trainee from subunit 'VII' who reported on 06 January 2011. He had reported with cough and fever after rejoining the institution after the term break. He was treated as a case of acute bronchitis in the institute's hospital. There after two cases reported in the month of January 2011 and 4 cases till 11 February 2011. No case reported between 11 February and 22 February 2011 which was followed by a sudden spurt in the number of cases from 23 February 2011 onwards and till 08 March 2011 ten more cases reported which prompted investigation into the cause of the outbreak. The epidemic curve of the outbreak is given in Fig. 1.

The trainees in the institution were staying in separate cabins (size: length 12 feet, width-10 feet, height 14 feet). A small number of first term trainees were sharing a cabin (size: length 12 feet, width-24 feet, height 14 feet) with two trainees per cabin. The ventilation of the cabins was found to be good with no apparent overcrowding. There were no cases among roommates.

The purpose of this investigation was to identify the cause of outbreak and to control it. Hence following interventions were implemented:

- (a) Segregation: As largest number of cases were reported from subunit 'XII', trainees from this subunit were segregated from rest of the trainees and all their

Table 3 – Term wise breakdown of cases of respiratory illness.

Term	Cases	Rate per 1000
1st	17	51
2nd	07	22.7
3rd	08	25.3
4th	08	21.2
5th	06	18.7
6th	06	16.5
Total	52	25.8

activities including training and dinning were carried out separately.

- (b) One outdoor camp which was to begin from 12 March 2011 involving the entire term was cancelled with the purpose of avoiding any strenuous group activity that was likely to increase the risk of transmission.
- (c) All central congregations and other group activities were restricted to bare minimum.
- (d) Health education initiative to educate trainees about warning signs was conducted by the hospital and health staff and they were encouraged to report early. They were also educated about cough and hand hygiene.

Despite implementation of control measures, fresh cases continued to be reported. On 18 March 2011, three sputum cultures were reported positive for *Streptococcus pneumoniae*. Based on this information, 'mass supervised chemoprophylaxis' for all trainees was started on 19 March 2011 with azithromycin 500 mg once a day orally after breakfast for three days. Total of 1957 trainees, 177 permanent staff and 22 support staffs were given the drug under supervision. This was followed by two more weekly doses on 28 March 2011 and 04 April 2011. No major side effects were reported by any of the trainees or staffs who were administered the drug. Last case reported on 25 March 2011, was diagnosed as URTI and treated with antibiotics and was discharged at a later date.

Discussion

It has been long recognized that military populations, especially recruits are particularly susceptible to ravages of respiratory illnesses.² In the present outbreak 52 cases of respiratory illness were reported from the training institute. This investigation was started after 18 trainees in the institution had already been clinically diagnosed as pneumonia/bronchitis and treated with antibiotics. Hence there was a delay and difficulty in establishing the causative organism in the outbreak. However based on the laboratory results of sputum culture, the etiological role of *Streptococcus pneumoniae* was ascertained and interventions were initiated to control the spread of the infection. Literature also supports the fact that predominant pathogen in CAP is *Streptococcus pneumoniae* and accounts for about two thirds of the cases of all cases of bacterial pneumonias.⁷ Similar outbreaks associated with *Streptococcus pneumoniae* have been reported from military training institutions in India^{5,6} and rest of the world.^{6,8,9} In an outbreak in 2002, in a regimental centre in

Table 2 – Subunit wise breakdown of cases of respiratory illness.

Subunit	Cases	Rate per 1000
I	02	14.8
II	01	7.5
III	04	28.9
IV	07	52.2
V	02	15.0
VI	02	14.8
VII	05	37.0
VIII	04	29.6
IX	01	7.4
X	0	0
XI	03	22.9
XII	15	111.9
XIII	03	22.9
XIV	03	22.0
XV	—	0
Total	52	25.8

Fig. 1 – Epidemic curve of the outbreak 06 Jan to 07 Apr 2011.

India, 8 out of 31 blood cultures were positive and 11 out of 26 sputum smears showed diplococci.⁴ While in another outbreak in a regimental centre in 2004 in India, only 8.91% samples showed a mixed growth predominantly *Streptococcus pneumoniae*.⁵ However in the current outbreak no blood cultures showed any growth, but 8 (25.4%) out of 31 sputum samples showed the growth of *Streptococcus pneumoniae*.

Initially in the outbreak, very few cases were reported and maximum cases were seen only in the month of March. It is known that *Streptococcus pneumoniae* is a commensal organism with colonization rates from approximately 8%–45%.¹⁰ Rates of this asymptomatic carriage vary with age, environment and presence of upper respiratory tract infections. In military installations as many as 50–60% of service personnel may be carriers.¹¹ Also the pneumococcal serotypes most often responsible for causing infection are those most frequently found in the carriers.¹¹ In the present outbreak *Streptococcus pneumoniae* was grown from sputum samples. Since the serotyping was not done, source of infection cannot be commented upon with certainty. However, the gap between the index case and the peak of the epidemic can be explained with the hypothesis that the new cases probably resulted from exposure to the nasopharyngeal carriers in the training institution.

Overcrowding is known to increase the risk of spread of respiratory infections. In a study in Russia, conditions like overcrowded accommodation, mixing of personnel during duty and excessive cooling have been found to result in increased incidence of pneumonia among troops.¹² However, in the present outbreak there was no apparent overcrowding in the living area. Relationship between stress and respiratory infections has also been established by many workers.⁹ Most

likely explanation is that severe physical and mental stress of military training in addition to intermingling of trainees of different terms and subunits resulted in spread of infection to nearly all subunits. The infection was probably introduced by one of the trainees who reported back to the institution after term break.

The epidemic curve [Fig. 1] shows a sudden and abrupt drop in the cases after institution of 'mass supervised chemoprophylaxis' with azithromycin which was started on 19 March 2011. A number of studies have evaluated appropriate antibiotic, other than penicillin to treat recruits: erythromycin was found effective at twice daily oral dose of 250 mg. Azithromycin, although expensive, has also been shown to be highly efficacious, and the dosing regimen of 500 mg orally every week is well tolerated.² Banerjee et al. report using erythromycin 250 mg twice a day for 5 days or azithromycin 250 mg once a day for 5 days to control an outbreak.⁴ While Sanchez et al. report using low dose oral azithromycin prophylaxis 250 mg weekly for 2 weeks which resulted in 69% reduction in pneumococcal carriage and 94% reduction in pneumonia rates.⁶ Drugs like amoxicillin and clarithromycin have also been tried for management of CAP and found effective.¹³ Nancy et al. also report control of an epidemic of pneumonia associated with Group A *Streptococcus* in 2002 by administration of single dose of intramuscular benzathine penicillin (1.2 million units) or azithromycin (1 g orally).⁸ Use of pneumococcal polysaccharide vaccine is recommended in adults >65 years or high risk persons between 2 and 64 years of age for prevention of invasive complications and has not yet been recommended for use in healthy adults for prevention of CAP.¹⁴ In the present outbreak, decision was taken to give azithromycin 500 mg once a day for first three days followed by two weekly doses of

500 mg as a follow up which resulted in cutting off the chain of transmission and hence was an effective control measure.

Conclusion

Streptococcus pneumoniae has been repeatedly identified as a causative organism in community acquired pneumonia outbreaks in closed settings like military training institutes. The present outbreak once again highlights the importance of this organism to cause epidemics of severe infection and reiterates the need for formulating a policy for continuous surveillance. The success achieved in control of the outbreak using azithromycin mass chemoprophylaxis strengthens the case for use of this method in any such future outbreaks. The lessons learnt from this outbreak can be incorporated in the SOP for outbreak control in military training institutions and disseminated to all concerned.

It is suggested that in future cost effectiveness studies be carried out to compare the pharmacological and non pharmacological intervention in control of such outbreaks. This would further strengthen background for formulating policies in Armed Forces.

Conflicts of interest

All authors have none to declare.

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