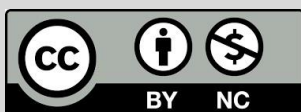# Original Article

Epidemiological and Clinical Characteristics of Patients with Diphtheria Attending the Infectious Disease Hospital in Delhi

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ABSTRACT

Diphtheria is a re-emerging disease with a changing epidemiology. It is thus essential to recognize diphtheria's clinical profile, patterns of morbidity and mortality, and the level of immunization. This study aimed to analyze the clinical-epidemiological profile of patients with diphtheria at the Infectious Disease Hospital, New Delhi, India. The present study was a cross-sectional investigation conducted on 94 patients diagnosed with diphtheria. The data collection tool was a questionnaire that had questions eliciting details such as socio-demographic characteristics, clinical history, examination findings, and vaccination history. The case fatality rate was calculated. Means and proportions were also measured, and the significance level was set at P <0.05. The mean±SD age of the participants was 9±4.4 years. Laryngeal involvement was found in 10 (11%) participants. Complete diphtheria vaccination doses were taken by 6 (6.4%) participants. The case fatality rate was 13%, and complications such as neuropathy were found in 21 (22%) cases, cardiac problems in 12 (13%), and respiratory problems in 13 (14%). Longer duration of the illness, delayed presentation, and complications were associated with poor clinical outcomes (P<0.05). The majority of diphtheria cases were 6-10 years old and had a low socio-economic status. Most of them had a partial vaccination against diphtheria. Around one-third of the patients had complications related to diphtheria, and the case fatality rate was also high. Key preventive measures for controlling the deadly diphtheria disease include specialized immunization programs for areas with poor immunization coverage, as well as the early detection and treatment of suspected cases.

Keywords: Clinical profile, Complications, Diphtheria, Mortality

1. Introduction

Diphtheria is caused by gram-positive *Bacillus* known as *Corynebacterium diphtheriae* (1). It spreads from person to person, often via the respiratory route and occasionally through direct contact with infected skin lesions. Although diphtheria is a vaccine-preventable disease, it can become severe in rare cases and lead to several complications or even death. Diphtheria was a major cause of childhood morbidity and mortality before the introduction of its vaccine (2). However, despite universal immunization programs, this disease continues to be reported in many regions of India. Many outbreaks of diphtheria from various states in India have been reported in recent times (3-6). The present situation in India suggests a lack of immunization coverage and awareness, as well as the necessity for appropriate intervention programs and laboratory confirmation. Indian hospitals should aim to identify clinical and demographic characteristics of diphtheria cases and predictors of mortality at an early stage. The lack of attention to diphtheria over the last century resulted in knowledge gaps about its epidemiology, transmission, and control. Although diphtheria has been eliminated by many developed countries through effective immunization, it continues to exist in India and is the leading cause of morbidity and mortality in various states and border regions. Diphtheria is a re-emerging disease with a changing epidemiology. Therefore, there is a need to recognize the clinical profile, morbidity, and mortality pattern of diphtheria, as well as the immunization status against it. As for the changing epidemiology of diphtheria, studies have reported clinical profiles, and varying patterns remain scanty in North India. This study thus aimed to investigate the clinical and epidemiological profile of patients with diphtheria at the Infectious Disease Hospital, New Delhi, India.

2. Materials and Methods

The present study was a cross-sectional investigation conducted at the Infectious Disease Hospital, New Delhi, India. After obtaining the required consent from patients or their guardians, a total of 94 patients with a confirmed diagnosis of diphtheria at the age of 1-30 years from May 2020 to October 2020 were included in this study. The WHO case definition of diphtheria is an illness characterized by laryngitis, pharyngitis, or tonsillitis, as well as an adherent membrane of the tonsil, pharynx, and/or nose (7). Laboratory criteria for diagnosis were the isolation of *Corynebacterium diphtheriae* from a clinical specimen or a fourfold greater rise in serum antibody (only if both serum samples were obtained before the administration of diphtheria toxoid or antitoxin). A confirmed case was a case that is laboratory-confirmed or was epidemiologically linked to a laboratory-confirmed case. A questionnaire was used to elicit details such as socio-demographic characteristics, clinical history, examination findings, and vaccination history. The case fatality rate was also calculated. The outcomes were classified as good and unfavorable. Ethical approval was obtained from the Institutional Ethics Committee, North DMC Medical College, Delhi, India (IEC ref No. 639). Permission from the Medical Superintendent of Infectious Disease Hospital, Delhi, was obtained for conducting the study and accessing patients' data. All information collected during the study was kept confidential. No personally identifying information was disclosed. Written informed consent was also obtained from adult patients and the guardians of younger patients. Data were entered into Microsoft Excel (version 2016; Microsoft, Redmond, WA, USA) and analyzed using STATA (version 13; Stata Corp., LLC, 4905 Lakeway Drive, College Station, TX 77845, USA). Descriptive statistics were applied to analyze sociodemographic details, clinical symptoms of patients, and complications. The Chi-squared test was applied to find differences, and a *P*-value of <0.05 was considered significant.

3. Results

The mean±SD age of the study participants was 9±4.4 years, with the minimum and maximum age being 1 and 28 years, respectively (Table 1). The throat swab was positive in 79 (84%), the nasal swab was positive in 24 (26%), and the contact history was positive in 6 (6.4%) participants. Complete diphtheria vaccination doses were taken by 6 (6.4%), partial vaccination was taken by 82 (87%), and vaccination status was unknown in 6 (6.4%) participants (Table 2). The median (IQR) duration of illness was 14 (12-19) days (Figure 1). Among the study participants, 82 (87%) recovered and were discharged, whereas 12 (13%) expired. The case fatality rate was 13%. No complications were developed in 65 (69%) participants (Table 3). Longer duration of illness, delayed presentation, and complications were associated with poor clinical outcomes (Table 4).

4. Discussion

In the present study, female participants (56.0%) were more than males (44.0%). In a similar study conducted in Karnataka by Harwalkar KK (8), 52.6% of the participants were male and 47.3% were female. In addition, in this study, almost half of the cases (54.0%) were 6-10 years old, while only 4.0% were 19-30. In a similar study conducted in Lucknow by Singh SN (9), almost half of the participants (49.5%) were 1-5 years old, followed by 43% in the age group of 5-10 years old. Harwalkar KK (8) study found that diphtheria was more common in the age group of 6-10 years.

Table 1 Baseline Characteristics Of The Study Participants. (n=94)

S. no.	Socio-Demographic Profile	N(%)
1.	**Gender** Male Female	41(44) 53(56)
2.	**Age group (in years)** 1 - 5 6- 10 11- 18 19 - 30	14(15) 51(54) 25(27) 4(4)
3.	**Residence** City Town Village	37(40) 21(22) 36(38)
4.	**Education of father** Illiterate Primary High secondary Graduate and above	32(34) 42(45) 18(19) 2(2)
5.	**Occupation of the father** Unemployed Unskilled/ Semiskilled Skilled Clerk, Shop owner, farmer	3(3) 65(69) 2(2) 24(26)
6.	**Education of mother** Illiterate Primary High secondary	63(67) 21(22) 10(11)
7.	**Occupation of the mother** House wife Unskilled/ Semiskilled Skilled	72(76) 12(13) 10(11)
8.	**Religion** Hindu Muslim	50(53) 44(47)
9.	**Socioeconomic class** Upper Upper Middle Lower Middle Lower	0 2(2) 15(16) 77(82)
10.	**Type of family** Nuclear Joint	75(80) 19(20)

Table 2: Clinical Presentation Among The Patients With Diphtheria. (N=94)

| S. no.	Clinical symptoms	N(%)
1.	**Clinical symptoms***	
	Fever	94(100)
	Throat pain	90(96)
	Membrane	94(100)
2.	**Laryngeal involvement**	
	Yes	10(11)
	No	84(89)
3.	**Pharyngeal/tonsillar involvement**	
	Yes	14(15)
	No	80(85)
4.	**Cervical lymphadenopathy**	
	Yes	21(23)
	No	73(77)
5.	**Stridor**	
	Yes	8(8)
	No	86(92)
6.	**Membrane**	
	Thin	4(4)
	Thick	90(96)
7.	**Membrane colour**	
	White	89(95)
	Grey	11(5)
8.	**Membrane removal**	
	Removal on striping	35(37)
	Non-removal	59(63)
9.	**Illness before admission**	
	< 5 days	11(12)
	5- 10 days	67(71)
	>10 days	16(17)

*multiple options
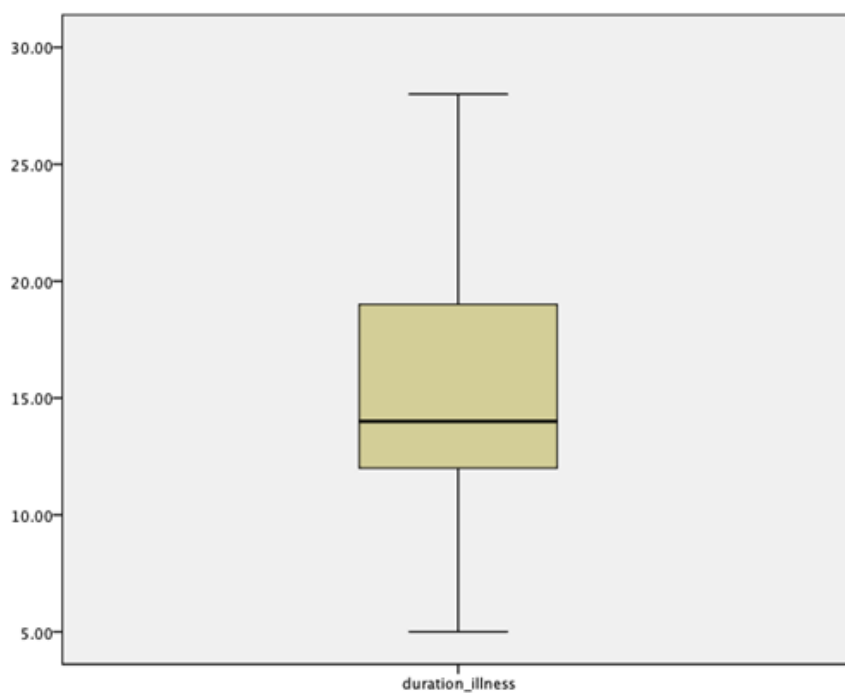
Figure 1: Mean duration (in days) of illness among the study participants. (n=94)

Table 3 Complications Among The Patients With Diphtheria. (N=94)

S. no.	Complications	N(%)
1.	**Neuropathy**	
	Palatal	11(12)
	Palatal + polyneuropathy	21(22)
	Carditis	
	Tachyarrhythmia	6(6)
	Bradyarrhythmia	12(13)
	Acute renal failure	2(2)
	Thrombocytopenia/Bleeding disorders	5(89)
	Respiratory failure/Airway compromise	13(14)
	ECG abnormalities	
	No complications	65(69)

Table 4: Comparison Of Outcome With Selected Variables. (N=94)

S.No.	Variables	Survived N=82	Expired N=12	OR(95%CI)	P-value
1.	**Gender**				
	Male	33(40)	8(67)	1.0	0.139
	Female	49(60)	4(33)	2.1(0.3-4.3)	
2.	**Age group**				
	≤ 10	57(69)	8(67)	1.0	0.098
	>10	25(31)	4(33)	3.2(0.9-2.1)	
3.	**Duration of illness**				
	≤ 10 days	45(55)	2(17)	1.0	0.021
	>10 days	37(45)	10(83)	2.6(1.4-3.8)	
4.	**Complications**				
	No complications	64(78)	1(8)	1.0	0.03
	Complications	18(22)	11(92)	3.4(1.8-4.5)	
5.	**Illness before admission**				
	< 10 days	76(80)	2(17)	1.0	0.01
	>10 days	6(20)	10(83)	2.1(1.6-3.9)	

Chi square tests, p value of > 0.05 is significant

In terms of clinical manifestations, all our study participants (100%) had fever and the presence of membranes, and the majority (96%) had throat pain. Similar findings were found in a study conducted in Maharashtra by Meshram RM (10), in which all patients presented with fever and membrane in the throat, and the majority (95.74%) had throat pain. The present study also found that only 11% had laryngeal involvement and 15% had pharyngeal/tonsillar involvement. In another study conducted in Maharashtra by Meshram RM (10), the majority of participants (80.85%) had enlarged/congested tonsils. Furthermore, out of all the patients in our study, about one-fourth (23%) had cervical lymphadenopathy, and only 4% had a thin membrane. Another similar study by Singh SN (9) revealed that about two-thirds (63.9%) of study participants had neck swelling, and one-fourth (76.4%) had laryngeal membrane involvement. Moreover, in the present study, the majority of participants (71%) had an illness 5-10 days before admission, while 12% of them had the illness less than 5 days before admission. Another study by Singh SN (9) reported that the majority (83.9%) of participants presented with an illness they had

for less than 14 days. Considering vaccination, only 6.4% of the participants in this study had taken complete diphtheria vaccination doses, and the majority (87.0%) of participants had had partial vaccination. In a similar study by Harwalkar KK (8), more than half of the participants (59.5%) were partially immunized. In another study conducted in Maharashtra by Meshram RM (10), it was found that only 4.25% of participants were completely immunized, while more than half (57.45%) were partially immunized, and about two-thirds (38.30%) were not immunized at all. In addition, in the present study, the majority of the participants (87%) were recovered and discharged, and 13% of them expired. However, in a similar case study conducted in Maharashtra by Meshram RM (10), about one-fourth (21.2%) of the participants expired. In another study by Singh SN (9), about half of the participants (48.0%) expired. In the present study, about two-thirds of the participants (69.0%) had developed no complications. Among those who developed a complication, the most common complication (69.0%) was respiratory failure/airway compromise, followed by one-fourth (22.0%) having palatal palsy and polyneuropathy. Only 6% of the

participants in the present study had tachyarrhythmia and bradyarrhythmia. The most common complication (51.6%) reported was airway compromise, while only 7.2% and 14.0% had developed tachyarrhythmia and bradyarrhythmia, respectively. A similar study by Harwalkar KK (8) revealed that palatal palsy was the most common complication (10.7%), followed by myocarditis (8.6%) and asymptomatic bradycardia (4.3%). In a similar case study conducted in Maharashtra by Meshram RM (10), myocarditis was the most common complication (42.5%), followed by palatal palsy (14.89%), and only 4.25% developed acute renal failure and shock. In this study, longer duration of illness, delayed presentation, and complications were significantly associated with poor clinical outcomes, while they were not significantly associated with age group or gender. Another similar study conducted in Singapore by Ang LW (11) revealed that the seroprevalence in males (93.7%) was not significantly different from that of females (90.8%). There was also no difference in seroprevalence according to gender distribution, as reported by Meshram and Patil (10). Moreover, Ang LW (11) revealed that the prevalence of diphtheria declined significantly with age. In this study, the majority of diphtheria cases were 6-10 years old and had a lower socio-economic status. In addition, most of the patients had a partial vaccination against diphtheria, and around one-third of them had complications related to diphtheria. The case fatality rate was also high. Longer duration of illness, delayed presentation, and complications were associated with poor clinical outcomes. Therefore, special immunization campaigns for areas with low immunization coverage and the early identification and treatment of suspected cases will be key preventive strategies for controlling the deadly disease of diphtheria.

Novelty of the Study

This study reports findings from an exclusive Infectious Diseases Hospital, New Delhi, India. The study reported the case fatality rate of a vaccine-preventable disease, diphtheria, and assessed in detail the determinants of the clinical outcomes.

Authors' Contribution

BK, SKS, VGC, GM, and SJ conceived the idea and planned the study. VGC, BK, SKS, and JJ performed data extraction and tabulation. VGC, BK, SKS, SJ, GM, and JJ prepared the manuscript. All the authors read and approved the final manuscript.

Ethics

The study was conducted after receiving approval from the Institutional Ethics Committee. The confidentiality of study participants is maintained.

Conflict of Interest

None.

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