

PROSPECTIVE STUDY OF NOSOCOMIAL ENTERIC INFECTIONS IN A PEDIATRIC HOSPITAL, CALCUTTA

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ABSTRACT

Hospital acquired enteric infections were investigated by studying 3138 children under 5 years of age who were admitted without diarrhea in nine medical wards of a pediatric hospital, Calcutta during the period between March and September 1987. Three hundred and twenty (10.2%) children developed nosocomial diarrhea during their hospital stay. Fecal samples from 178 nosocomial diarrhea, 345 hospitalized diarrhea cases, 178 hospital controls and 200 outpatient controls were collected for detection of established enteropathogens. There were no statistically significant differences in the detection of most of the enteropathogens from fecal samples of nosocomial diarrhea, hospitalized diarrhea and hospital controls. Enteric pathogens were detected at a higher frequency (statistically significant) from fecal samples of nosocomial diarrhea cases as compared to outpatient controls. This study highlights the importance of most of the enteropathogens like Shigella, Salmonella, rotavirus, enteropathogenic E.coli as the cause of hospital cross infection. This study reinforces the importance of developing preventive measures in order to reduce the frequency of illness.

Key words: Nosocomial enteric infection, Nosocomial diarrhea, Shigella, Salmonella typhimurium, Rotavirus.

Infections acquired in the hospital (nosocomial infections) remains a major problem for patients and physicians alike both in developed and developing countries(1). Even with the high standard of personal and hospital environmental hygiene, nosocomial infections occur in many developed countries(2-5). Approximately two million nosocomial infections occur annually in patients admitted to acute care hospitals in the USA(6). Hospitals in the developed countries have taken renewed interest in the problem of nosocomial infections and its control(3-5,7). National nosocomial surveillance system has also been set up to accumulate the informations of nosocomial infection nationwide and to identify the priorities for prevention and control of nosocomial infections(3-5,8). In contrast, most of the hospitals in the developing countries including India, do not take proper care to identify the problem of nosocomial infections and planning for its prevention and control(9,10). There is also no existence of nationwide surveillance system. Urinary tract infection, pneumonia, septicemia and wound infections are the most common nosocomial infections(11). In addition to these infections, nosocomial enteric infections (nosocomial

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diarrheas) are also creating a lot of problem in almost all the pediatric hospitals and neonatal nurseries in our country(9,10).

We conducted a prospective case control study to assess the extent of nosocomial enteric infections in the medical wards of a big pediatric hospital, Calcutta, during a diarrhea season (period between March and September) in 1987 with special regards to enteropathogens implicated.

Patients and Methods

Background

Dr. B.C. Roy Memorial Hospital for Children is one of the biggest children hospitals in Calcutta, providing free treatment to inpatients and outpatients. Patients come to this hospital from all socio-economic groups. This hospital has nine medical wards. Approximately 6000 patients with acute watery diarrhea or dysentery are admitted to this hospital annually. Patients are treated throughout the year but most are seen during hot summer months (March to June) and during monsoon (July to September). Along with the children having different medical problems, diarrhea children are also housed in all the wards.

Patients

Children of both sexes up to the age of 5 years, suffering from nosocomial diarrhea or dysentery during the first four days of the week in the period between March and September 1987 were included in the study. Children of same age group suffering from acute watery diarrhea or dysentery admitted in the same wards where nosocomial diarrhea occurred, between 8 a.m. and 1 p.m. during the first four days of the week were also studied. Hospitalized diarrhea cases who had received antibiotics

before admission or those who were suffering from diarrhea for more than 3 days were excluded from this study.

Controls

A case match control group was selected from hospitalized patients without diarrhea who had following characteristics: located on the same hospital ward as case, hospitalized within a minimum of 72 hours of a case, having the same or similar underlying medical diagnosis and treatment (hospitalized control).

Another case match control group was also selected from outpatients who attended the surgical outpatient department for their minor surgical problems but did not suffer from diarrhea for last 3 weeks (outpatient controls).

Follow up

• Prospective hospital based study was carried out at the medical wards of Dr. B.C. Roy Memorial Hospital for Children, Calcutta. Children admitted to the hospital for different medical problems (other than diarrhea) were followed up. Physicians made daily hospital rounds in search of prospective nosocomial diarrhea cases. If patients developed diarrhea during follow up period special records were also made about frequency of stools per day, stool character, abdominal pain, tenesmus, fever ($>38^{\circ}\text{C}$) and of hydration status. Hospitalized diarrhea cases were also followed up daily as nosocomial diarrhea cases. The total number of admission (diarrhea cases and cases with other medical problems) was obtained from admission register maintained by the hospital authority.

Collection of samples

Catheter specimen of fecal samples of nosocomial and hospitalized diarrhea cases

were collected in sterile McCartney's bottle. Freshly passed stool samples were also collected from two types of control children. Immediately after collection, these samples were transported to the laboratory.

Microbiological methods

Fecal samples were processed for isolation of bacterial pathogens and detection of parasites using standard method(12). An aliquot of sample was stored at -30°C for subsequent detection of rotavirus antigen using Enzyme Linked Immunosorbent Assay (ELISA) technique(12).

Definitions

Nosocomial diarrhea was defined in cases who developed diarrhea at least 72 hours after hospitalization. Diarrhea was defined in cases who passed a minimum of 4 unformed stools within a 24 hours period.

Statistical methods

Statistical analysis was done by using Chi-square test. A probability value below <0.05 was considered as the level of significance.

Results

During the period between March and September 1987, 1078 children suffering from acute diarrhea or dysentery (hospitalized diarrhea) and 3138 children suffering from other medical illnesses were admitted in the medical wards of the hospital. Of these 3138 children suffering from different medical illnesses, 320 (10.2%) children developed diarrhea during the hospital stay (nosocomial diarrhea). Fecal samples were collected from 178 nosocomial diarrheal children and 345 hospitalized diarrheal children for identification of established enteropathogens. Stool samples were also

collected for the same purpose from 178 hospitalized and 200 outpatient control children.

Table I shows the detection of enteropathogens from nosocomial and hospitalized diarrhea cases. There was no statistically significant difference in the detection of most of the infecting enteropathogens from the fecal samples of nosocomial and hospitalized diarrhea cases. However, *S. typhimurium* was detected at a higher frequency in the nosocomial diarrhea cases as compared to the hospitalized diarrhea cases. *V. cholerae* and *E. histolytica* could not be detected from nosocomial diarrhea cases. Table II shows the differences in the detection of established enteropathogens among nosocomial diarrhea, hospital controls, hospitalized diarrhea and outpatient controls. There was also no statistically significant difference in the rate of detection of major enteropathogens from the stool samples of nosocomial diarrhea cases as compared to that of hospital controls. However, detection of major enteropathogens from outpatient controls was statistically significantly low as compared to hospitalized diarrhea cases. *S. typhimurium*, *C. jejuni*, *Cryptosporidium*, *C. difficile* and enterotoxigenic *E. coli* could, however, be detected at the same frequency in hospitalized diarrhea cases and in out-patient controls. However, enteropathogenic *E. coli*, *Shigella* species, *S. typhimurium* and rotavirus were detected at a higher frequency from fecal samples of nosocomial diarrhea cases as compared to that of outpatient controls. The differences in the rate of detection of these enteropathogens were also statistically significant (Table III).

Discussion

This prospective study of hospital

TABLE I—Isolation of Enteropathogens from Nosocomial and Hospitalized Diarrhea Cases

Enteropathogens	Nosocomial diarrhea cases (n=178)		Hospitalized diarrhea cases (n=345)		p value
	No.	%	No.	%	
Enteropathogenic <i>E. coli</i>	26	(14.6)	36	(10.4)	0.209*
<i>Shigella</i> species	22	(12.3)	32	(9.3)	0.344*
<i>Salmonella typhimurium</i>	20	(11.2)	9	(2.6)	0.0001**
Rotavirus	15	(8.4)	29	(8.4)	0.874*
<i>C. jejuni</i>	10	(5.6)	17	(4.9)	0.897*
<i>Aeromonas</i> species	6	(3.4)	16	(4.6)	0.6498*
Cryptosporidium	2	(1.1)	9	(2.6)	0.2166*
<i>C. difficile</i>	2	(1.1)	1	(0.3)	0.268*
Enterotoxigenic <i>E. coli</i>	2	(1.1)	2	(0.6)	0.4199*
<i>V. cholerae</i>	0	(0.0)	32	(9.3)	0.0000009**
<i>E. histolytica</i>	0	(0.0)	5	(1.4)	0.1236*
Mixed pathogens	24	(13.6)	49	(14.2)	0.926*
	129	(72.5)	237	(68.7)	0.428*

* Statistically not significant; ** Statistically significant.

acquired enteric infection in a pediatric hospital shows a high prevalence of cross infection with different established enteropathogen particularly in a period when the rate of infection caused by these organisms is at its peak in the community and the rate of hospitalization of these infected cases is also high.

The present investigation distinctly shows that hospitalized infectious diarrhea cases who acquired the infection in the community brought the infection in the hospital wards at large and contaminate the immediate surroundings and the hospital environment. Detection of major enteropathogens at the same frequency from nosocomial and hospitalized diarrhea cases

strongly supports our hypothesis that occurrence of nosocomial diarrhea in children resulted from the exposure of these children to various enteropathogens as they were housed in the same wards along with the hospitalized diarrhea cases. Statistically significantly high rate of detection of enteropathogens from hospital control also indicates that children suffering from other medical illness, housed in the same medical wards also infected by most of the major enteropathogens like *Shigella*, *Salmonella* and rotavirus; however, they do not suffer from nosocomial diarrhea subsequently. Detection rate of enteropathogens is statistically significantly low in outpatient controls as compared to that of nosocomial

TABLE II—Isolation of Enteropathogens from Nosocomial and Hospitalized Diarrhea Cases and their Controls

Enteropathogens	Nosocomial diarrhea cases (n=178)		Hospital controls (n=178)		p value	Hospitalized diarrhea cases (n=345)		Outpatient controls (n=200)		p value
	No.	%	No.	%		No.	%	No.	%	
Enteropathogenic <i>E. coli</i>	26	(14.6)	13	(7.3)	0.0417**	36	(10.4)	2	(1.0)	0.00006**
<i>Shigella</i> species	22	(12.6)	16	(9.0)	0.3908*	32	(9.3)	1	(0.5)	0.0007**
<i>S. typhimurium</i>	20	(11.2)	15	(8.4)	0.4764*	9	(2.6)	1	(0.5)	0.068*
Rotavirus	15	(8.4)	8	(4.5)	0.1958*	29	(8.4)	5	(2.5)	0.0103**
<i>C. jejuni</i>	10	(5.6)	8	(4.5)	0.809*	17	(4.9)	8	(4.0)	0.774*
<i>Aeromonas</i> species	6	(3.4)	0	(0.0)	0.0149**	16	(4.6)	1	(0.5)	0.004**
Cryptosporidium	2	(1.1)	1	(0.6)	0.5*	9	(2.6)	1	(0.5)	0.068*
<i>C. difficile</i>	2	(1.1)	1	(0.6)	0.5*	1	(0.3)	0	(0.0)	0.633*
Enterotoxigenic <i>E. coli</i>	2	(1.1)	0	(0.0)	0.249*	2	(0.6)	0	(0.0)	0.4003*
<i>V. cholerae</i>	0	(0.0)	0	(0.0)	—	32	(9.3)	3	(1.5)	0.0007**
<i>E. histolytica</i>	0	(0.0)	1	(0.6)	0.5*	5	(1.4)	0	(0.0)	0.1006*
Mixed pathogens	24	(13.5)	16	(9.0)	0.2401*	49	(14.2)	0	(0.0)	<10(-6)**
	129	(72.5)	79	(44.4)	<10(-6)**	237	(68.7)	22	(11.0)	<10(-6)**

* Statistically not significant; ** Statistically significant.

TABLE III—Differences in the Detection of Enteropathogens from Nosocomial Diarrhea Cases and Outpatient Controls

Enteropathogens	Nosocomial diarrhea cases (n=178)		Outpatient controls (n=200)		p value
	No.	%	No.	%	
Enteropathogenic <i>E. coli</i>	26	(14.6)	2	(1.0)	0.0000015**
<i>Shigella</i> species	22	(12.3)	1	(0.5)	0.000004**
<i>S. typhimurium</i>	20	(11.2)	1	(0.5)	0.000016**
Rotavirus	15	(8.4)	5	(2.5)	0.0193**
<i>C. jejuni</i>	10	(5.6)	8	(4.0)	0.62*
<i>Aeromonas</i> species	6	(3.4)	1	(0.5)	0.044**
Cryptosporidium	2	(1.1)	1	(0.5)	0.4563*
<i>C. difficile</i>	2	(1.1)	0	(0.0)	0.2211*
Enterotoxigenic <i>E. coli</i>	2	(1.1)	0	(0.0)	0.2211*
<i>V. cholerae</i>	0	(0.0)	3	(1.5)	0.1471*
Mixed pathogens	24	(13.5)	0	(0.0)	<10(-6)**
	129	(72.5)	22	(11.0)	<10(-6)**

* Statistically not significant; ** Statistically significant.

diarrhea cases which indirectly indicates that hospital environment becomes highly contaminated by established enteropathogens and the situation becomes worse than community. Nosocomial diarrhea occurs particularly among children because of continuous exploration in contaminated close environment(13) with frequent hand to mouth or subject to mouth contact. The infectious enteropathogens spread to the susceptibles by their own hands or by the hands of care givers.

Occurrence of nosocomial diarrhea either sporadically(14) or as an outbreak(15) with specific enteropathogen has been documented earlier from this hospital. In this prospective study we want to highlight that most of the major enteropathogens are responsible for sporadic noso-

comial diarrhea in this hospital throughout the year but prevalence rate is much higher in diarrhea season. Nosocomial diarrhea is not only the problem of this particular hospital but is the common problem of most of the pediatric hospitals and neonatal nurseries of our country(9,10). Many of the hospitals in our country do not have separate diarrhea ward though it is primarily the basic criteria of the hospital to prevent hospital acquired enteric infections particularly in children. The World Health Organization also recommends in their Diarrheal Diseases Control Programme that diarrhea cases should be treated in the separate ward(16) which will not only help proper management of diarrheal diseases but also resist the spread of infection in other wards of the hospital.

Prevention and control of nosocomial enteric infections in the hospitals depends on several factors(17) including: creation of separate ward for hospitalized diarrhea patients, maintenance of hygienic standards in the hospital, surveillance of nosocomial infection and education of parents and personnel involved in hospital care regarding infection control. The cornerstone of nosocomial diarrheal disease prevention in the hospital is the opening of separate diarrhea ward in each an every hospital where pediatric patients are admitted and secondly the maintenance of optimal hygienic standard. Surveillance is also an essential element in prevention and control of nosocomial enteric infections in the hospital settings. The major purpose of surveillance is to allow early detection of disease problem and prompt implementation of control measures. Education of nursing staffs, paramedical staffs and parents about personal hygiene with special reference to careful cleaning of their hands is also the essential component of prevention of incidence of nosocomial enteric infections in the hospital.

An awareness of these facts may permit similar institutions to adopt strategies to reduce the incidence of nosocomial enteric infections.

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NOTES AND NEWS

SEX AND HEALTH EDUCATION FOR SCHOOL CHILDREN

It is proposed to introduce a nationwide programme to impart health education to school children in the fields of sex education and HIV, mother craft, nutrition, physical fitness and promotion of cardiovascular health, personal hygiene, vaccines and prevention of diseases and substance abuse, etc. The Academy would like to establish a Task Force and organize a workshop to develop appropriate tools and teaching material to meet this objective. Those members of the Academy who have special interest and expertise in this field and can spare their time are requested to send their names along with brief synopsis of their contribution already made in this area to the undersigned within the next two weeks.

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