article

Role of tracheo-oropharyngeal & gastric colonization in Nosocomial Pneumonia in ICU patients

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Abstract

Tracheal, oropharyngeal and gastric cultures were obtained daily from 75 patients while a nasogastric tube in place. The sequential isolation and coincidental localization of bacterial species from the three sites after 48h. of admission, was considered evidence of acquisition of organism from one site to another. Organisms of the same genus and species were considered identical when the-minimum inhibitory concentration toward at least 3 antibiotics was identical. Eight cases of nosocomial pneumonia (10.5%) caused by bacteria transfered from the stomach, were diagnosed. These bacteria were Klebsiella pneumoniae (three cases, 37.5%), E. coli (two cases, 25%) and Pseudomonas aeruginosa, Staphy locoecus aureus and Enterobacter spp. (one case by each, 12.5 %). Percentage occurrence of nosocomial pneumonia according to the type of stress ulcer prophylaxis: Antacid, Tagamet or Zantac was 19, 8, 6.8% respectively.

Keywords: nosocomial pneumonia gastric colonization

Introduction

Hospital acquired pneumonia represents a frequent and potentially life-threatining condition of critically ill patients (Neiderman, et al., 1990, Boston, et al., 1996; 1997; Ewig, et al., 1998). The exact sources and routs involved in acquiring colonization leading to nosocomial pneumonia are still under depate. Nevertheless, colonization of gastrointestinal tract, especially stomach, is believed to play an important part via gastropulmonary rout of infection (Inglis, et al., 1993, Torres, et al, 1996; Bonten, et al., 1997). Particulary when gastric pH is raised above bactericdal level through the use of stress ulcer prophylaxis (Heylando Mandell, 1992) or-gastric nutrition (Pingleton, et al., 1986).

In most cases, nosocomial pneumonia is mainly caused by enteric gram negative bacteria, Pseudomonas aeruginosa or Staphylococcus aureus (Emori & Gaynes, 1993; Bonten,et al, 1995). These bacteria are known to cause serious infections under certain circumstances and considered as potential pathogens (Bonten, et al., 1997).

The aim of the present study is to examine the role of the stomach in the aetiopathogensis of nosocomial pneumonia, in a group of ICU patients using nasogastric tubes, through following sequence of bacterial colonization between oropharynx, trachea and stomach.

Materials and Methods

The study was conducted from August 1998 to March 1999 in Intensive Care Unit (ICU) in Basrah General Hospital IRAQ. Patients with nasogastric-tubes who had an expected ICU stay for at least 3days were eligible for this study. The characteristics of 75 patients, included in this study, are listed in Table (1).

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Microbiological Studies

Samples of gastric aspirates, sputum and oropharyngeal swabs were collected within the 24h. of admission and subsequently every day as long as nasogastric tubes in place. Oropharyngeal samples were obtained by rubbing the buccal mucosa with a sterile cotton swab placed in Brain Heart Infusion. Gastric aspirates were obtaind by aspirating early morning gastric contents via the gastric feeding tube. All samples were cultured within 30 min. of collection by plating on blood and MacConkey's agar, they were aerobically incubated at 35 °c for 24-48h. and all recovered bacterial colonies were identified by the following characterization tests: Gram staining, fermentation-oxidation capability, production of:catalase, oxidase, urease, hydrogen sulfide, acetyl methyl carbinol and indole; decarboxylation of:arginine, lysine and ornithine; methyl red reaction and utilization of citrate (Finegold and Baron, 1986; Colle et al., 1996). Production of coagulase and B-galactosidase were tested for gram positive cocci (Talan, et al., 1989).

Susceptibility patterns of identified isolates to antimicrobial agents were determined by Minimal Inhibitory Concentration (MIC) (Colle, et al.,1996). The following antibiotics were used: Ampiclox, Cefotaxime, Gentamycin, Tetracyclin, Ampicillin, Amoxicillin, Trimethoprim, Chloramphenicol, Cephalothin, Erythromycin, Streptomycin and Vancomycin.

Sequence of colonization was examined by comparing isolates of the same species, cultured from two or morb sites Strains were considered identical when MICs toward at least three antibiotics were concordant (Bonten et al., 1994; Palmer, et al., 1995).

Results

The total number of samples yeilded aerobic and facultative anaerobic microorganisms is shown in Table (2). Klebsiella pneumoniae was predominant in gastric sampled. Gram positive cocci (Staphylococci and Streptococci) in addition to E. coli were present more frequently in oropharynx while tracheal samples yeilded Enterobacter spp. and Pseudomonas aeruginosa more frequently than other sampi -ing sites.

Table (3) Illustrates number of patients harboring microorganisms colonizing oropharynx, trachea and stomach, when the first culture was obtained in the ICU within 24h after admission. Also, Table (3) showes acquird colonization which was established when cultures after 48 h. were positive at trachea and stomach, when the first culture was obtained in the ICU within 24h after admission. Also, Table (3) shows acquired colonization which was established when cultures after 48 h. were positive at two occasions consecutively and no colonization within that particular species was present on admission. Recovery of Kelbsiella pneumoniae was significantly ($P< 0.05$) more frequent in stomach (15 patients) than in trachea (5 patients). Significant difference ($P<0.01$) was also demonstrated by Pseudomonas aeruginosa between trachea (eleven patients) and stomach (2 patients) and oropharynx (3 patients). Among the three sampling sites no significant difference was recorded by the remaining microorganisms.

Initial acquired colonization was identified in the stomach of eight patients after 2-3 days of hospitalization; three patients acquired colonization with K. pneumonia, with E. coli, two patients, and with Enterobacter, S. aureus and P. areuginosa, one patient each. At that time, no colonization was detected in tracheal or oropharyngeal samples of these patients. Therefore, further sampling from the three sites of the eight patients was continued; cultures from the stomach were repeatidly positive after 4-5 days of hospitalization and at this time only, tracheal and oropharyngeal samples started to demonstrate positive cultures of above indicated bacteria. All samples from the three sites after the 5th day were still positive for the indicated acquired bacteria.

MICs of the sequential and coincidental localized isolates of the same genus and species were found concordant toward seven out of 10 antibiotics (Table 4). Acquired pneumonia in those eight patients was found more frequent among those using antiacids as compared to those using Tagamet or Zantac (Table 5).

Discussion

The study population was at risk of developing nosocomial pneumonia since more than one risk factors of developing pneumonia were present i.e intubation, presence of a nasogastric tube and an ICU stay exceeding 3 days (Joshi, et al., 1992; Bonten, et al., 1994). Moreover, all patients were recieving stress ulcer prophylaxis other than sucralfate reported to prevent nosocomial pneumonia (Kappstein, et al, 1991). Gastric pH is < 3.5 which in physiologic situation acts as an effective barrier against bacterial growth (Wilder-Smith, et al., 1992). Alkalization of gastric pH through the use of Antiacids.although non significantly different from Tagamet or Zantac (Table

acts as an effective barrier against bacterial growth (Wilder-Smith, et al., 1992). Alkalization of gastric PH through the use of Antiacids.although non significantly different from Tagamet or Zantac (Table 5) have exerted a crucial part in the development of nosocomial pneumina (Apte et al., 1992).

The present study demonstrates that stomach was the intitial site of colonization in 8 out of 75 ICU patients which is in accordance with Bonten, et al., (1995). Chronological patterns of colonization from the stomach to the tracheobronchial tree was demonstrated by coincidental localization of identical strains (from the three sites), and was recognized because their MICs to seven antibiotics were concordant which is higher than that suggested by Bonten et al., (1994) and Palmer et al., (1995).

Isolation of Gram negative enteric bacteria and pseudomonas from gastric samples earlier than from tracheal samples indicating the intestine as a possible source of colonization since enteric bacteria belong to commensal colon flora and may colonize the oropharynx under retrograde colonization via the colonize the oropharynx under retrograde colonization via the stomach. Furthermore, rectal colonization with enterobacteriaceae and pseudomonas may proceed tracheal colonization in ICU patients (Flynn, et al., 1987; Murthy, et al., 1989; Noone, et al, 1983; Bonten, et al., 1997).

Among the pathogens associated with nosocomial pneumoirn reported in this strudy. Was S. aureus. Gastric colonization with S. aureus was also demonstrated by Bonten, et al., (1994) in less than 5% of mechanically ventillated patients which is in line with our results.

Although S. aureus has an exceptional source since it is derived almost exclusively from human reservoir but individual bacteria may have different colonization patterns (Kropec, et al., 1993).

In conclusion, acquired gastric colonization reported in this study (10.5%) is found consistent with respect to the importance of the gastropulmonary roufclof colonization in pathogenesis of nosocomal pneumonia.

Table 1: Characteristics of 75 patients with nasogastric tubes

Age	**Median**	**40"19.72**
	Rang	**5-78 yrs**
Sex (%)	**Male**	**44 (58.67)**
	Female	**31 (41.33)**
Days in ICU	**Median**	**8"(1.867)**
	Range	**5-11 days**
Medical speciality (%)	**Surgery**	**48(64)**
	Medical	**27 (36%)**
Stress ulcer prophylaxis (%)		
	Antacids	**21 (28)**
	Tagamet	**25 (33.3)**
	Zantac	**29 (38.6)**
Systemic antibiotic use %		**75 (100)**
Mortality %		**6 (8)**
Gastric pH on admission (%)		
	pH.> 4	**61 (81.33)**
	< 4	**14 (18.67)**

Table 2: Number of Samples with aerobic and facultative anaerobic Microorganisms

Bacteria	Oropharynx n=(276)	Trachea n=(256)	Stomach n=(212)
Klebsiella pneumoniae	25	29	37
E. coli	32	22	28
Enterbacter spp	19	28	12
Proteus mirabilis	8	8	5
Serratia marcescens	4	5	0
Pseudomonas aeruginosa	23	50	8
Streptococcus	31	23	15
Staphylococcus aureus	28	24	6
Coogulase negative staphylococci (CONS)	34	18	0
Yeasts	30	35	22

n= number of samples

Table 3: Number of patients colonized on admission (l-24h) and number of patients acquiring colonization (< 48h) in oropharynx (0), trachea (T) and stomach (S).

Bacteria	ON admission N0. Of patients O / T / S	Acquired colonization N0. Of patients O / T / S
Klibsiella pneumoniae	8 / 5 / 8	9 / 5 / 15*
E. coli	5 / 3 / 5	6 / 4 / 5
Enterbacter spp	3 / 4 / 3	4 / 6 / 4
Proteus mirabilis	2 / 2 / 1	2 / 2 / 1
Serratia marcescens	2 / 1 / 0	2 / 1 / 0
Pseudomonas aeruginosa	4 / 8 / 2	3 / 11 / 2
Streptococcus	7 / 3 / 2	3 / 2 / 4
Staphylococcus aureus	6 / 5 / 2	5 / 4 / 2
Coogulase negative staphylococci	8 / 4 / 0	5 / 4 / 0

* Species was not isolated from any site before 48h.

Table 4: Minimal inhibitory concentrations of antibiotics against acquired bacteria in stomach (S), oropharynx (O) and trachea (T)

Bacterial species	Site	C	E	ST	VAN	TE	AMP	AMO	TRI	CL	AMX	CTX	GE
K. pneumoniae	S	768<	-	768<	-	512	384	256	192	384	256	32	16
	O	768<	-	768<	-	512	384	256	192	384	256	32	16
	T	768<	-	768<	-	512	384	256	256	384	256	32	32
Enterbacter spp	S	768<	-	768<	-	768	256	192	192	256	192	128	64
	O	768<	-	768<	-	768	256	256	192	256	192	128	64
	T	768<	-	768<	-	768	256	256	192	384	192	128	128
E. coli	S	768	-	512	-	384	256	256	192	192	256	32	8
	O	768	-	512	-	384	256	256	256	192	256	32	8
	T	768	-	512	-	384	384	256	256	192	256	32	16
S. Aureus	S	192	192	192	48	192	256	256	192	128	192	8	8
	O	192	192	192	48	192	256	256	256	128	192	8	8
	T	192	192	192	48	192	256	384	256	128	192	8	8
K. Pneumoniae	S	768<	-	768	-	384	256	192	256	192	192	64	192
	O	768<	-	768	-	384	256	192	256	256	192	64	192
	T	768<	-	768	-	384	256	256	256	256	192	128	192
P. aeruginosa	S	768<	-	768<	-	-	-	-	-	768<	-	192	256
	O	768<	-	768<	-	-	-	-	-	768<	-	192	256
	T	768<	-	768<	-	-	-	-	-	768<	-	192	256
E. Coli	S	768<	-	768<	-	256	384	256	192	256	256	32	192
	O	768<	-	768<	-	256	512	256	192	256	256	32	192
	T	768<	-	768<	-	384	512	256	192	256	256	48	192
K. Pneumoniae	S	768<	-	768<	-	256	384	256	192	384	256	8	8
	O	768<	-	768<	-	256	384	256	256	384	256	8	8
	T	768<	-	768<	-	256	384	384	256	384	256	8	8

Ampiclox - AMX , Cefotaxime - CTX , Gentamycin GE, Trachea T, Orophrynx - O , Stomach S, Teracyciln - TE , Ampicillin - AMP , Amoxicillin - AMO , Trimethoprim - TRI , Chlornmphenlcol CL, Cephalothih - C , Erythromycin - E , Streptomycin - ST , Vancomycin - VAN

Table 5:Correlation between stress ulcer prophylaxis and nosocomial pneumonia

Type of prophylaxis	N0. Of cases / N0. Of ICU patients (%)	Bacteria	N0. Of patients
Antacids	4 / 21 (19)	Kl. Pneumoniae E. coli S. Aureus Eenterobacter spp	1 1 1 1
Cimetidine	2 / 25 (8)	E. Coli Kl. Pneumoniae	1 1
Ranitidine	2 / 24 (8.6)	Kl. Pneumoniae P. Aeruginosa	1 1

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