Colonization and infection in surgical intensive care patients – a prospective study


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Abstract. Nosocomial infections are a major problem in intensive care patients. Thirty-nine patients, requiring intensive care for 5 days or more (mean 15.8 days) were prospectively investigated, to determine the relation between colonisation and nosocomial infection. Thrice weekly, cultures from the oropharynx, respiratory and digestive tract were obtained. Colonization with aerobic gram-negative microorganisms of the oropharynx, respiratory and digestive tract significantly increased during the stay in the Intensive Care Unit. In 29 patients (74%) 78 nosocomial infections were diagnosed. The most frequent nosocomial infections were pneumonia (26 patients, 66.6%), catheter-related bacteraemia (11 patients, 28.2%), and wound infections (7 patients, 17.9%). In 59 instances (75.6%), colonization with the same potential pathogenic microorganism proceeded the nosocomial infection. The overall mortality was 25.6% (10 patients), bacteraemia with aerobic gram-negative microorganisms being the cause of death in 7 patients.

Key words: Intensive care unit – Colonization – Nosocomial infection

Critically ill patients who require prolonged intensive care are at risk of acquiring infections [1–5]. The most frequent nosocomial infections are urinary tract, wounds and respiratory tract infections [1, 7, 8–10]. Most nosocomial infections are caused by aerobic gram-negative bacteria [5, 6]. During their stay in intensive care, patients are rapidly colonized with aerobic gram-negative bacteria (Enterobacteriaceae and Pseudomonaceae) in the oropharynx [9, 11, 14], and in the gastrointestinal tract [12, 13]. It has been suggested, that colonization of the oropharynx and digestive tract with aerobic gram-negative microorganisms precedes infection [5, 6, 11, 14]. However there are only few prospective studies concerning the relationship between colonization with nosocomial gram-negative bacteria and subsequent infection caused by the same microorganisms. This prospective study was performed to determine the frequency of colonization of the oropharynx, respiratory tract, digestive tract and urinary tract with nosocomial bacteria and the relationship of such colonization to infection.

Patients and methods

Patients, admitted to the Surgical Intensive Care Department of the University Hospital in Utrecht who required intensive care treatment for 5 days or more were included in the study. All patients were intubated and mechanically ventilated. Indwelling urinary catheters, nasogastric tubes, arterial and central venous lines were used routinely. All indwelling urinary catheters were attached to a closed drainage system and were opened twice daily to irrigate the bladder with 50 ml Hibitane 0:5000, International Medical Products, Zutphen, the Netherlands) for 60 seconds. Indwelling arterial and central venous catheters were inserted under sterile precautions; the skin was cleaned before insertion with an Iodine solution. Every 48 h new dressings were applied. The catheter remained in place unless signs of infection occurred. Volume controlled respirators were sterilised according to the recommendations of the manufacturer. Tubings were replaced every 48 h. All patients were examined daily for clinical evidence of infection. Haematological and biochemical data (haemoglobin, haematocrit, leucocyte and differential counts, thrombocyte count, urea, creatinine and bloodgases) were collected at least daily. Chest X-rays were taken daily.
**Microbiological investigations**

Thrice weekly samples, obtained from the oropharyngeal cavity, tracheal aspirate, urine and faeces or rectal swabs were cultured. Samples from suspect areas, such as wounds, drains or inflamed tissue were also cultured. For the isolation and enumeration of aerobic bacteria the material was cultured on MacConkey agar (Oxoid Ltd., Basingstoke, UK), selective for gram-negative bacteria; staphylococci and streptococci were cultured on blood agar (Blood Agar Base with 7% defibrinated sheep blood, Oxoid), Sabouraud dextrose agar (Difco Laboratories, Detroit, Mich.), was used for the culture of yeasts. Enterobacteriaceae were identified with enterotubes (Hoffmann-la Roche, Basel, Switzerland). Antimicrobial susceptibility was tested by an agar diffusion method on Isosensitest agar (Oxoid Ltd.) with Neo-sensitabs (Rosco; Taastrup, Denmark).

**Definitions**

Colonization was defined as the presence of the same microorganism in two or more consecutive cultures of samples, taken from the same site. Microorganisms isolated from cultures obtained during the first 48 h after admission were defined to be part of the flora, present on admission. Microorganisms isolated from cultures obtained after 48 h were considered acquired. Infections were considered acquired, when signs and symptoms of infection developed 48 h after admission. An infection was diagnosed based on the presence of three or more of the following criteria on the same day: rectal temperature above 38.5 °C (lasting 12 h or more); leucocyte count above 10.0·10^9 or less than 4.0·10^9; at least 3% band formed granulocytes; unexplained decrease in thrombocyte count (<100·10^9/1); unexplained decrease in the systolic blood pressure (>30 mmHg); deterioration of renal function due to acute tubular necrosis; progressive respiratory failure. Absolute criteria for infection were bacteraemia and a both clinically and bacteriological documented peritonitis. Lower respiratory tract infection was diagnosed based on physical and radiological signs of pulmonary infiltration. An urinary tract infection was diagnosed based on the isolation in the urine of more than 10/5 bacteria/ml and the presence of leucocytes in the urine sediment. Wound infection was diagnosed based on clinical signs of inflammation and isolation of bacteria from wound cultures. A restrictive antibiotic policy was followed, according to the recommendations of the hospital formulary committee. Antibiotic therapy was started when an infection was diagnosed; if possible, depending on the antibiogram of the isolated microorganisms.

**Results**

Thirty-nine patients, 9 female and 30 male were included in the study which was performed from April 1 to December 31, 1984. The mean length of stay was 15.8 ± 8.4 (mean ± SD) days. The age was 50.2 years (range 18 to 82 years). The diagnosis at admission was multiple trauma in 21 patients, major vascular surgery in 9 patients, abdominal surgery in 7 patients and major thoracic surgery in 2 patients. From 30 patients samples for surveillance cultures were obtained on admission.

**Colonization of the oropharynx** (Fig. 1)

On admission gram-negative bacteria were isolated in 7 patients (23%), gram-positive bacteria in 3 patients (10%) and yeast in 10 patients (33.3%). After 10 days stay in the Intensive Care Unit colonization by gram-negative bacteria was observed in 31 patients (86%), colonization by gram-positive bacteria was observed in 14 patients (39%) and colonization by yeast 25 patients (70%). After 15 days the oropharyngeal cavity of all patients was colonized by gram-negative bacteria.

**Colonization of the respiratory tract** (Fig. 2)

On admission gram-positive bacteria were isolated in the tracheal aspirate of 7 patients (23.3%), gram-negative bacteria in 9 patients (30%) and yeast in 9 patients (30%). After 10 days of treatment in the ICU 30 patients (83%) were colonized by gram-negative bacteria and 20 patients (55%) by yeast. The tracheal aspirate, obtained from patients staying in the ICU, for more than 15 days, was found to be colonized by gram-negative bacteria and yeast in 87% and 54% of the patients respectively.