H. Lode, T. Schaberg, R. Stahlmann

Selective Decontamination of the Digestive Tract: Indications and Problems

Introduction

Three approaches can be taken for the prevention of infectious diseases: 1) isolation, 2) immunization, and 3) chemoprophylaxis. This paper explores the use of chemoprophylaxis.

When considering ventilated patients in the intensive care unit (ICU), the objectives of chemoprophylaxis are to reduce colonization by pathogens and resulting infections, as well as mortality and costs. The development of pneumonia in ventilated patients in the intensive care unit (ICU) starts with gastric or oropharyngeal bacterial colonization. These pathogens are aspirated. Subsequently, depending on the number and virulence of the organisms and the effectiveness of the patient's lung defences (which may be defective in this patient population), pneumonia may develop. Of patients undergoing long-term ventilation, 40–60% develop pneumonia.

The causative pathogens in these cases of pneumonia are shown in Table 1 [1]. Gram-negative bacteria arising from the gastrointestinal tract are the most commonly isolated organisms (accounting for 50–60% of cases), while gram-positive cocci account for a further 5–25%.

Selective Decontamination of the Digestive Tract

Following the observation in the early 1980s that one particular group of pathogens was responsible for most infections in pneumonia, *Stoutenbeck* et al. developed the concept of selective decontamination [2,3]. Infections were divided into three groups. Primary endogenous infections, which were caused by throat pathogens, occurred early and were prevented only by intravenous antibiotics. Secondary endogenous infections, which were caused by nosocomial pathogens, occurred late and were prevented by selective decontamination. Exogenous infections, which were caused by pathogens from outside the patient's body, were prevented by hygienic practices. To prevent primary and secondary endogenous infections, intravenous antibiotics and selective decontamination of the digestive (SDD) tract have to be combined.

Two main concepts have envolved for prophylaxis of infections by selective decontamination – SDD and selective parenteral and enteral anti-sepsis regimens (SPEAR). SDD reduces aerobic gram-negative rods only and has no effect on anaerobic gut flora. The three stages of SDD are shown in Table 2. SPEAR consists of the SDD process with the addition of intravenous cefotaxime for four days.

Evidence from Individual Studies

The effectiveness of SDD was studied by *Stoutenbeck* et al. in multiple trauma patients [3]. A total of 122 patients who had spent more than 5 days in the ICU were divided into two groups. Group I (n=59) received no prophylactic antibiotics and was investigated retrospectively. Group II (n=25) underwent selective decontamination of the gastrointestinal tract and oropharynx, while Group III (n=63) received SPEAR. A total of 44% of patients in Group I had primary respiratory infections and 20% had secondary respiratory infections, while no patients in Group III had either primary or secondary respiratory infections.

A small study conducted by *Unertl* et al. investigated the prevention of infection in ventilated patients using local antibiotic prophylaxis compared with controls [4,5]. A mixture of polymyxin B, 50 mg, and gentamicin, 80 mg, in 0.9% saline solution was administered every 6 h (1 ml was applied to each nostril, 3 ml was applied to the oropharynx and 5 ml was instilled into the stomach), and amphotericin B, 300 mg, was applied to the oropharynx. Although pneumonia was reduced in the experimental group, the incidence of febrile tracheobronchitis and the overall mortality rate were not different in the two groups; six patients (30%) in the control group died compared with five patients (26%) in the local prophylaxis group.

Ledingham et al. investigated the prevention of acquired infection in ICU patients using a triple regimen of SDD, systemic cefotaxime and microbiological surveillance [5]. A total of 324 patients were divided into two groups; 163 patients received prophylaxis while 161 patients acted as controls. Overall, a mortality rate of 24% was found in both the control and study groups. Among the patients who were admitted to the ICU due to trauma, however, there was a significant reduction in the incidence of pneumonia in patients who received prophylaxis compared with controls (six patients in the control group developed pneumonia compared with none in the study group, p=0.002).

Evidence from Meta-analysis

A meta-analysis conducted by the Selective Decontamination of the Digestive Tract Trialists' Collaborative Group included 22 trials and a total of 4,142 patients [6]. This analysis revealed an odds ratio of 0.37, which indicates a statistically significant reduction in the incidence of respi-

Prof. Dr. *H. Lode*, PD Dr. *T. Schaberg*, PD Dr. *R. Stahlmann*, Städtisches Krankenhaus Zehlendorf, Pneumologische Klinik I, Zum Heckeshorn 33, D-14109 Berlin, Germany.

Table 1: Pathogens causing nosocomial pneumonia.[a]

Pathogen	Prevalence (%)
Enteric gram-negative bacilli	50-60
Klebsiella spp.	
Enterobacter spp.	
Proteus spp.	
Pseudomonas aeruginosa	
Serratia spp.	
Acinetobacter spp.	
Legionella pneumophila	0-15
Gram-positive cocci	
Staphylococcus aureus	15-25
Streptococcus pneumoniae	5-10
Gram-negative coccobacilli	
Haemophilus influenzae	5-10
Moraxella catarrhalis	< 1
Anaerobes	35
Viruses	
Adenovirus	< 1
Influenza virus	< 1
Respiratory syncytial virus	< 1
Fungi	
Aspergillus fumigatus	< 1
Candida albicans	< 1

[a] [1].

Table 2: Selective decontamination of the digestive tract (SDD) and the selective parenteral and enteral anti-sepsis regimen (SPEAR).

	Constituents	Administration
SDD		
Cefotaxime	50 mg/kg/day	Administered intravenously for 4 days
Sticky ointment ('Orabase')	● Polymyxin E ● Tobramycin ● Amphotericin B } 2% w/w	Applied to the oropharynx four times daily
Suspension	● Polymyxin E, 100 mg ● Tobramycin, 80 mg ● Amphotericin B, 500 mg	Applied to the stomach four times daily
SPEAR		
As for SDD with the addition of cefotaxime	As above (SDD)	Administered intravenously

ratory tract infections, related to the use of SDD (Figure 1). Subgroup analysis revealed that different decontamination approaches (e.g. local prophylaxis, SPEAR)

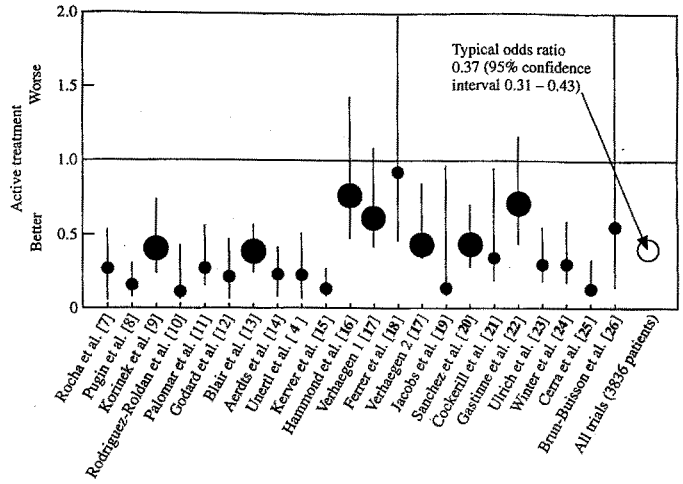

Figure 1: The overall effect of selective decontamination of the digestive tract on the incidence of respiratory tract infections. Meta-analysis revealed an odds ratio of 0.37, which indicates a statistically significant reduction in the incidence of respiratory tract infections related to the use of selective decontamination. Reproduced with permission [6].

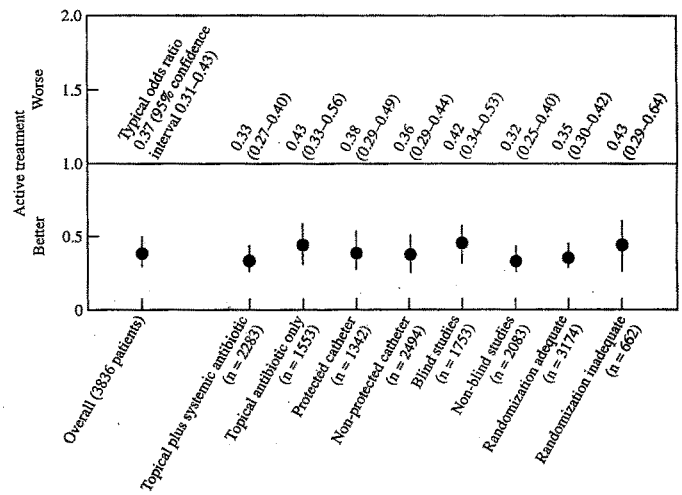

Figure 2: Subgroup analysis revealed that different decontamination approaches showed a consistent reduction in respiratory tract infections. Reproduced with permission [6].

showed a consistent reduction in respiratory tract infections (Figure 2). The effect of SDD on mortality, however, was not statistically significant (Figure 3); there was no difference in the mortality rate between those patients who had received prophylaxis and those who had not. Subgroup analysis of the effect of SDD on mortality showed the combination of systemic (SPEAR) plus local prophylaxis to be the most effective approach (Figure 4).

A number of conclusions were drawn from this study: 1) selective decontamination significantly reduced infection-related morbidity in ICU patients, 2) despite the large number of trials available for analysis, definite conclusions cannot be drawn about the effect of prophylaxis on mortality, and 3) based on the most favourable results (ob-

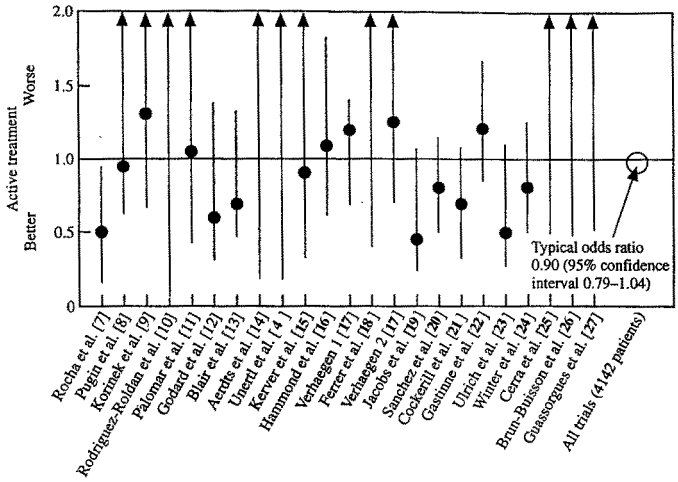

Figure 3: As a whole, selective gut decontamination did not affect mortality. Reproduced with permission [6].

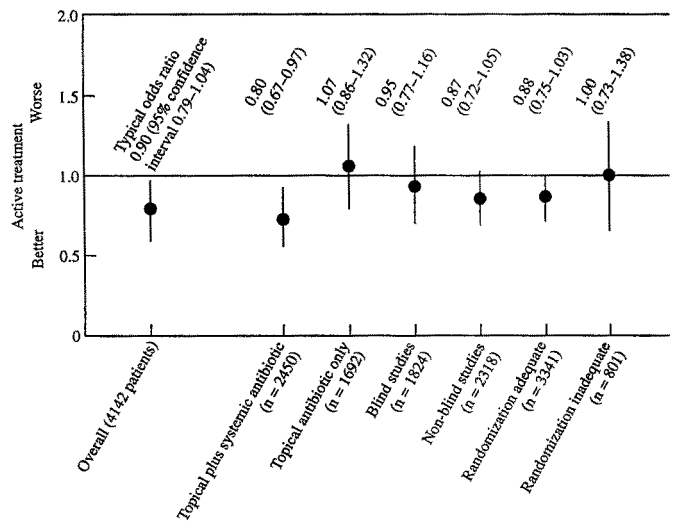

Figure 4: Subgroup analysis of the effect of selective decontamination on mortality showed the combination of systemic plus local prophylaxis to be the most effective approach. Reproduced with permission [6].

tained by pooling data from trials which combined systemic and local prophylaxis), six patients (range 5–9 patients) would have to be treated to prevent one respiratory tract infection, and 23 patients (range 13–139 patients) would have to be treated to prevent one death.

Problems and Unproven Effects

SDD is associated with a number of problems and unproven effects, including no reduction in mortality, low cost effectiveness, selection pressure for gram-positive pathogens and an increase in pathogen resistance. In the case of the emergence of pathogen resistance, for example, a number of studies in neurological, medical and surgical ICUs reported increased resistance in staphylococci, enterococci, *Pseudomonas* spp. and coagulase-negative staphylococci during the course of selective decontamination [13,26,28–31].

Conclusions

SDD in ventilated ICU patients continues to be a controversial issue. This form of prophylaxis significantly reduces infection-related morbidity in ICU patients, but, despite the large number of trials assessed, no definite conclusions can be drawn about the effect of this type of prophylaxis on mortality.

There is evidence to support the use of SDD in some patient populations, including ventilated polytrauma patients, patients who have undergone surgery for oesophageal tumours and liver transplant patients. The use of SDD in patients receiving long-term ventilation, must, however, be questioned.

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