Bacterial translocation in surgical patients
(a prospective study)

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Abstract
Bacterial translocation may be defined as the passage of intestinal microflora across the lamina propria to local mesenteric lymph nodes and from there to other normally sterile extraintestinal sites. It has been proposed that bacterial translocation may initiate a cytokine-mediated response from macrophages which may, under certain conditions, predispose the host to the development of septic morbidity and multiple organ failure [1].

Introduction
Many studies in animals, using a wide variety of experimental techniques, support this concept of the gut as the originator of septic complications and that bacterial translocation may be an important intermediary mechanism in the development of such septic. A number of factors have been shown to predispose to bacterial translocation. These include shock and reduced splanchnic blood flow, parenteral nutrition, experimentally induced damage to the intestinal epithelium and antibiotic therapy. On the basis of these animal studies, it has been suggested that susceptibility to bacterial translocation is increased by impairment of intestinal barrier function, alterations in gut microflora and by immunosuppression [2]. The clinical significance of bacterial translocation in surgical patients remains unclear, although there is increasing circumstantial evidence to suggest that it may play an important role in the causation of sepsis. For example, the well-recognised phenomenon whereby nosocomial infection is frequently a consequence of gut-derived organisms such as E coli lends credence to the hypothesis [3]. Many authors have reported an increased incidence of septic complications in patients receiving parenteral as opposed to enteral nutrition and this, it is suggested, could be accounted for by alterations in intestinal barrier function predisposing to bacterial translocation [4]. Finally, an association between upper gastrointestinal microflora and subsequent septic complications has been explained on the basis of bacterial translocation [5]. However, there are no published studies to date which confirm these associations on the basis of microbiologically confirmed bacterial...
translocation. This prospective study (2001-2004) which were undertaken at Hella hospitals/Babylon/Iraq over the past 3 years [6-9]. The aims of these investigations were to determine the prevalence of bacterial translocation and establish its clinical significance.

Patients and Methods
A consecutive series of 248 surgical patients aged (25-78) years old the main age ( 51.5 ) undergoing laparotomy were examined for evidence of bacterial translocation. Immediately after opening the peritoneum, before conducting exploratory laparotomy, a serosal scraping from the antimesenteric border of the terminal ileum sampled using a fresh surgical blade. Patients with peritonitis or those who had received preoperative antibiotics were excluded from the study.

Results
Bacterial translocation was confirmed in 34 patients (15.4%). The most common organism identified was E coli (54%). Both enteric bacteria typical of indigenous intestinal flora and non-enteric bacteria were isolated. Postoperative septic complications developed in 52 patients (23%). Enteric organisms were responsible in (74%) of these patients. Of patients who had evidence of bacterial translocation, (41%) developed sepsis compared with (14%) in whom no organisms were cultured (P<0.001). Patients were stratified according to the presence or absence of clinical conditions which have been associated with translocation in previous studies. These results are shown in Fig.1. There was no significant difference in the prevalence of translocation in malignancy, inflammatory bowel disease, jaundice, significant preoperative weight loss. In contrast, there was a significant increase in the prevalence of bacterial translocation in patients who were aged over 70 years (P,0.001, 21% vs 11%), in patients who were operated on as emergencies (P,0.02, 21% vs 12%) and in those patients presenting with distal intestinal bowel obstruction (P,0.001, 41% vs 13%). These results are illustrated in Fig.2.

Figure 1
Figure 2

Discussion

This study indicates that bacterial translocation does occur in surgical patients and is associated with an increased incidence of septic complications. It occurs most frequently in patients with distal intestinal obstruction. Our results may underestimate the prevalence of bacterial translocation in surgical patients, as more extensive tissue sampling might have shown a greater number of positive cultures. However, logistical and ethical constraints precluded more extensive sampling and, therefore, the results obtained in this study must represent a minimum level of translocation. Further, as there are theoretical grounds for considering translocation to occur more frequently in severely immunocompromised individuals, the absence of large numbers of such cases from this study will inevitably result in a lower overall prevalence of translocation. The occurrence of increased translocation in patients undergoing emergency surgery, those with intestinal obstruction and the elderly supports the suggestion that immunosuppression predisposes to translocation. Few previous studies have investigated the prevalence of bacterial translocation using tissue sampling techniques. Dietch found 10 of 17 patients (59%) with intestinal obstruction had positive translocation identified from mesenteric lymph nodes, while only one of 25 (4%) operated on for other reasons demonstrated translocation[10]. Reed et al. [11] examined mesenteric lymph nodes in 16 patients operated on for abdominal trauma. Nodes showed evidence of bacterial translocation in 13 patients (81%). It is interesting to note that culture of the nodes was positive in only 4 of the 13, the remainder only being found so by electron microscopy examination. Bacterial translocation in this small series did not correlate with infection severity, injury or shock. Braithwaite et al. [12] reported 20 patients requiring laparotomy without perforation. Both portal venous blood cultures as well as lymph node cultures were obtained. Portal blood was positive in only three patients and lymph node culture in only one, but evidence of E. coli B-galactosidase activity was found within the cytoplasm of all mesenteric lymph node macrophages. This latter would suggest the occurrence of translocation with subsequent control by the reticuloendothelial system. Ambrose et al. [13] examined 46 patients operated on for Crohn’s disease. Intestinal bacteria were isolated from the serosa of 12 patients(27%), compared with six of 43 (15%) controls, and from mesenteric nodes in 15 patients with Crohn’s disease (33%)
and two of 43 (5%) controls, suggesting transmucosal passage of bacteria. It is not clear from this study whether this could have occurred as a result of contamination from serosal involvement. There would seem little doubt, therefore, that bacterial translocation does occur in surgical patients, that it is associated with septic morbidity and that immunosuppression may be a predisposing factor to its occurrence.

**Intestinal Microflora**

The human gastrointestinal tract contains an enormous variety of aerobic and anaerobic bacteria which interact in a complex ecosystem. Each section of the intestinal tract characteristically contains a unique flora which is prevented from gaining access to other sites by a single epithelial layer on the mucosa. Most bacteria are destroyed by gastric acid in the upper gut and stomach where bacterial concentrations rarely exceed $10^3$ colony forming units/ml (cfu/ml). Gram-positive and aerobic microflora such as streptococci, staphylococci, lactobacilli and fungi predominate. In the distal ileum, Gram-negative bacteria outnumber Gram-positive organisms. Enterobacteriaceae are consistently present and anaerobic bacteria are found in substantial numbers. Distal to the ileocaecal sphincter, bacterial concentrations increase dramatically attaining concentrations of $10^{12}$ cfu/ml. Anaerobic bacteria greatly outnumber aerobes. Many factors have been implicated in the regulation of the different populations of microflora. These include the creation of 'microclimates' whereby facultative bacteria, for example, utilise oxygen, thereby ensuring a suitable environment for obligate anaerobes. It is well known that antibiotic therapy radically alters intestinal microflora and there is much recent evidence demonstrating that substrate utilisation by different organisms will also influence other bacterial concentrations. All these factors may be important in the causation of bacterial translocation. There is now much experimental evidence from animal studies to show that alterations in the concentrations of certain bacteria, most particularly *E. coli*, as well as in the spectrum of indigenous bacteria, will predispose to increased rates of translocation [14]. There is also circumstantial evidence from human studies that suggests that alterations in gastrointestinal microflora may be important in the development of septic morbidity. For example, results from investigations of selective gut decontamination point to reductions in septic complications and analyses of changes in upper gastrointestinal microflora have been shown to predict which patients are prone to septic morbidity [5]. Whether or not these effects are mediated by bacterial translocation in humans, however, remains unproven.

**Conclusion**

Bacterial translocation does occur in surgical patients and is associated with septic morbidity. (Measurements of intestinal barrier function using villous morphology to assess structure and dual sugar probes to determine permeability do not provide any indication as to the likely propensity to translocation. Their relevance as indicators of intestinal barrier function remains questionable). There is little doubt that alterations in gastrointestinal microflora will influence translocation rates. The wide variety of organisms seen to translocate suggests that translocation occurs by a non-specific mechanism which is independent of the type of organism and more related to the spectrum of bacteria resident within the lumen of the gut. The presence of obligate anaerobes does not confer protection against translocation and *Candida* appears to result in septic morbidity by a means other than translocation. Bacterial translocation probably occurs in healthy individuals, but is not clinically significant in the presence of a fully functional immune system. Isolation of viable bacteria in
mesenteric lymph nodes once translocation has occurred is dependent on the immunological competence of the host and individual bacterial virulence factors which prevent their destruction. In more severely immunocompromised individuals, such as the aged and those with distal bowel obstruction, there is a failure to prevent the propagation of these viable bacteria from the mesenteric lymph nodes to extraintestinal sites which become potential foci of postoperative sepsis. Thus, bacterial translocation appears to be an important early step in the promotion of sepsis in debilitated postoperative patients, rather than the sole initiator. Elucidation of the defence mechanisms by which intestinal microflora are confined within the gut lumen and translocation rates are kept to a minimum will be a significant advance in the understanding of gut-derived infection. These studies provide a rationale for the use of selective gut decontamination.

Reference
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