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The microflora of the oesophagus

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Summary

A study of the oesophageal microflora was undertaken in 51 normal adults and in 50 patients with carcinoma of the oesophagus. Aerobic organisms were present in every case. Anaerobic organisms were cultured from 41 (80%) of normal controls and 48 (96%) of patients with carcinoma. The isolation rate of all species of aerobic and anaerobic bacteria was similar in both groups. The antibiotic sensitivities of the oesophageal microflora were examined to determine appropriate antibacterial therapy for patients undergoing oesophageal surgery and for the treatment of oesophageal perforation.

Introduction

Perforation of the oesophagus is more dangerous than perforation of any other part of the alimentary tract and is associated with a fatal outcome in 20 to 65% of cases *(1,2,3)*. Many factors contribute to the high mortality of oesophageal perforation but most deaths are associated with failure to control infection in the mediastinum and pleural cavities *(3)*. It is likely, therefore, that the microflora of the oesophagus assume a high degree of virulence outside their natural habitat.

It is usually assumed that microorganisms present in the oesophagus have been swallowed with food and saliva and are similar to the normal bacterial flora of the oral cavity and pharynx *(4)*. But it is not known which microorganisms are most frequent in the normal oesophagus and if the oesophageal microflora is altered by disease.

This paper is a report on the morphology of organisms isolated from the normal and the malignantly obstructed oesophagus. The sensitivity of the bacterial isolates to antibiotics in common use has been determined.

Material and Methods

Oesophageal aspirates were collected from 101 adults. Of these, group 1 comprised 51 individuals with no evidence of oesophageal disease but who required general anaesthesia and surgery for extraabdominal conditions. Group 2 comprised 50 patients with carcinoma of the oesophagus undergoing oesophagoscopy and biopsy. No patient had received antibiotic therapy prior to this study.

After induction of general anaesthesia, muscle relaxation and endotracheal intubation, the mouth and pharynx were suctioned. In group 1 patients, a sterilized endotracheal tube was inserted into the oesophagus under direct vision and a sample of oesophageal secretions aspirated using a sterile catheter passed through the tube. In group 2 patients, a sterile catheter was introduced through the rigid oesophagoscope which had been autoclaved prior to use.

Immediately after aspiration, the material was injected into an anaerobic transport bottle containing Porto-Cul (B.B.L.) to ensure the viability of fastidious anaerobes. This sample was used both for aerobic and anaerobic cultures, as aerobes are not adversely affected by brief exposure to anaerobic conditions during transport to the laboratory *(5)*.

The media incubated aerobically included McConkey agar, blood agar, dextrose agar with chloramphenical and bacitracin-heated blood agar in a CO_2-enriched atmosphere. Prereduced brain heart broth, peptone yeast glucose broth, 10% blood agar and amikacin-incorporated blood agar were incubated anaerobically. The GasPak system (B.B.L.) was used to ensure an absence of oxygen in the anaerobic jars.

After incubation, aerobic and anaerobic subculturing onto selective agar media was performed. Organisms were identified by their morphology and biochemical reactivity. The antibiotic sensitivities of the bacteria recovered by subculture were then determined.

Results

BACTERIOLOGICAL IDENTIFICATION

Positive bacterial growth was obtained from every oesophagus. Of the 14 different species of aerobic organisms identified in group I (Table 1), *Streptococcus viridans* was the most common isolate (88%) followed by *Haemophilus influenzae* (37%), *Neisseria catarrhalis* (18%), *Klebsiella pneumoniae* (16%) and *Streptococcus group B* (16%). In this group, *coliform* bacteria were identified in 53% and *Candida albicans* in 12% of the oesophageal aspirates.

Nineteen species of aerobes were found in the oesophagus of group 2 patients. *Streptococcus viridans* (74%) was more frequently isolated than *Streptococcus faecalis* (30%). *Haemophilus influenzae* (24%) and *Neisseria catarrhalis* (24%). *Coliform* bacteria were recovered from 54% and *Candida albicans* from 10% of patients in this group.

Nine anaerobic bacterial species were isolated from group I and 12 species of anaerobes from group 2 patients. However in both groups (Table II), *Peptococcus* was the most common anaerobic isolate (group 1 67%, group 2 88%) followed in frequency by *Peptostreptococcus* (63%, 42%), *Bacteroides melaninogenicus* (43%, 24%) and *Bacteroides fragilis* (6%, 8%).

A mixed growth of 4 or more organisms was cultured from 36 patients in group 1 and from 30 patients in group 2; almost all patients in either group had at least 2 different bacterial species present in the oesophagus (Table III).

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The Editor would welcome comments in this paper by readers

TABLE I *Identity of bacterial aerobic isolates*

Aerobic organisms	*Source of isolates* Group 1	Group 2
Staphylococcus		
Staph. aureus	3	3
Staph. epidermis	4	1
Streptococcus		
S. faecalis	6	15
S. group B	8	5
S. haemolytic nongroup B	0	1
S. pyogenes	2	1
S. viridans	45	37
Neisseria catarrhlis	9	12
Haemophilus influenzae	19	12
Proteus		
P. mirabilis	5	4
P. vulgaris	0	1
Escherichia coli	2	7
Enterobacter		
E. agglomerans	0	1
E. cloacae	2	2
Citrobacter freundi	3	3
Klebsiella pneumoniae	8	9
Pseudomonas aeruginosa	3	1
Acinctobacter lwoffii	0	1

Group 1 normal patients
Group 2 patients with carcinoma of the oesophagus.

TABLE II *Identity of bacterial anaerobic isolates*

Anaerobic organisms	*Source of Isolates* Group 1	Group 2
Bacteroides		
B. fragilis	3	4
B. melaninogenicus	22	12
B. urealyticus	2	2
B. vulgatus	1	0
Clostridium		
C. perfringens	0	1
C. sporogenes	0	1
Peptococcus	34	44
Peptostreptococcus	32	21
Veillonella	0	1
Fusobacterium		
F. rusii	0	1
F. nucleatum	1	0
Eubacterium	1	2
Microaerophilic streptococcus	2	1

Group 1 Normal patients.
Group 2 Patients with carinomia of the oesophagus

TABLE III *Number of bacterial species in isolates*

Number of species	*Source of Isolates* Group 1	Group 2
1	3	1
2	5	7
3	8	12
4	15	16
5	13	6
6	6	5
7	2	1
8	0	1
9	0	1
Total	51	50

Group 1 Normal patients
Group 2 Patients with carinoma of the oesophagus

TABLE IV *Antibiotic sensitivities of 405 organisms isolated from the oesophagus (101 patients)*

Antibiotic	*Aerobic* Gram+ve (134)	Gram−ve (92	*Anaerobic* (179)
Ampicillin	95%	64%	
Cephalosporin	99%	88%	
Gentamycin	9%	100%	
Tetracycline	90%	80%	100%
Penicillin	94%		95%
Clindamycin			94%
Cefoxitin			100%
Metronidazole			100%

ANTIBIOTIC SENSITIVITIES

The sensitivities of organisms isolated from the oesophagus to selected antibiotics are listed in Table IV. The gram negative aerobic organisms were uniformly sensitive to gentamycin. Almost all of the gram positive aerobic bacteria and anaerobic bacteria were sensitive to penicillin with the notable exception of *Bacteroides fragilis* and *Bacteroides vulgatus* which were sensitive to metronidazole.

Discussion

All of the groups of bacteria that occur in faeces are represented in the saliva of the healthy adult *(6)*. The continuous flow of saliva leads to repeated swallowing even during sleep *(7)* so it is not surprising that many different microorganisms were identified in the oesophagus.

There was no statistically significant difference in the number and type of bacterial species found in the normal and the malignantly obstructed oesophagus, the aerobic and anaerobic microorganisms most frequently isolated being similar to the principal inhabitants of saliva. However, in this study, quantitative bacterial analysis was not performed and it is very likely that the total viable counts of oesophageal microorganisms would be significantly higher in patients with carcinoma of the oesophagus. The presence of necrotic tumour tissue and stasis of secretions elsewhere in the alimentary tract invariably results in bacterial proliferation.

Most infections occurring after gastrointestinal operations are caused by dissemination of bacteria present in the lumen of the gastrointestinal tract at the time of surgery *(8)*. Lau *et al (4)* showed that organisms identified in the oesophagus preoperatively could be recovered from the pleural cavity in patients suffering empyema thoracis after oesophagectomy. Considerable differences in the oesophageal microflora do exist between individuals, some patients in this study having more than 7 different species of bacteria present in the oesophagus. However identification of the microbial flora in the oesophagus prior to oesophageal surgery would allow a rational selection of prophylactic antibiotics and, it is hoped, reduce the incidence of postoperative infective complications.

Clinical *(9, 10)* and experimental studies *(11)* have established that a pathological synergy exists between aerobic and anaerobic bacteria. With few exceptions, a mixed growth of aerobic and anaerobic bacteria was isolated from both the normal and the diseased oesophagus. This finding may in part explain why perforation of the normal oesophagus is as potentially lethal as perforation of the obstructed oesophagus *(2)*. The results of the antibiotic sensitivity tests demonstrate that no single antibiotic can be expected to be effective against all varieties of oesophageal microorganisms. Therefore, when perforation of the oesophagus is diagnosed, therapy should include antibiotics active against gram negative and gram positive aerobes as well as the anaerobic bacteria.

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THE FAMILY OF WILLIAM CLIFT

Two short books about members of the Clift family are about to be published. The First Conservator of the Hunterian Museum was a systematic hoarder of family papers. They were dispersed after his death, but Dr Frances Austin of the University of Liverpool has located the bulk of them, and thereby been able to write these books about two members of the family.

The longer book, *The Letters of William Home Clift 1803–1832* is of particular interest because in it Dr Austin has edited all the known surviving letters of Clift's only son. These letters, linked by explanatory narrative, provide a biography of the man who, had he not been killed at the age of 29, would have succeeded his father as Conservator. Little has hitherto been known about him, but now, at last, he reveals himself in his own words. He was a lively character, and his letters reflect a born humorist. But for his early death, Owen would not have had such a long connection with the Hunterian Museum. As things turned out, Clift's only daughter, after the death of William Home Clift, was to marry Owen.

The other book, *Robert Clift of Bodmin, Able Seaman*, is a short biography of William Clift's almost illiterate sailor brother, Robert, who died before William Home Clift was born. Nothing has been known of Robert Clift, and his story is tragic. He was treated as 'the black sheep' of the family, and it is almost certain that William Clift hid what he knew from their brothers and sisters. Dr Austin has discovered that he died in 1799, yet William Clift allowed the family to think that he was in the West Indies as late as 1805. William Clift's mania for collecting has now made possible Dr Austin's record of one who had a raw deal in life even from his own family.