THE BACTERIOLOGY OF PERFORATED APPENDIX

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SUMMARY

Perforated appendix is a serious surgical condition that carries a high morbidity. Antibiotic treatment is often started before the availability of bacteriological reports. The choice of antibiotics would depend on the bacteriology associated with perforated appendix. In a retrospective survey of the bacteriology of peritoneal pus obtained from cases of perforated appendix at the General Hospital, Kuala Lumpur, E. coli *was found to be the most commonly encountered organism. This was followed in order of decreasing frequency by streptococci,* Bacteroides *species,* Klebsiella-Enterobacter *group and* Pseudomonas aeruginosa. *From the results of the antibiotic sensitivities an antibiotic regimen comprising of a combination of gentamicin, metronidazole and penicillin is recommended as appropriate chemotherapy in perforated appendix.*

INTRODUCTION

Appendicectomy is the commonest intestinal operation performed in hospitals. While the mortality is low, morbidity is common and about 30% of patients develop wound infection. [1] When perforation is present, the incidence of wound infection in the absence of appropriate chemotherapy may be as high as 60%. [2] In addition there is also a high incidence of intra-abdominal sepsis. [3] Post-operative sepsis after appendicectomy depends on several factors. Besides the presence or absence of perforation, factors like the age of the patient, delay in diagnosis, difficulty of the operation, the skill of the surgeon and the use of appropriate antibiotics may all influence the development of sepsis.

The success of chemotherapy depends on the sensitivity of the likely contaminating bacteria towards antibiotics. Very often it is necessary to start chemotherapy before the availability of bacterial culture and sensitivity reports. Unfortunately, there has been only a few studies on the bacteriology of appendicitis and these have all been done overseas.

The purpose of this survey is to determine the bacteriology associated with cases of perforated appendix in a Malaysian hospital. With the information obtained and from the analysis of the antibiotic susceptibility patterns we hope to be able to recommend an antibiotic regimen which would be suitable for the treatment of perforated appendix.

MATERIALS AND METHODS

A total of 83 patients was entered into this retrospective survey. These patients were admitted to the surgical unit of the Universiti Kebangsaan Malaysia, Faculty of Medicine, at the General Hospital, Kuala Lumpur during a one-year-period (January-December 1982). All patients were found to have perforated appendix during operation. Free pus was found in the peritoneal cavities of all

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patients. The volume of pus ranged from 5 ml to 100 ml. A pus swab was taken during operation and sent to the bacteriology laboratory in Stuart's transport medium. The swab was cultured on to blood agar, MacConkey agar and 0.1% kanamycin blood agar. The blood agar plate and the MacConkey agar plate were incubated aerobically while the kanamycin blood agar plate was incubated in an anaerobic jar.

A metronidazole disc (5 units) was placed on the kanamycin blood agar to facilitate recognition of anaerobic bacteria. The plates were examined after 24 hours incubation at 37°C and again after a further 24-hour incubation period. All bacteria isolated were identified using routine laboratory methods and antibiotic susceptibility testing was done by a comparative disc method.

RESULTS

The 83 patients comprised 61 males and 22 females with ages ranging from two years to 78 years. No bacteria was isolated from the specimens of 13 patients (16%). Of the 70 specimens which gave positive cultures, pure cultures were obtained from 38 while mixed cultures were obtained from the other 32. The culture results are summarised in Table I. *E. coli* was the most often isolated bacteria (isolated from 51% of the cases) followed by Streptococci (19%), *Bacteroides* species (18%), *Klebsiella-Enterobacter* group (18%) and *Pseudomonas aeruginosa* (12%).

TABLE I
ORGANISMS ISOLATED FROM 83 CASES OF PERFORATED APPENDIX

Organism	Pure culture	Mixed culture	Total
No growth	–	–	13
E. coli	17	25	42
Streptococci	4	12	16
Bacteroides	1	14	15
Klebsiella-Enterobacter	8	7	15
Pseudomonas aeruginosa	3	6	9
Proteus	2	2	4
Staphylococcus	3	0	3
Citrobacter	0	1	1
Aeromonas	0	1	1

The antibiotic susceptibilities of the commonly isolated bacteria are shown in Table II. A high incidence of ampicillin resistance among *E. coli* and the *Klebsiella-Enterobacter* group is noted. Cephalexin, chloramphenicol, cotrimoxazole, gemtamicin and kanamycin were however still fairly active against these isolates. *Pseudomonas aeruginosa* is usually resistant to most antibiotics. Of the nine isolates of *Pseudomonas aeruginosa,* seven were sensitive to gentamicin. One of the gentamicin-resistant strains was in addition also resistant to carbenicillin, tobramycin and netilmicin. All the isolates of *Pseudomonas aeruginosa* were however sensitive to amikacin. All 15 isolates of *Bacteroides* species were sensitive to chloramphenicol, 14 out of 15 isolates were sensitive to metronidazole and 13 out of the 15 isolates were sensitive to clindamycin. All the isolates of Streptococci were sensitive to penicillin.

DISCUSSION

Perforated appendix is a serious condition which requires prompt surgery to prevent the spread of infection and antibiotic therapy to minimise the risk of sepsis. Secondary peritonitis occurs as a result of spillage of the bacterial flora of the gut into the peritoneal cavity. There have been few reports on the bacteriology of appendicitis. Shandling *et al.,* in a survey of 592 case of perforated appendix reported that *E. coli* was the most commonly encountered organism. This was followed in order of decreasing frequency by *Pseudomonas aeruginosa,* enteric Streptococci, *Bacteroides* species and other Streptococci. Gilmore and Martin also reported *E. coli* to be the commonest organism isolated from the appendix fossa. *Bacteroides* species in their survey was found in only 9 out of a total of 146 cases. [4]

In contrast to this, other surveys have shown *Bacteroides* species to be the commonest organism isolated in association with appendicitis. Leigh *et al.,* isolated *Bacteroides* species from 79% of cases of perforated appendix. [2] In another survey conducted by Marchildon and Dudgeon, *Bacteroides* species was isolated in as high as 93% of cases of perforated appendix whenever anaerobic cultures were performed. [5]

In this survey *Bacteroides* species was isolated in only 18% of cases. The reason for this rather low rate of isolation is due probably to deficiencies in the collection and transport of specimens from the operating theatre to the laboratory. This is also reflected in the fairly high proportion of 'sterile' cultures. As pointed out by Leigh *et al.,* [2] *Bacteroides* species is rather difficult to isolate

TABLE II
ANTIBIOTIC SUSCEPTIBILITIES OF COMMONLY ISOLATED ORGANISMS IN 83 CASES OF PERFORATED APPENDIX

Organisms	Number	Percentage of isolates sensitive to antibiotic*														
		AMP	CAR	CEP	CHL	COT	ERY	GEN	KAN	PEN	TET	MTZ	DAL	TOB	NET	AMI
E. coli	42	57	–	91	81	91	–	100	93	–	–	–	–	–	–	–
Klebsiella-Enterobacter	15	13	–	100	73	80	–	94	80	–	–	–	–	–	–	–
Pseudomonas aeruginosa	9	–	89	–	–	–	–	78	–	–	–	–	–	89	89	100
Bacteroides species	15	–	–	–	100	–	87	–	–	7	73	93	87	–	–	–
Streptococci	16	100	–	–	–	93	100	–	–	100	93	–	–	–	–	–

*AMP : Ampicillin
CAR : Carbenicillin
CEP : Cephaloridine
CHL : Chloramphenicol
COT : Cotrimoxazole
ERY : Erythromycin
GEN : Gentamicin
KAN : Kanamycin
PEN : Penicillin
TET : Tetracycline
MTZ : Metronidazole
DAL : Clindamycin
TOB : Tobramycin
NET : Netilmicin
AMI : Amikacin

unless special precautions are taken in the collection of the swab and its subsequent transport to the laboratory.

In their study, swabs were placed in Robertson's meat broth which is probably superior to Stuart's medium for the purpose of anaerobic culture. Furthermore, our laboratory does not operate a 24-hour service and considerable delay in receipt of specimens was experienced whenever the operation was performed after office hours or during weekends.

A high proportion of specimens yielded mixed cultures. This is not surprising as the offending pathogens are derived from the colonic flora. Because secondary peritonitis is often a mixed infection, antibiotic therapy therefore should be a broad spectrum and provide adequate aerobic as well as anaerobic cover.

In most instances antibiotics have to be started before bacterial culture and sensitivity results are available. From the results of this survey it appears that a combination of an aminoglycoside, an anti-anaerobic antibiotic and a penicillin would be required to provide adequate cover in cases of perforated appendix. An aminoglycoside like gentamicin is necessary because of its excellent activity against *Enterobacteriaceae*. The incidence of resistance to ampicillin is now too high to warrant its use in perforated appendix. A suitable anti-anaerobic antibiotic like metronidazole is required to cover for *Bacteroides* species. Metronidazole has been shown to effectively reduce the incidence of intra-abdominal sepsis after appendicectomy. [6]

Clindamycin is another effective antibiotic against *Bacteroides* species but suffers from the serious gastrointestinal complication of pseudomembranous colitis. [7] Chloramphenicol is shown in this study to be active against *Bacteroides* species as well as *Enterobacteriaceae*. It however lacks activity against *Pseudomonas aeruginosa*. Another drawback of chloramphenicol is its potential toxicity which may become a major problem when given in high doses as required for treatment of serious anaerobic infection.

We feel that penicillin should also be added to the treatment regimen because of the frequent isolation of Streptococci from the specimens.

We would, therefore, recommend an antibiotic regimen consisting of a combination of gentamicin metronidazole and penicillin for cases of perforated appendix. As pointed out by Emmerson [8], these antibiotics should be given before the operation together with the premedication and then continued for at least five days.

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