Hospital Topics

Survey of antibiotic prophylaxis in gastrointestinal surgery in Scotland

N I L WILSON, P A WRIGHT, C S McARDLE

Abstract

The current use of prophylactic antibiotics in gastrointestinal surgery in Scotland was established by postal questionnaire. Twenty-one per cent of surgeons used prophylactic antibiotics during cholecystectomy, 49% during appendicectomy, and 95% for elective colorectal surgery. Two-thirds of those surgeons who did not provide routine antibiotic cover considered that the incidence of wound sepsis in their surgical practice was too low to merit special measures. Most surgeons using prophylaxis chose an appropriate antibiotic. The parenteral route for administration of antibiotic was used by 93% of surgeons during cholecystectomy, 29% during appendicectomy, and 45% in elective colorectal surgery. Most did not prolong cover beyond 24 hours post-operatively. This survey shows that the concepts governing the use of antibiotic prophylaxis have been absorbed into current surgical practice. Most surgeons used appropriate antibiotic regimens; many prefer the parenteral route of administration; most do not prolong cover beyond 24 hours.

Introduction

The principles of antibiotic prophylaxis in gastrointestinal surgery are now well established. The choice of antibiotic depends on the pathogenic organisms likely to be present in the gastrointestinal tract at the time of surgery, while the mode and administration should be designed to achieve high tissue levels at the time of surgery without provoking toxicity or precipitating the emergence of resistant organisms. Randomised prospective controlled trials have clearly shown the value of prophylactic antibiotics in patients undergoing various gastrointestinal surgical procedures.

The extent to which these concepts have been implemented in surgical practice has not been assessed. We therefore undertook a postal questionnaire of all consultants and senior registrars in general surgery in Scotland, asking for details of their use of prophylactic antibiotics.

Methods

Postal questionnaires were sent to all consultants and senior

registrars in general surgery throughout Scotland in June 1980. The surgeons were asked for details of their use of antibiotic prophylaxis in patients undergoing cholecystectomy, appendicectomy, and elective colorectal surgery. Those surgeons using prophylactic antibiotics were asked to give their choice of antibiotic, the timing and route of administration, and the duration of cover provided. Those surgeons who did not use routine antibiotic cover were asked to select from the following those reasons which they thought appropriate:

- (1) The incidence of infective complications did not merit special measures.
- (2) The role of prophylactic antibiotics had not been proved.
- (3) Concern about the emergence of resistant organisms.
- (4) Concern about potential toxicity.
- (5) Regard for cost versus benefit.

More than one option could be selected. Surgeons were also questioned about their use of wound instillation.

Results

Of the 176 questionnaires circulated, 146 (83%) were returned.

Thirty surgeons (21%) used routine antibiotic prophylaxis during elective cholecystectomy, 72 (49%) during appendicectomy, and 138 (95%) during elective colorectal surgery.

Of the 116 surgeons who did not use routine antibiotic prophylaxis during elective biliary surgery, 77 (66%) thought that the incidence of infective complications was too low to merit special measures, 28 (24%) that proof of the efficacy of prophylaxis was lacking, and 24 (21%) thought it would encourage the emergence of resistant organisms (table I). An additional 27 (23%) surgeons said that they used systemic prophylactic antibiotics in selected patients—for instance, those with stones in the common bile duct and those undergoing emergency cholecystectomy. Of the 74 surgeons who did not use routine antibiotic prophylaxis for appendicectomy, 47 (64%) thought that special measures were not indicated, 22 (30%) that the value of antibiotic prophylaxis had not been proved, and 20 (27%) were concerned about the possible emergence of resistant organisms.

TABLE I—Reasons given for not using prophylactic antibiotics

Reasons	Cholecystectomy (n = 116)	Appendicectomy (n = 74)	Colorectal surgery (n = 8)
Low incidence of sepsis	77 (66%)	47 (64%)	3 (38%)
Lack of proof for efficacy	28 (24%)	22 (30%)	1 (13%)
Possible development of resistance	24 (21%)	20 (27%)	2 (25%)
Cost versus benefit	17 (15%)	12 (16%)	0 (—)
Drug toxicity	9 (8%)	8 (11%)	0 (—)
Use in selected cases	27 (23%)	3 (4%)	1 (13%)
Involved in trial	11 (9%)	3 (4%)	3 (38%)
Multiple reasons given	40 (35%)	13 (18%)	1 (13%)

CHOLECYSTECTOMY

Of the 30 surgeons who used routine prophylactic antibiotics in elective gall-bladder surgery, 20 used a cephalosporin, seven co-trimoxazole, and three other antibiotics. The parenteral route of administration was used by all but two surgeons: 19 of the 28 surgeons

University Department of Surgery and Department of Bacteriology, Royal Infirmary, Glasgow

N I L WILSON, MB, FRCS, surgical registrar
P A WRIGHT, MB, MRCPATH, consultant bacteriologist
C S McARDLE, MD, FRCS, consultant surgeon

used a single injection, four gave cover for under 24 hours, while five prolonged cover beyond 24 hours. Of the 27 surgeons who used antibiotic prophylaxis in selected patients, most used a second-generation cephalosporin.

APPENDICECTOMY

Of the 72 surgeons who used routine prophylaxis in appendicectomy, 69 used metronidazole either alone or in combination (table II). Twenty used intravenous metronidazole, usually as a single injection; 49 used metronidazole in suppository form, 33 of these for under 24 hours.

TABLE II—Use of metronidazole in appendicectomy (n=69)

Route	No (%)	Duration	
		Single dose	
		< 24 hours	> 24 hours
Intravenous	20 (29%)	18 (90%)	2 (10%)
Per rectum	49 (71%)	16 (33%)	17 (35%)
			16 (33%)

COLORECTAL SURGERY

Of the 138 surgeons who used routine prophylaxis in elective colorectal surgery, two indicated that they used antibiotics but did not provide further information. Three failed to indicate the route of administration and eight did not provide specific information about the timing and duration of antibiotic prophylaxis. The practice of these 13 surgeons has not been included in the analysis. Of the remaining 125 surgeons, 69 (55%) used oral antibiotics as preoperative bowel preparation, 40 (32%) used parenteral antibiotics alone and 16 (13%) used a combination of oral and parenteral prophylaxis (table III).

TABLE III—Antibiotic use in colorectal surgery (n=109)

Oral (n=69)		Parenteral (n=40)	
Regimen	No (%)	Regimen	No (%)
Metronidazole + neomycin	42 (71%)	Metronidazole + aminoglycoside	16 (42%)
Metronidazole alone	9 (15%)	Metronidazole + cephalosporin	21 (55%)
Other regimen effective against anaerobes	8 (14%)	Metronidazole alone	1 (3%)
Regimen ineffective against anaerobes	10 (14%)	Regimen ineffective against anaerobes	2 (5%)
Duration: < 4 days	56 (81%)	Duration: single dose	12 (30%)
> 4 days	13 (19%)	< 24 hours	20 (50%)
		> 24 hours	8 (20%)

Most of the 69 surgeons who used oral antibiotics as a preoperative bowel preparation used metronidazole either alone or in combination with neomycin. Ten (14%) failed to use an antibiotic regimen effective against anaerobes. Thirteen started oral antibiotics more than four days before surgery. Of the 40 surgeons who used the parenteral route for prophylaxis, most used metronidazole in combination with either an aminoglycoside or cephalosporin; two surgeons failed to provide adequate cover against anaerobes. Only eight surgeons prolonged antibiotic cover beyond 24 hours.

WOUND INSTILLATION

Wound instillation was used routinely by 20 surgeons during cholecystectomy, by 37 for appendicectomy, and by 40 during elective colorectal surgery. The commonest agent used was providone-iodine

Discussion

Postoperative sepsis is of major concern to all surgeons. Any patient in whom the continuity of the gastrointestinal tract has been breached at the time of surgery is at particular risk. Wound

sepsis occurs in 20% of patients undergoing elective biliary surgery,¹⁻³ 20-30% of those undergoing appendicectomy,^{4 5} and 40-60% of patients undergoing elective colorectal surgery.^{6 7} The failure of modern aseptic techniques to reduce the incidence of wound sepsis in gastrointestinal surgery has led to a reawakening of interest in the concept of antibiotic prophylaxis.

Sepsis after gastrointestinal surgery is endogenous in origin. Good correlation has been shown between the organisms found in the gastrointestinal tract at the time of surgery and those subsequently isolated from wound cultures.⁸ The rationale behind prophylactic antimicrobial treatment is that a high concentration of antibiotics should be present in the circulation and tissues at the time when bacteria are implanted into the operation site. Adequate antibiotic prophylaxis requires that the following criteria are fulfilled.⁹

(1) The antibiotic should be administered immediately before the surgical procedure.

(2) The duration of prophylaxis should not extend beyond 24 hours.

(3) The antibiotic should be given parenterally (or per rectum for metronidazole).

(4) The antibiotic chosen should provide suitable cover for organisms likely to be found at the time of surgery.

Randomised prospective control trials have shown that the incidence of wound sepsis in biliary surgery can be reduced by the use of an aminoglycoside,¹ cephalosporin,² or co-trimoxazole.³ The use of metronidazole alone, either parenterally or by suppository, has been shown to reduce the wound sepsis rate in appendicectomy to less than 10%.^{4 5} Numerous studies have shown the value of metronidazole in combination with either an aminoglycoside or a cephalosporin in elective colorectal surgery.^{6 7}

In 1975 a survey of prophylactic antimicrobial treatment at five London teaching hospitals showed that the basic concepts underlying the use of antibiotic prophylaxis were poorly understood.¹⁰ There was little agreement about the indications for prophylaxis, the choice of antibiotic, and the duration of cover. In most hospitals most surgical procedures were performed without antibiotic cover. Most surgeons used oral neomycin or sulphathiazole for up to 10 days as preoperative bowel preparation. The most commonly used antibiotic after bowel surgery was ampicillin, starting with the premedication and continuing for up to 10 days postoperatively. Neither regimen is effective against the most important anaerobes in the gastrointestinal tract. Furthermore, most hospital-acquired coliforms are now resistant to ampicillin. In patients undergoing laparotomy antibiotic or antiseptic wound sprays or intraperitoneal ampicillin were used.

In 1978 a survey of antibiotic prescribing in a London district general hospital showed that ampicillin was still used in 33% of cases receiving prophylactic antibiotics for surgery.⁹ Using the four criteria described above to assess the adequacy of antibiotic prophylaxis, only 7% of courses fulfilled all four criteria; 22% fulfilled none. The most frequent error was excessive duration of prophylaxis. Over 80% of courses were continued for longer than 24 hours; 66% being started before the day of operation or after the surgical procedure. Of the antibiotics prescribed, only 45% were judged to provide adequate cover.

In contrast, the results of this study suggest that the principles of antibiotic prophylaxis are now well recognised and widely applied in routine surgical practice. Nevertheless, a considerable number of surgeons in Scotland still do not provide routine antibiotic cover for biliary surgery or appendicectomy. Two-thirds of these surgeons have stated that they believe that the incidence of sepsis in their practice is too low to warrant the use of routine prophylactic antimicrobial treatment. It is, however, well recognised that most surgeons will tend to underestimate the incidence of wound sepsis in their own practice unless they are undertaking a prospective assessment. Furthermore, the criteria that they apply may vary. Wound sepsis rates in the untreated control groups in the prospective randomised trials of antibiotic prophylaxis show remarkable consistency.

Just over a quarter of surgeons felt that definitive proof of efficacy was lacking despite the results achieved in numerous well-conducted, reproducible, randomised prospective trials. Roughly one-quarter of the surgeons thought that antibiotic prophylaxis might lead to the emergence of resistant organisms. With modern prophylactic antimicrobial treatment, however, this is unlikely as most antibiotic regimens are of short duration. Antimicrobial agents such as metronidazole have a narrow spectrum and to date few reports of resistant organisms have appeared. Furthermore, the use of prophylactic antimicrobial treatment in all patients may result in less overall antibiotic use than when those patients who developed septic complications are given long courses of antibiotics in the postoperative period.

Twenty-one per cent of surgeons used routine prophylactic antimicrobial treatment in biliary surgery, with a further 18% using the systemic antibiotic prophylaxis in selected patients. Most surgeons used an appropriate antibiotic administered by the parenteral route in the immediate preoperative period, thereby achieving high tissue levels at the time of surgery. In 82% the duration of cover was under 24 hours.

Forty-nine per cent of surgeons used routine prophylactic antimicrobial treatment during appendicectomy. This figure is similar to that obtained in a recent survey of junior surgical staff in England.¹¹ Ninety-six per cent of surgeons used metronidazole either as a single infusion or in suppository form, in most cases for under 24 hours.

The concept of gut sterilisation before elective colorectal surgery is now outmoded. Yet two-thirds of surgeons in this study still used oral antibiotics as part of bowel preparation before elective colorectal surgery. Keighley *et al*¹² have shown the peroperative parenteral administration of antibiotics to be superior to oral bowel preparation. Furthermore, 19% of these surgeons used a prolonged course of preoperative oral antibiotics. This can only increase cost, the possibility of superinfection, and the emergence of resistant organisms. Despite the importance of bacteroides, 14% of surgeons did not use a preparation effective against anaerobes.

This survey has documented the use of prophylactic antibiotics in gastrointestinal surgery in Scotland. In general, awareness of the potential role of antibiotic prophylaxis is increasing. Most surgeons who use prophylactic antibiotics use

regimens that fulfil the established criteria for effective prophylactic antimicrobial treatment, although a few still use regimens that, in the light of recent evidence, may be suboptimal. Nevertheless, 79% of surgeons do not use prophylactic antibiotics in elective biliary surgery and 51% do not provide antibiotic cover for patients undergoing appendicectomy.

We thank colleagues throughout Scotland who completed and returned the questionnaires.

References

- 1 Keighley MRB, Baddeley RM, Burdon DW, *et al*. A controlled trial of parenteral prophylactic gentamicin therapy in biliary surgery. *Br J Surg* 1975;**62**:275-9.
- 2 Strachan CJL, Black J, Powis SJA, *et al*. Prophylactic use of cephalosporins against wound sepsis after cholecystectomy. *Br Med J* 1977;**iii**:1254-6.
- 3 Morran C, McNaught W, McArdle CS. Prophylactic co-trimoxazole in biliary surgery. *Br Med J* 1978;**iii**:462-4.
- 4 Rodgers J, Ross D, McNaught W, Gillespie G. Intrarectal metronidazole in the prevention of anaerobic infections after emergency appendicectomy: a controlled clinical trial. *Br J Surg* 1979;**66**:425-7.
- 5 Greenall MJ, Bakran A, Pickford IR, *et al*. A double-blind trial of a single intravenous dose of metronidazole as prophylaxis against wound infection following appendicectomy. *Br J Surg* 1979;**66**:428-9.
- 6 Goldring J, Scott A, McNaught W, Gillespie G. Prophylactic oral antimicrobial agents in elective colonic surgery. *Lancet* 1975;**iii**:997-9.
- 7 Eykyn SJ, Jackson BT, Lockhart-Mummery HE, Phillips I. Prophylactic peroperative intravenous metronidazole in elective colorectal surgery. *Lancet* 1979;**ii**:761-4.
- 8 Robson MC, Bogart JN, Heggors JP. An endogenous source for wound infections based on quantitative bacteriology of the biliary tract. *Surgery* 1970;**68**:471-6.
- 9 Moss F, McNicol MW, McSwiggan DA, Miller DL. Survey of antibiotic prescribing in a district general hospital. I. Pattern of use. *Lancet* 1981;**ii**:349-52.
- 10 Study Group on the Use of Antimicrobial Drugs. Prophylactic antimicrobial drug therapy at five London teaching hospitals. *Lancet* 1977;**i**:1351-3.
- 11 Campbell WB. Prophylaxis of infection after appendicectomy: a survey of current surgical practice. *Br Med J* 1980;**281**:1597-1600.
- 12 Keighley MRB, Arabi Y, Alexander-Williams J, Youngs D, Burdon DW. Comparison between systemic and oral antimicrobial prophylaxis in colorectal surgery. *Lancet* 1979;**ii**:894-7.

(Accepted 1 July 1982)

MATERIA NON MEDICA

Away from it all

For a young family doctor in search of a hideout from the developing rat race the answer came quite unexpectedly one morning: 10 acres of virgin bush in a small district known as Kangaroo Ground, only 25 miles from Melbourne. In addition, it had a river frontage on the banks of the much maligned River Yarra.

The first impression was indescribable: glorious sunshine, natural bush, pure white clouds, brilliant blue sky overhead, the sound of running water, and, finally, the stretch of almost white river sand edging the crystal clear river. When I had settled in to this little paradise a stroll along a bush track early one morning presented one of the most beautiful sights imaginable—a complete spider's web, perfect in every detail even to the last tiny strand of silver thread, and brought out in magnificent relief by the thousands of minute dew drops shining like countless small diamonds in the dazzling morning sunlight.

"The spider's touch how exquisitely fine
Feels at each thread and lives along the line.
All are parts of the one stupendous whole,
Whose body Nature is, and God the soul."—POPE

With such a vision before my eyes I realised how close to the Creator one could be in this small spot of the Australian bush with its peace of mind and tranquillity.

"For it's Mornin' Mornin'. The world is wet with dew,
With the tiny drops atwinkle where the sun comes shinin'
through."—C J DENNIS

The next phase of the plan was a long one to provide some possible recompense for the later years and consisted of the establishment of a small pine plantation. Solid hobby, spread over many years, eventually resulted in a mini-forest with some 2500 trees of *pinus radiata* reaching a height of 50 feet or more and greatly admired by visiting friends.

Thirty years later, again without warning, a typical Australian bush fire swept down the river valley, fanned by vicious north winds, and in less than half an hour the "little paradise" was completely destroyed. The utter devastation was beyond description and the intensity of the heat can only be imagined: lumps of rubble picked from the debris were made up of metal, glass, and china all fused into one conglomerate mass.

After the fire came a soaking three inches of rain, and once again the natural bush made its usual amazing recovery and the old warriors of gum trees along the river bank shed the old blackened bark and appeared in all their glory, even more beautiful than before.

"I love all gum trees well. But best of all,
I love the tough old warriors . . . these grave old veterans,
scarred and stern,
Changeless throughout the changing seasons they."—C J DENNIS

In spite of the "ups and downs" of the 60 years I still consider, while relaxing well into my ninth decade, that it was all worth while. Experience is a really hard but a very efficient teacher.—ROBERT SOUTHBY, retired consultant paediatrician, Melbourne.