

Proposed definitions for the audit of postoperative infection: a discussion paper

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The report of a workshop convened by the Surgical Infection Study Group with the following participants:

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Infection is an important arbiter of success or failure of surgical practice and the incidence of infection is incorporated into all surgical audit systems. If audit is to be of value the outcome end points of clinical practice must be defined. We have attempted to derive clinical definitions suitable for bedside diagnosis of infection and believe that these should be supported by, but not be dependent upon, the results of laboratory or imaging techniques.

The proposed definitions are intended to form the basis for clinical audit and to allow meaningful comparisons to be made on clear clinical criteria.

Audit in surgical practice involves analysis of activity, methods, resources and outcome. The incidence of mortality after any operative procedure can be recorded accurately, but the incidence of short-term morbidity and the audit of long-term success or failure may be more difficult to achieve. Comparisons can only be made satisfactorily when outcome definitions have been agreed by those undertaking the assessment (1) and where terminology is clear and universally recognised (2).

Infection is the most common form of postoperative morbidity and a major cause of mortality in all surgical specialties. An attempt to define clinical infection has been made previously, but the authors have relied upon the results of laboratory or imaging investigations, or resorted to the inclusion of vague criteria such as the 'attending surgeon's or physician's diagnosis of infection' (3). This makes standardisation difficult and the reliance

on laboratory or imaging techniques makes no allowance for these facilities being unavailable or not usable.

The Surgical Infection Study Group (SISG) considered there is a need to establish definitions for each form of infectious morbidity which can be readily applied *clinically* by surgeons in the majority of specialties. The definitions proposed in this paper are the result of a workshop held in January 1990, and are based principally on clinical criteria supported by confirmatory laboratory data when this is available. Additional investigations (isotopic, radiological, CAT or ultrasonographic) have been included only where they are considered essential for confirmation of the presence or absence of infection. We have not proposed infection scoring systems as we believe that these do not assist in the recognition of the infection, and may be impracticable for many surgeons in terms of time constraints (4).

Definitions

Wound infection

A wound is defined as a break in an epithelial surface which may be surgical or accidental. Burns, ulceration and pressure sores have been excluded in this definition, but drain sites should be included. A wound infection should have either a purulent discharge in, or exuding from, the wound (5), or a painful, spreading erythema indicative of cellulitis.

Bruising, haematoma formation, serous and lymph collections, are complications which may predispose to the development of wound infection, and may lead to

diagnostic difficulties. Infection should be considered to be present when there is fever, tenderness, oedema and an extending margin of the erythema. The discharge of clear fluid from a wound does not indicate an infection unless accompanied by cellulitis. The definition of wound infection should not be dependent on the results of bacteriological studies. False-negative cultures can occur and on other occasions organisms isolated from cultures may represent either secondary colonisation or merely contamination.

Wound infection may be classified according to aetiology, time, or severity.

Primary and secondary wound infection

The infection should be considered primary unless there is a predisposing complication. Secondary infection may follow a complication which results in the discharge of serum, haematoma, cerebrospinal fluid, urine, bile, pancreatic juice, gastric or intestinal contents from the wound, contaminated by bacteria from within the patient or from the environment (6).

Time

With regard to time, wound infection may be divided into:

Early. Presenting within 30 days of operation.

Intermediate. Presenting between 1 and 3 months of operation.

Late. Presenting more than 3 months after operation.

Severity

Wound infection should be classified as minor when there is discharge of pus from the wound without lymphangitis or deep tissue destruction, and major when the purulent discharge is accompanied by partial or complete dehiscence of the fascial layers of the wound, or by spreading cellulitis and lymphangitis that requires antibiotic therapy (7).

Wound scoring systems have been developed in order to identify accurately those wound infections that result in serious morbidity with important resource and financial implications (8,9). One system uses four categories—serous exudate, erythema, purulent exudate and deep suppuration. Each wound is then ascribed a score according to the percentage of the length of the wound that is involved (8).

The reported incidence of wound infection rises when wounds are assessed by trained community nursing staff at regular intervals after hospital discharge, especially in the clean or clean/contaminated categories, and nearly one-half became apparent after the 7th postoperative day (10).

Postoperative septicæmia

The diagnosis of septicæmia should be made when rigors occur together with one or more of the following signs:

fever, higher than 38°C on more than one occasion in 24 h, and/or hypotension, and/or oliguria. Objective evidence of the source of infection and laboratory confirmation of viable microorganisms (bacteraemia) or their products (exo- or endotoxins, antigen or antibody) in the blood are desirable to confirm the diagnosis.

We appreciate that for a variety of reasons rigors may not be noted or detected and accept that their absence does not totally exclude the diagnosis of septicæmia. The importance of a clinical definition has recently been stressed (11), since patients with life-threatening sepsis require rapid identification and treatment if mortality is to be reduced, but it was also acknowledged that in these patients the presence of fever, shock, respiratory and multiple-organ failure may not be associated with positive blood cultures.

Postoperative urinary tract infection

A postoperative urinary tract infection should be diagnosed in the presence of microorganisms in the urine accompanied by one or more of the following: dysuria, urgency, loin pain, tenderness, pyrexia or pyuria. A bacterial count greater than 10⁵ organisms/ml is generally considered significant in a midstream specimen of urine. A lesser number of organisms (10³ organisms/ml) could be significant if a specimen is obtained by suprapubic puncture or where there is a pure growth of the common pathogens which can include *Escherichia coli*, *Proteus mirabilis*, coagulase negative staphylococci (CNS); *Streptococcus faecalis*, *Klebsiella* spp, *Pseudomonas* spp and *Acinetobacter*.

Interpretation of the laboratory results may need to be modified if the patient is already receiving antibiotics. A polybacterial culture may indicate contamination.

Postoperative chest infection

Pneumonia should be defined as new or increased production of purulent sputum, and/or a fever greater than 38°C persisting for more than 48 h together with the appropriate clinical signs. New or progressive radiological infiltrate may be apparent on chest radiograph and a positive sputum microscopy and culture may be available. A fresh sample of sputum should routinely be examined microscopically before starting antimicrobial therapy (12). In this way purulence can be confirmed and the significance of the organisms cultured can be evaluated.

Lung abscess and empyema are defined as the collection of pus within the lung or pleural cavity respectively accompanied by clinical and radiological evidence (abscess cavitation or fluid in the pleural space), supported by positive bacterial culture.

Postoperative generalised peritonitis

Generalised peritonitis is a diffuse inflammation of the peritoneum caused by infective agents or by toxic substances associated with the clinical manifestations of

abdominal pain, tenderness and guarding, and subsequently by impaired alimentary tract function. The latter may be absent under certain postoperative conditions, eg artificial ventilation, and it is accepted that clinical symptoms and signs may be difficult to interpret in the immediate postoperative period (12). It is desirable that the diagnosis of peritonitis due to infection is supported by positive bacterial culture of the peritoneal exudate.

Postoperative pelvic abscess

A pelvic abscess is characterised by the localised collection of infected fluid within the pelvic cavity, usually the rectouterine or rectovesical pouch. There will be evidence of infection (pyrexia in excess of 38°C) and a mass, which may be tender, is frequently apparent on abdominal or pelvic examination. The diagnosis can be supported by laboratory evidence including the isolation of bacteria from cultures of the aspirate and a raised WBC count (greater than $11 \times 10^9/l$). Appropriate imaging will usually confirm the location, and in gynaecological practice may help to differentiate the separate entities of tubo-ovarian abscess or pyosalpinx.

Postoperative subphrenic abscess

A subphrenic abscess is defined as a collection of infected fluid beneath the diaphragm with either clinical or laboratory evidence of infection. Clinical symptoms and signs include pain or discomfort, anorexia, weight loss, impaired diaphragmatic movement, pleural effusion or inflammatory swelling. Any of these together with a persistent pyrexia (greater than 38°C) and a raised WBC count greater than $11 \times 10^9/l$ should alert the clinician to the possibility of this diagnosis (13). Laboratory confirmation by the isolation of bacteria from cultures of the aspirate, from drainage or using ultrasonographic or other guidance, should be sought.

Anastomotic leak

This is defined as a leak of luminal contents from a surgical join between two hollow viscera. The luminal contents may emerge either through the wound or at the drain site, or they may collect near the anastomosis, causing fever, abscess, septicaemia, metabolic disturbance and/or multiple-organ failure. The escape of luminal contents from the site of the anastomosis into an adjacent localised area, detected by imaging, in the absence of clinical symptoms and signs should be recorded as a subclinical leak.

Postoperative infection in bone

Surgically induced infection in bone and joints may present early or late (13). The diagnosis of *early infection* is based on the presence of pain at rest, a fever greater than 38°C persisting for more than 48 h supported by the isolation of bacteria from cultures when available. *Late infection* (defined as infection presenting more than 3

months after surgery) is indicated by the presence of pain at rest, a persisting elevation of the erythrocyte sedimentation rate greater than 30 mm/h above the preoperative level, radiological changes in bone indicative of infection and the isolation of bacteria from cultures when available. Deep cultures obtained by aspiration or surgical exploration are preferred since the results of superficial wound cultures may yield results that are difficult to interpret due to the presence of skin flora.

These definitions may also be applied to traumatic (open) injuries and in this context the degree of associated soft tissue injury, periosteal stripping and vascular injury assumes considerable importance in subsequent management. Gram-negative organisms assume greater significance when there is vascular impairment.

Infection after implant surgery

Infection of an implant is indicated by the presence of one or more of the following: pain, persistent pyrexia greater than 38°C for 48 h, local signs of inflammation where the implant is superficial, radiological signs where the implant involves, or is adjacent to, bone, an elevated WBC count (greater than $11 \times 10^9/l$). The diagnosis of infection may be substantiated by the isolation of bacteria from cultures of peri-implant fluid, wound or sinus discharge, or blood. Opportunistic organisms, such as CNS, are becoming increasingly important.

Differences in the sites and types of prostheses do not allow an absolute generic definition of infection to be made. Because infection may occur late, all deep infections related to the operative site and to the implant within 1 year of operation should be audited as postoperative infection (3).

Discussion

This paper aims to address the lack of recognised outcome definitions in surgical practice by providing acceptable definitions that are memorable, easy to apply, based on clinical evidence, and allow data comparison to be made on reliable baselines. Difficulties, such as the effects of prophylactic antibiotics, will exist and disagreement is inevitable but audit, if it is to be of value, must include accurate outcome comparisons.

Pain, swelling, erythema, warmth and impairment of function have long been recognised as the hallmarks of inflammation and are especially relevant to the diagnosis of superficial infection presenting in the community. For hospital acquired infection this purely clinical approach is less adequate, but nevertheless we would wish to stress the importance of the presence of clinical symptoms and signs in the definitions, with the results of bacteriological studies providing important supportive evidence. In only one of the infectious conditions that we have considered, urinary tract infection, is appropriate bacteriological evidence of infection considered essential to the definition. Imaging provides important supportive evidence and the importance increases when infection is suspected

in the deep tissues, eg bone, around implants, and abscess(es) within body cavities.

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Notes on books

Thyroid Disease: Endocrinology, Surgery, Nuclear Medicine and Radiotherapy edited by Stephen A Falk. 644 pages, illustrated. Raven Press, New York. 1990. \$150.00. ISBN 0 88167 630 6

The forty chapters of this large format, glossy page, well-illustrated volume cover every possible aspect of thyroid disease and its treatment. It will interest not only the endocrine surgeon but also the physician, pathologist, radiotherapist and specialist in imaging techniques. There is even a chapter on general anaesthesia in thyroid surgery! Extensively referenced and up-to-date, this book deserves to be read.

Shackelford's Surgery of the Alimentary Tract edited by G D Zuidema. 3rd edition. Vol 1, **Esophagus** coeditor M B Orringer. 485 pages, illustrated. W B Saunders Company, Philadelphia. 1991. ISBN 0 7216 2505 3

The series is not suitable for trainees at the start of their careers. The contributors write with clarity and authority, backing their arguments with references up to 1989. Basic information includes development, anatomy, function and investigations. Varied forms of hiatal hernia are described but no editorial selection is offered. Barrett's oesophagus, varices and trauma are also described. The approaches to oesophageal carcinoma range from blunt to radical resection. Since the coeditor is a well-known proponent of blunt oesophagectomy and devotes a major chapter to it, the book is biased. A weakness is that the series falls between being a standard textbook and an operative surgery manual.

Shackelford's Surgery of the Alimentary Tract edited by G D Zuidema. 3rd edition. Vol 2, **Stomach and Duodenum** coeditor W P Ritchie Jr. 395 pages, illustrated. W B Saunders Company, Philadelphia. 1991. ISBN 0 7216 2506 1

The title of this volume is incomplete since more than one-third is devoted to abdominal incisions, closure, drains, bowel anastomoses, and wound complications. It is altogether a less satisfactory volume compared with Volume 1. For example, out of nearly 400 pages, duodenal ulcer claims but 15, gastroduodenal tumours a mere 8. At least postgastrectomy syndromes receive only 5 pages, most of which could be relegated to the surgical history. Inevitably in an American text, operations for morbid obesity are included; I hope British readers will continue to leave this practice in the hands of a few surgeons.

Surgical Pathology of the Female Reproductive System and Peritoneum edited by Stephen S Sternberg and Stacey E Mills. 305 pages, illustrated. Raven Press, New York. 1991. \$102.00. ISBN 0 88167 726 4

The contents of this volume are reprinted from the much larger book entitled *Diagnostic Surgical Pathology* edited by Sternberg *et al*. It comprehensively covers all aspects of surgical pathology of the female reproductive tract with copious illustrations and many references.