Appropriate Technology

Operating theatre and equipment

PETER BEWES

I believe that good surgery can be performed in comparatively simple surroundings, which lack the apparently limitless resources of the West, and that it is possible to construct operating theatres where such surgery may be carried out without breaking the bank.

Priorities in allocating funds in surgery

Providing the minimum amount of essential equipment should take precedence over plans for elaborate hospital buildings in areas where resources are limited. A visually splendid hospital without a functioning autoclave or a bronchoscope is clearly a planning disaster. The architectural requirements of a district hospital operating theatre are not necessarily expensive,¹ and local materials may be used for much of the building. Water is so basic to surgery, that it must be available readily and this must be borne in mind in the initial decision about where the hospital is to be situated. A hospital that depends on a piped water supply that is not under its own control is vulnerable to the vagaries of the urban water supply, which may totally disrupt surgical services for extended periods. Ideally the operating theatre should have a reasonably large water tank of its own to allow some flexibility when the main hospital tank is depleted for any reason.

Air conditioning may be desirable in hot and humid climates, but it is usually better to ensure that the theatre is kept reasonably cool by attention to architectural detail (adequate roof overhang, proper ventilation etc) rather than by installing an air conditioner that may actually impede the flow of air when—as is so often the case—it breaks down.

Electricity is not essential to the practice of surgery, but it is desirable, for operating the autoclave, the theatre lights, the suction, and the diathermy. There are alternative sources of energy for most of these, however, and diathermy is not essential. If electricity is to be used, a reliable alternative means of generating it must be installed, in case the mains supply fails. This usually implies the installation of a diesel or petrol driven generator.

Sterility

Asepsis is essential to modern surgery, and an autoclave must be regarded as a standard piece of equipment. If there is a source of pressurised steam in the hospital, the autoclave will run off that (fig 1). Where electricity is provided, a semi-automatic electric autoclave such as the Matron made by Surgical Equipment

Supplies Ltd is satisfactory. If electricity is not available, an autoclave designed to work on a different type of fuel, such as kerosene, or even charcoal, may be used. Simple boiling does not destroy spores (or even vegetative organisms at high altitudes). It is only in very remote areas that it is necessary to rely solely on chemical means of providing sterility—for example, wringing out the drapes in antiseptic—but these methods may be used successfully.²

FIG 1—This autoclave is suitable for use where there is a source of steam under pressure.

Lighting

A mistake that is often made is installing complex lights over the operating table, lights that are later found to have bulbs that are almost impossible to trace and reorder when they burn out. While it is possible to operate under a triangle of three fluorescent tubes suspended over the table, a shadowless lamp is better. One of the best patterns (fig 2) has a series of radiating mirrors reflecting light from a single centrally placed bulb. (The Scialytic lamp is a good example.)

Ideally, manufacturers should be encouraged to make a model that uses a standard domestic electric lamp, which is easy to replace. Contrary to popular belief, such a bulb gives a good light,

FIG 2—Overhead lamp which is satisfactory for most forms of surgery and may be modified to take household light bulbs.

quite sufficient for operations high under the diaphragm or deep in the pelvis. If the hospital cannot afford a conventional suspension system, the light may be suspended by stout cables from an overhead girder. Alternatively, a floor mounted lamp will have to serve as the main light source.

Operating table

The choice of operating table is critical. If the local repair services cannot maintain the more complex hydraulic types of table, then insist on a simpler pattern. In small hospitals a simple table such as that shown in fig 3 will provide good service for many years, and prove adequate for all the surgery that is likely to be carried out. It also has the advantage of costing only about one hundredth of the cost of the hydraulic table. More expensive tables that still give good value for money include the *Seward Minor* table and the *Thackray Specialist Four*.

Instruments

It is foolish to buy the cheapest equipment; artery forceps are useless if their points do not meet. Kidney dishes should be of stainless steel and not enamel, which does not last so long and soon chips and becomes difficult to clean. Instruments should be simple but good—that is, sharp and well maintained. They should be in use in the teaching hospitals, even though more elaborate equipment may also be present, so that the doctor who proposes to go to work up country has the opportunity to become familiar with them long before he has to use them unsupervised and on his own. For example, excellent skin grafts may be taken with a simple Blair knife (indeed, they have been taken with kitchen knives on occasions), but it is commonplace to hear of hospitals where skin grafting is considered impossible because the residents there have been taught to use only mechanical dermatomes and knives with rollers and disposable blades. I taught myself how to take grafts with a Blair knife, and learnt (from a barber) how to hone and strop it to a keen edge. If there were enough money in all countries to buy Humby knives with their disposable blades, no doubt they would be the best buy; but there isn't, and hence simpler instruments must be purchased.

One or two "general sets" of instruments are sufficient for most operations, and these should be supplemented by special sets for more elaborate procedures. The range of such supplementary sets must be determined by the experience of the sur-

geon likely to be working in the hospital, but in larger hospitals they might include "specials" such as tracheostomy sets, plastic, gynaecological, urological, thoracic, vascular, and skull instruments. A separate orthopaedic set is also necessary in the larger hospitals. Relatively simple, but good equipment is needed to deal with fractures. Both Jellis and Charnley have argued that non-operative methods may be used in the management of the commoner fractures.^{3 4} Jellis goes so far as to say that elaborate apparatus for internal fixation of fractures has no place in an isolated rural hospital. I agree with this view, and believe that such surgery should be undertaken here only by surgeons with adequate orthopaedic experience who have access to good equipment, in the form of traction stirrups, Denham pins, and Kirschner wire tensioners and drills for their easy insertion. Finally, only high quality plaster of paris should be used for it is very difficult to get good results with locally made plaster of paris bandages.

In district general hospitals endoscopes should be available but smaller hospitals will require only facilities for proctoscopy, sigmoidoscopy, culdoscopy, and laryngoscopy. If bronchoscopes, oesophagoscopes, cystoscopes, and gastroscopes are to be ordered, they should share a standard light source with common fittings. It should go without saying that if a certain endoscope is on the list of approved medical stores, then so should be its bulbs, without which it is useless. Where a battery box is necessary for any particular instruments, it should function with the batteries that are likely to be available locally.

Other equipment

I have visited many rural hospitals which boasted a suction machine, but this was rarely in working order. A good argument may thus be made for using a reliable and robust foot operated suction pump based on the car tyre pump, which will continue to give good service even under adverse circumstances (fig 4). Diathermy is not essential, and should probably be reserved for the more affluent hospitals, and those that will need to perform thoracic, neurosurgical, and other forms of major surgery.

Prepackaged suture material swaged on to eyeless needles is some 30 000 to 40 000% more expensive than reels of monofilament polyamide (nylon) material bought in bulk. This is suitable for most operations, and spools of suture thread may be mounted on the wall of the room where operation trays are assembled and wrapped. Special suture material should be kept for eye operations and vascular work, and for example, closing the gastric and vesical mucosa.

An arkansas stone should be available in the theatre suite, so that suture needles, scalpels, and skin graft knives can be reused.

FIG 3—A simple operating table with height and tilt adjustments.

FIG 4—A robust foot operated suction pump modified from a car tyre pump.

A hand sharpened needle will be quite as sharp (and therefore kind to the tissues) as a new eyeless one, and may, on occasions, be even sharper.

Library

Perhaps the most neglected aspect of providing the necessary equipment and facilities for surgery, is making provision for a library. A well protected and well kept set of books must be available for the hard pressed doctor who may be called to operate under difficult conditions. Among these I would include

Hamilton Bailey's *Emergency Surgery*, A K Henry's *Extensile Exposure*, John Charnley's *Closed Treatment of Common Fractures*, Farquharson's *Operative Surgery*, and F N Prior's *Manual of Anaesthesia*. It is hoped that new texts will be published which are specifically geared to the needs of the isolated general duty doctor working in the operating theatre of a rural hospital.

References

- ¹ Jorgensen TA. *Proceedings of the Association of Surgeons of East Africa*. 1981;4:64-8.
- ² Dick JF. Surgery under adverse conditions. *Lancet* 1966;iii:900-1.
- ³ Jellis J. *Proceedings of the Association of Surgeons of East Africa*. 1981; 4:95-102.
- ⁴ Charnley J. *The closed treatment of common fractures*. 3rd edn. Edinburgh: Churchill Livingstone, 1961.

Recommended reading

Tropical Doctor is a good source and the Christian Medical Fellowship, 157 Waterloo Road, London SE1 sends this free to missionaries who would like it.

KCMC 10th Seminar (Surgery). This may be obtained from the education committee, Kilimanjaro Christian Medical Centre, Private Bag, Moshi, Tanzania, cost £1 + postage and packaging.

KCMC 6th Seminar (Anaesthesia), same source as above.

For medical assistants the African Medical Research Foundation, PO Box 30125, Nairobi, Kenya has published a series of manuals on many topics of rural health care. They have a base in London, telephone 01-629 7137.

Reprints of articles for a mission hospital may be obtained from WHO, Avenue Appia, 1211 Geneva 27, Switzerland.

The proceedings of the Association of Surgeons of East Africa, PO Box 8159, Lusaka, Zambia is produced annually and contains useful articles.

MATERIA NON MEDICA

Letter from tomorrow

29 February 1996

Dear Past,

Just a short line to express my feelings about the Artificial Intelligence Patient Care Computer you recently sent me. It arrived four weeks ago and now its square screen has pride of place in my dingy office. No longer do I wade through a cauldron of clinical chemistry sheets to get to my equally chaotic desk. My world is ordered now.

The artificial intelligence machine, which I affectionately call Dr Robertson after one of my favourite clinicians, wakes me between 8 30 and 9 00 am depending on the number of bloods required. By the time I've downed coffee and toast and wandered to the ward, all the appropriate forms await my shoddy signature, leaving me with the mere task of drawing up that wondrous red fluid. At first Dr Robertson would wish me good morning on my arrival at the ward, but the job has lightened so much I often show up at 9 30 am when the "Good morning" feels more like criticism than cheery greeting. That problem has been deprogrammed.

Provided I feed Dr Robertson with accurate data, he is tremendously helpful, and not just with forms. He helps with clinical decisions—mostly using his own circuits, but occasionally with aid from the new regional medical computer, which advises him on more delicate matters.

Admissions are no longer a chore, despite the unfortunate monotonies of the bed bureau (due to be phased out next year). No sooner have I stated the patient's details and typed in my own security code, than all previous medical information is assembled. Before the patient arrives Dr Robertson has provided me with a provisional checklist of things to do and has arranged the inevitable ECG and chest x ray film, leaving me more time with the patient. When Dr Robertson feels he has enough data he dutifully bleeps my registrar.

My registrar hates computers and prefers to attempt diagnosis

unaided—perhaps because of his impending MRCP examination. But I'm sure he appreciates the rapid data gathering and the feedback it provides to his own conclusions.

The consultants, however, are hellish. Despite the potential butter smoothness of ward rounds, they're always punctuated by "differences in opinion" between the consultant and Dr Robertson. Nothing pleases them more than to outsmart Dr Robertson. Naturally since the consultants write the references, it's with them that my loyalties lie, though between me and you I reckon Dr Robertson's got the edge.

So, dear past, I'd like to thank you for your gift; my remaining five months as a house officer are going to be easy, but I would like to impress upon you one rather sore point: Dr Robertson and his fellow patient care computers have doubled the number of patients a single junior hospital doctor can handle and from this August I'm out of work—that's why I'm trying to carve myself a career in medical journalism. Yours sincerely—J R BRIMACOMBE, house officer, Deaconess Hospital, Edinburgh.

Clinical curio: an original juvenile diabetic

A 74 year old man, who was recently admitted to hospital, was taking 80 U of insulin daily. "You may think it's a lot" he said, "but I'm a juvenile diabetic. I've been taking insulin since 1922. I was a kid of 12, in Toronto then, dying of diabetes. They had these guys there, Banting and Best, and this new fangled insulin they had just discovered. . . . It saved my life, and has kept me going for the past 60 years!"

He has recently received a medal from the American Diabetic Association. He believes he is the only "original" juvenile diabetic surviving.—OLIVER W SACKS, professor of neurology, New York, WALTER SCHWARTZ, medical director, New York.