patient had a persistent fever and cardiac failure after replacement of aortic and mitral valves with Björk-Shiley prostheses. Reoperation four months later was performed as an emergency in the face of uncontrolled infection and the patient died from rupture of a large mycotic aneurysm of the aortic root which burst when the sternum was opened.

Endocarditis occurring late after cardiac surgery is usually caused by transient bacteraemias from procedures such as urinary tract manipulations or dental treatment,[6] and the latter was responsible for two of the four cases we operated on with late infections. Patients with cardiac prostheses should therefore always be advised to take the same precautions against infection as those with congenital or rheumatic heart disease. The prognosis in this group is better than in those developing endocarditis soon after surgery, and provided the prosthesis is well incorporated the infection can sometimes be cured with antibiotics alone.[20] Partial detachment of a prosthesis or damage to a homograft valve secondary to infection requires surgical treatment on its own merits.

Coincident with the decrease in incidence of bacterial endocarditis after cardiac surgery has been an increase in fungal endocarditis. Ostermiller *et al.*[8] reviewed the cases of 48 patients with fungal endocarditis reported in the literature between 1956 and 1970. They concluded that the chief aetiological factors were prolonged antibiotic therapy, general debility, and the use of steroids and found a mortality rate of no less than 89%. *Candida albicans* is by far the commonest causative agent[8] and the diagnosis may be difficult to confirm.[21] Fungi not normally pathogenic to man can also cause endocarditis.[22] In this series the single case of fungal endocarditis occurred after prolonged intravenous antibiotic treatment for first streptococcal and then staphylococcal septicaemias. Successful eradication of the infection followed the combination of antifungal chemotherapy and excision and replacement of all three cardiac prostheses.

Conclusion

Our results indicate that in addition to elective valve replacement surgery has an important role both in the management of intractable heart failure consequent on bacterial endocarditis and in the eradication of infection. The timing of operation is crucial, particularly where valve destruction occurs early, and in this event operation may be necessary before completion of antibiotic therapy.

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Impressions of Cogwheel

A Divisional Study

FROM A SPECIAL CORRESPONDENT

British Medical Journal, 1972, **4**, 602–604

In recommending the divisional structure as the best way of organizing medical work in hospitals the original Cogwheel Report[1] was probably thinking mainly of the clinical specialties. Physicians and surgeons of various persuasions would easily fit together in divisions of medicine and surgery. Indeed, some physicians had already thought about forming division-like structures themselves.[2] So, unless they were numerous enough to form divisions of their own, paediatricians might be expected to join the physicians and anaesthetists to join the surgeons. Nevertheless, because this tidy scheme left many specialists out of account in some hospitals groups pathologists, radiologists, clinical physiologists, physicists, pharmacists, and so on have been distributed into the other divisions or have been able to form divisions of their own. In other circumstances the solution has been to group the "services" specialists together—in other words, the "second-line" experts to whom the "front-line" clinicians send requests for services. Sometimes anaesthetists have been included in this category.

I talked to Dr Delahay,* a pathologist who is a member of a services division which includes diagnostic radiologists (but not radiotherapists) and pathologists, and also biochemists, physicists, and pharmacists who are not medically qualified. This is therefore a heterogeneous group of people without many interests in common but serving the same group of requesting clinicians in several hospitals. Naturally, Dr. Delahay said, the discussions tend to become a trifle factional, but on the whole the meetings remain amicable. Medical physics, diagnostic radiology, and pathology all need large

* This name is fictional.

allocations of capital, while pharmacy needs a large current account. This means that compared with other divisions this division needs a lot of money and much of their discussion centres on this question. The services division is represented on the group medical executive committee by its chairman and secretary.

Cancelled Meetings

On the other hand, Dr. Delahay said, many of his monthly divisional meetings were cancelled for lack of items on the agenda. Divisional agendas were circulated only to their own members so that other divisions were not warned that matters affecting them might be discussed in the services division. Conversely, nor did the services division hear that complaints about their services were being raised at meetings of other divisions until they saw them in the divisional reports which appeared in the group committee minutes, which were circulated to all divisional members. Because of this he thought that though Cogwheel had greatly improved communications vertically between a division and the group committee, there was still too little horizontal exchange among the individual divisions. In fact the divisions had "compartmentalized" discussion, and this was overcome only by those who frequently lunched in the hospital or had other informal contacts across the divisional boundaries.

The meetings of the services division were attended by about two-thirds of the members, Dr. Delahay continued. The junior staff played only a small part. There was provision for the registrars and senior house officers to be represented but in the service specialties there were only a few of them and they seldom attended or spoke. Though the general practitioners had access to the services provided by the services division, they had no representative to tell the division whether the services provided were appreciated or whether they could be organized or publicized more conveniently in some other way

The chairman was elected for three years on a postal vote, the results of which were published in the minutes. He received no allowance of money or time for his services. Two members of the group administrative office took all the minutes for all the divisions and the group medical executive committee and circulated them quickly. Although the services division spent a lot of money, members of the administration did not normally attend its meetings, though Dr. Delahay thought that this might be a sensible idea. The Hospital Activities Analysis reports were not presented to the divisions, nor were any other statistics about work loads. Nevertheless, each division had to prepare regular forecasts for expansion, improvement, equipment, and staff needs for up to four or five years ahead and data had to be collected for this exercise.

Slow Machinery

Dr. Delahay's main complaint about Cogwheel was that the whole machinery was so slow. A simple request for information by a clinical division might have the following critical path: raised at a monthly meeting of a clinical division; brought up at the monthly meeting of the group medical executive committee and referred to the services division; informal discussions with appropriate staff; brought up at next monthly meeting of the services division; again discussed at the group committee; answer reported to the next meeting of the clinical division; total 2½ months. "Anything that becomes contentious can be dragged on ad infinitum," Dr Delahay commented.

A further unsolved difficulty concerned the specialist hospital in the group which he also attended. Unlike a maternity hospital (which could be under the wing of the division of obstetrics and gynaecology), this hospital was visited by consultants from nearly all the divisions but was primarily represented by none. So there the old medical staff advisory committee still ruled but had no representation on the group committee. Consequently, the interests of this hospital did not receive much attention at the level where attention counted. Dr. Delahay thought that such problems must exist in many areas and that the specialty-division Cogwheel structure was not quite the answer to their needs.

Even so, the division was not the only outlet for Dr. Delahay. There was a second hospital group in this city, in which the Cogwheel scheme had also been brought in, (55% of the consultants had sessions in both of the hospital groups and consultant appointments were made to the composite "area"). To provide a forum for both groups there was an area consultants' committee and executive, which considered matters such as the proposed new consultant contract. In addition there were area specialists' committees, which were like joint divisions. Thus pathologists had an area committee of their own, with a rather more catholic membership—including junior staff, chief technicians, and public health laboratory staff. New staff appointments and job specifications were considered at this level.

Future Benefits

This level of reorganization for the area specialists may be of great value in 1974 when the new area health authorities are appointed. Already a study of the area by management experts has suggested that this particular area health authority should be divided into three districts. It is proposed that one district should contain the two hospital groups already mentioned plus a psychiatric group. The district management team would include representatives of the consultants and general practitioners, the dean of the medical school, an administrator, finance officer, nursing officer, and the specialist in community medicine—whose role is defined in the recent Hunter report.[3] This report made the interesting suggestion that the counterparts of these officers at the area and regional levels should be of the same or even junior rank. The plans for development should be developed at the district level by the people who would implement them. Such people, the report proposed, needed executive field rank while the area and regional people would be more like staff officers—a military as opposed to the traditional N.H.S. hierarchical concept.

Dr. Delahay was a little bewildered by the proposals for change in the 1974 reorganization of the health services and found both the White Paper[4] and the management study rather hard to digest. On the other hand, he was fairly happy with the group Cogwheel (which had been set up in 1969) apart from the ponderous nature of the divisional system and the "compartmentalization" of discussion in divisions which, he though, prevented real pressure being exerted on the group committee on management. The area consultants committees also worked reasonably smoothly, he said, and to the advantage of all including the patients. He had been surprised to learn that only recently had the chief nursing officer been asked to attend the group committee—and still did not attend as a right—but he thought that such anomalies would gradually be righted as pressure was applied by those who wanted these rights. In this group the Cogwheel structure itself could be reviewed by a body consisting of all members of the divisions. This body was empowered to set up new divisions, move consultants in minor specialties out of one division and into another, and to decide divisional representation on the group medical executive committee.

Individual Attitudes

It would be interesting to know if Dr. Delahay—a youngish, active consultant, a reasonably well-informed man who reads committee minutes and attends divisional meetings, without any training in administration but who is a potential divisional

chairman and member of the group medical executive committee—is a typical divisional member. Is a more active role in management going to be required of such doctors to make the resources of the N.H.S. look after the health of the individual adequately?

Perhaps understandably, the second Cogwheel report[5] does not say much about the attitudes of individuals to these subjects.

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Medical Engineering

Biomedical Engineering at King's

FROM A SPECIAL CORRESPONDENT

British Medical Journal, 1972, 4, 604–605

At present there are only a handful of medical engineering units in Britain, but even so it might seem fanciful to suggest that they have all developed in a similar way. If there is a common pattern this seems to be divisible into three main stages. To start with, a doctor reaches a stage in his research when he realizes that he needs help from non-medical scientists to help him solve his problems; he then sets about convincing other people that a multidisciplinary team is both desirable and necessary. Next, he spends a lot of time obtaining the right staff, building, equipment—and, in particular, sufficient money—to get a unit started. The third stage often the easiest; the actual research work itself, even though usually other problems or research projects are thrown up by it results. Finally, the unit may become so successful that other hospital departments seek its help. It is often just at this stage that the original grants run out, the whole team is plunged into uncertainty about its future, and much valuable time is spent in hunting for money.

Even if it is not a general rule, this pattern certainly applies to the Biomedical Engineering Unit at King's College Hospital in London. This arose out of the enthusiasm of Mr. L. T. Cotton, a consultant surgeon at the hospital whose interests have always been in the vascular field. He was dissatisfied with the then current methods of monitoring blood flow, and became concerned to find accurate answers to three main questions. How much is blood flow slowed in various conditions? How can this slowing be measured—before operation, during it, and afterwards? And how can slowing of flow be prevented, particularly to stop the development of deep vein thrombosis? To try to solve these and other problems he first established a link with the University of Surrey. But since most of the research would inevitably be patient-orientated it soon became evident that a unit would have to be established at the hospital itself. Here the connexion with Surrey University proved invaluable: the unit's research workers in the various engineering disciplines have all undertaken postgraduate studies in biomechanics at Surrey and while at King's are supervised for their Ph.D.'s by Professor J. M. Zarek, who heads Surrey's Mechanical Engineering Department and who shares a joint directorship of the department at King's. Moreover, postgraduates on the M.Sc. course at Surrey come to King's for a course on clinical aspects of biomedical engineering.

Having obtained a generous grant from the Wates Foundation, the unit was started at King's in 1967; subsequently, other funds were given by the British Heart Foundation, and this year it obtained £14,000 worth of machine tools under the Government's new scheme to help the industry, and £5,000 from the Beaverbrook Foundation. In 1971 the unit obtained the space it needed; most of it moved into the old pathology department at Dulwich Hospital nearby, though it still retains one room in the research corridor at King's itself, which forms a base for both clinical work and research carried out in the animal house. Mr. Cotton is the unit's director at King's, and there are six other members of the team: another surgeon, four professional engineers, and a secretary. Nevertheless, though the senior engineer now has honorary lectureship status, not a single one of the posts is established. Moreover, there has never been enough money to pay for a technician to service the machines or to do the routine work, all of which has always been done by the graduates themselves. With the Wates grant now drawing to an end the future is a constant worry—"all we really need is a little stability and some technical assistance," as one team member said quietly when asked what more they wanted.

Work in Progress

One major result of the team's work has been the development of a cheap, simple method of prophylaxis for deep vein thrombosis. The basis of this is intermittent compression of the legs throughout any surgical operation using a plastic bag supplied by a cylinder of compressed air, controlled by a small box with only simple pneumatic valves (Fig. 1). In practice, the new device is easy to use, and needs no attention during operation. It has been found to decrease the incidence of deep vein thrombosis by 80% for six days after surgery—in other words, to give rather better results than prophylaxis using techniques of passive exercise, which the team had originally worked on.

Another important research project has been to develop an accurate flowmeter using the principle of thermal dilution. Basically the device consists of a double-barrelled, fine nylon tube which is passed into the blood vessel. Saline at room temperature is injected through the inner channel and enters the blood stream a short distance away from the end of the tube. The probe contains a thermistor which measures the