Process and Outcome

The cost of cardiac surgery

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Summary and conclusions

A study in Wessex has shown that at 1977 prices, and excluding the cost of equipment already installed in the unit, the cost of replacing a man's aortic valve in this unit is about £1800. Nevertheless, this seems a small price to pay for return to health and full working capacity, particularly since such patients no longer need to draw social security benefits and their tax contributions will return to normal, thus probably paying for the operation within two years.

Introduction

Cardiac surgery is generally thought to be one of the more expensive forms of treatment offered by the National Health Service, yet there is little accurate or recent information about its cost. Any unit undertaking this work must be fully equipped with advanced equipment that is inevitably expensive. Nevertheless, separate from the cost of capital equipment, without which the unit could not function, is the cost of the surgical procedure itself. This can be determined either by calculating the total annual cost of running a unit and dividing by the number of operations, or by accurately determining the cost of one typical operation. At the Wessex Regional Cardiac and Thoracic Centre in Southampton we used both these methods to determine the cost of cardiac surgery.

Materials and methods

The regional cardiac and thoracic unit in Southampton cares for the cardiac surgical needs of Wessex and the Channel Islands—a population of about 2.7 million. The type of work undertaken has been reported elsewhere,¹ and surgery for rheumatic heart disease accounts for over half the bypass operations, with surgery for congenital heart disease and coronary heart disease accounting for most of the rest. In 1976 356 operations were performed under cardiopulmonary bypass and 37 without bypass. The cardiac surgical staff of the unit consists of two consultants, a senior registrar, registrar, and senior house officer. The junior staff rotate with a similar complement of three attached to two thoracic consultants. The two cardiologists have a senior registrar and registrar as well as two senior house officers and a house officer, who between them share most of the ward work

necessary for patients undergoing cardiac surgery. Management of patients in the postoperative recovery room, however, is shared among the surgical and anaesthetic staff.

The normal routine for patients requiring cardiac surgery is as follows. The patient is first admitted under one of the cardiologists for assessment and usually cardiac catheterisation with or without coronary angiography. During this admission one of the cardiac surgeons sees the patient and arranges a tentative date for surgery. The usual wait between referral and surgery for non-urgent cases is about two months. The patient is readmitted three days before the planned date of operation to allow for routine blood screening and cross-matching. The patient is anaesthetised by a consultant anaesthetist, and the operation carried out by the consultant surgeon or the senior registrar under his guidance. After the operation the patient is moved to the four-bedded intensive care room, where he is carefully monitored and usually ventilated overnight. Depending on his progress he usually returns to the ward after 24 or 48 hours. Twenty per cent of adults return to the ward within 24 hours and 80% within 48 hours. Half of the children return to the ward within 24 hours. On return to the ward patients are gradually mobilised, skin sutures are removed on the 10th postoperative day, and patients are discharged an average of 12 days after operation. The patient attends for a routine outpatient visit six to eight weeks after operation, and if all is then well he is advised to return to work.

For costing a single operation a patient with aortic valve disease requiring aortic valve replacement was chosen. Aortic valve replacement is the commonest type of procedure carried out in this unit, and, although no operation is absolutely typical, we thought that this would be representative. The patient was 42 years old and unable to do a full day's work because of shortness of breath due to aortic regurgitation after bacterial endocarditis. He underwent cardiac catheterisation on 1 June 1976, which confirmed severe aortic regurgitation. He was readmitted for operation on 17 June 1976, but had developed a tooth abscess and underwent dental extraction instead. He was admitted again on 17 July and the operation was carried out on 21 July. He spent 24 hours in the recovery ward after operation, and was discharged on 4 August. Hence admission for operation lasted 17 days, and he returned to work 11 weeks after operation.

COSTING OF A SINGLE OPERATION FOR AORTIC VALVE REPLACEMENT

The groundwork for this exercise was done before the patient's admission—indeed, before his selection. Interviews were held with staff in wards, theatres, catheter room, pathology laboratory, x-ray department, physiotherapy department, and the pharmacy, during which the purpose of the survey was extensively explained. All staff interviewed agreed to keep a detailed inventory of every item used during the patient's treatment. Staff commitment was enthusiastic and total. A member of the finance department was present in the catheter room and in the theatre, and listed every item used in both these areas. Other detailed lists were kept by the people previously interviewed so that when the patient was discharged there was a complete record of all consumables and drugs used and also all x-ray examinations and pathology tests carried out. These inventories were costed by the supplies department and correlated by the administrator who carried out the survey.

Staffing details were obtained for wards, theatres, and the catheter room, to include medical and nursing staff. Professional and technical staff recorded their time spent on this particular case. All this information was costed by the finance department. For medical and nursing staff a formula was derived from the annual salaries plus enhancements,

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Total cost* of surgical treatment of a man who underwent aortic valve replacement on 21 July 1976

Phase of treatment	Hotel services (£)	Medical staff (£)	Nursing staff (£)	Professional and technical staff (£)	Consumables (£)	Pharmaceuticals (£)	Pathology (£)	X-ray examinations (£)	Total (£)
Catheterisation (seven-day ward stay)	99.39	24.91	57.29	15.04	71.65	11.48	11.77	20.51	311.04
Dental treatment (two-day ward stay)	26.10	1.68	38.19	2.33	3.95	4.16	6.83	1.43	84.67
Cardiac operation		113.34	19.62	29.60	490.05	15.74	19.00		687.35
Intensive care (24 hours)	9.03	(Included in ward stay)	55.33	24.89	37.80	12.56	82.22	0.84	222.67
Ward stay (16 days)	208.81	82.65	302.60	6.10	10.58	22.25	62.08	2.10	697.17
Other general costs	1.80	25.44		7.11					34.35
Total	345.13	248.02	473.03	85.07	614.03	66.19	180.90	24.88	2037.25

* Price level: April 1976.

the number of beds in the relevant wards, and the annual bed occupancy to calculate the cost of one bed per day, which was then multiplied by the number of days the patient spent in each ward. For professional and technical staff the annual salaries were broken down into hourly costs, which were multiplied by the actual hours worked. The finance department calculated costs for hotel services, including administration, medical records, catering, cleaning, portering, laundry, linen, transport, and estate management. The patient was in hospital seven days for cardiac catheterisation, two days for dental treatment, and 17 days for cardiac surgery, of which one was spent in the intensive care room.

Results and comment

Costs, based on details carefully collected by all staff concerned, were calculated for each procedure, and these are summarised in the table, according to the constituent elements of each procedure. The cost of the admission for cardiac catheterisation was £311, and if this together with the cost of dental treatment is excluded, the cost of the operation itself was £1642, of which the Starr-Edwards valve accounted for £280. Thus the basic cost was £1362. As the total cost of the operation itself was £687, of which consumables including the valve totalled £490, the remaining cost of £197 was mostly accounted for by staff salaries, and this sum seems remarkably low. Not surprisingly, the one-day stay in the postoperative recovery room was expensive at £222, and £82 of this was for pathology investigations, which was mainly for blood gas analyses and electrolyte estimations. After the return to the ward, the single biggest cost was nursing staff at £302. When surveying the individual totals, x-ray examinations seem remarkably cheap, given that the bulk of the cost was for the catheterisation; the radiographer's time, however, was calculated under professional and technical staff.

COSTING OF THE WHOLE UNIT

The annual total cost of running the Wessex Regional Cardiothoracic Centre at the Western Hospital, Southampton, was calculated at £1 545 200 for 1976. Of this, the cardiac surgery service was calculated to cost £588 600 or £98 per inpatient day and £1574 for each patient. The total cost of the cardiological service was £470 000.

Discussion

This attempt to determine the cost of cardiac surgery was prompted by the singular lack of accurate information available on the subject, and was seen as complementing a study of the quality of life after cardiac surgery² already in progress in the unit. The final figure for a basic cardiac operation updated to 1977 prices would be £1510, which we thought was surprisingly low, though the cost of any valve inserted must be added to this. As a Starr-Edwards valve costs £324, the final cost for many operations will be higher. Nevertheless, it is reassuring that coronary artery bypass grafting, which is being performed increasingly often, is at the basic rate. It was useful to have two methods of assessing the cost of an operation, and, as they gave such similar results, the final figure is probably accurate. If any inaccuracy occurred in calculating the cost of the single operation it was probably in the difficult costing of staff time,

since the individual items used for this patient were noted very accurately, down to the last disposable needle.

Recently a group from St Thomas's Hospital, working on similar lines and quite independently, calculated the cost of a single operation, which also happened to be for aortic valve replacement.³ The total cost of the operation, including a xenograft (pig) valve at £438, was £2755. This excluded the cost of preoperative cardiac catheterisation, and their patient stayed 20 days in hospital and was in the intensive care unit for the first three days after operation. Even if the costs are scaled down to 17 days to match our patient's stay, and if the cost of the valve is excluded, the basic cost at 1977 prices at St Thomas's Hospital comes to about £2000, compared with £1510 in Southampton. As both units perform a roughly similar number of operations yearly, the cost of the operation at a London teaching hospital is apparently greater than in a provincial regional unit. Nevertheless, one interesting fact to emerge from the St Thomas's Hospital report was their comparison of the costs of the cardiac surgical operation and an oesophagectomy performed in the same hospital, which were £2755 and £1870 respectively. Given that the cost of the valve, disposable oxygenator, and extra technicians' time were included in the cost of the cardiac operation, the difference in cost between the two operations is not great. Furthermore, the five-year survival rate for oesophagectomy is unlikely to exceed 10%, whereas that after aortic valve replacement exceeds 80%, making the cardiac operation the better of the two essential operations in terms of cost-effectiveness. Furthermore, although the xenograft is more expensive initially than the Starr-Edwards valve, anticoagulants are not necessary after replacement with a xenograft valve, and this saving probably pays for the valve within two years. Nevertheless, the cost of different valves has not yet affected the decision about which to use.

The cost-effectiveness of cardiac surgery is clearly of great importance in planning a regional service. Not only the operative mortality but the improvement in quality of life after operation is important. The operative mortality rate is steadily falling despite widening application, particularly at either end of the age range, and this in itself makes the surgery more cost-effective. A study of the quality of life after operation² has established that, whereas only 33% of men of working age were at work before operation, 66% returned to work in the eight months after operation. Apart from the fact that many would have died without operation, this great improvement in the quality of life, as shown by the improved ability to work, makes the operation well worth while. A similar increase in the ability to do full-time and part-time jobs, as well as housework and shopping, was noted among women, and the elderly became much less dependent on others.

References

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