SYSTEMIC DISTURBANCE FROM THOMPSON'S ARTHROPLASTY

AN AGE-MATCHED AND SEX-MATCHED CONTROLLED RETROSPECTIVE SURVEY

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The records of 107 patients with displaced subcapital hip fractures treated by Thompson's femoral head replacements have been reviewed to determine the mortality and certain aspects of systemic morbidity. Comparison was made with a group, matched exactly for age and sex, in which intertrochanteric fractures were treated by nail-plate fixation. The patients treated by Thompson's arthroplasty were further subdivided into two groups: one in which methylacrylic cement was used, and one in which it was not used. We found no difference in the mortality of the patients undergoing replacement arthroplasty and nail-plate fixation. Similarly there was no difference in the incidence of cerebrovascular incidents and myocardial infarction after operation. There was a higher incidence of transient cardiac failure following Thompson's arthroplasty. Hypotension during the operation occurred irrespective of whether cement was used; nor was the use of cement associated with increased mortality. However, it seems that methylacrylic cement does contribute to the cardiac failure that may occur after Thompson's arthroplasty.

Hemi-arthroplasty of the hip using a Thompson prosthesis is frequently chosen for the primary treatment of the common subcapital fracture of the femoral neck; the fracture occurs in an aged and predominantly female population. The operation has a morbidity in terms of mechanical complication, such as dislocation, shaft perforation, wound infection and other problems that vary with different regimes and technical approaches (Chan and Hoskinson 1975; D'Arcy and Devas 1976), and it is accepted that such morbidity is high. There is another aspect of morbidity that is less commonly reported, namely major cardiovascular, respiratory or neurological disturbance. Part of this will be reflected in the high mortality rate of the operation (Gresham, Kuczyński and Rosborough 1971; Chan and Hoskinson 1975), but this must necessarily represent only the "tip of the iceberg". It is important to know the magnitude of these problems because surgeons must be aware of the extent of the surgical assault that they inflict on their patients. Hip replacement arthroplasty is relevant in this context because reaming of the femur and the insertion of methylacrylic cement and of the prosthesis could be implicated in the genesis of the fat embolism syndrome (Charnley 1970; Sevtitt 1972).

We have tried to answer the following questions:

1. What is the incidence of serious complications following Thompson's arthroplasty, with special reference to cardiac failure, collapse after operation, cerebrovascular incidents and death?
2. Was this morbidity

- and mortality associated with the use of cement?
3. Was this morbidity and mortality a reflection of surgical technique or of the age of this group of patients?

PATIENTS AND METHODS

A retrospective survey has been made of 107 Thompson's arthroplasties, undertaken at the Bath and Wessex Orthopaedic Hospital, for the primary treatment of displaced subcapital fractures of the neck of femur. The operations were carried out by various trainees and consultants, the bulk being done by registrars. Cement was used in the majority of patients, but two surgeons used cement only when, after reaming, the prosthesis was loose in the shaft.

As a control group an equal number of patients with intertrochanteric fractures treated by nail-plate fixation was used. The groups were paired exactly with reference to age and sex. Our choice of this control group was based on the following similarities. Both groups had proximal femoral fractures treated by early operation, and carried out by the same group of surgeons. The total anaesthetic time, the extent of the blood loss, and the management after operation of the patients were similar. It is important to note, however, that the control group is not random and cannot be used as an indication of the morbidity or mortality after nail-plate fixation.

We searched for and recorded the occurrence of:

1. Hypotension during operation of 20 millimetres of

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mercury or more relative to the established base line. 2. Major collapse in the first two weeks after the operation for which the resident was summoned urgently because of hypotension (usually 50 millimetres of mercury or more below the pre-operative normal), respiratory distress, deterioration in the level of consciousness, localising neurological signs or severe confusional states. Cardiac enzyme changes, electrocardiograph records and post-mortem examination were accepted as evidence of myocardial infarction. The diagnosis of heart failure or cerebrovascular accident was inferred from the clinical features recorded in the notes. 3. Death occurring while the patient was under our care.

We have related these changes to the use of methyl-acrylic cement to fix the prosthesis in the femoral shaft.

The results of the groups have been analysed for statistical significance using the χ^2 test.

RESULTS

Group characteristics

The age distribution of 107 patients undergoing Thompson's arthroplasty was along a normal distribution (Fig. 1). The mean age was 77.67 ± 8.14 (S.D.) years, with 95 per cent confidence limits of 79.24 and 76.10 years. There were nine men in the group, giving a male to female ratio of 1 to 8.4. As the control group was matched, the mean age, age distribution and the male to female ratio were identical.

The mean blood loss in the arthroplasty group was 386 ± 225 (S.D.) millilitres, and that of the nail-plate group was 376 ± 230 (S.D.) millilitres, the difference being statistically insignificant.

Comparison of Thompson's arthroplasty with nail-plate fixation (Table I)

The incidence of hypotension during operation was high in both groups. Though it was more common (27 per cent) during arthroplasty than during nail-plate fixation (18 per cent), the difference was not statistically significant. Nevertheless there was a difference in the pattern of changes in the two groups. In the arthroplasty group the hypotensive episode tended to occur with insertion of the prosthesis into the femoral shaft, whereas hypotension during nail-plate fixation occurred soon after induction of anaesthesia.

There was a significant difference in the incidence of hypotension after operation and of heart failure in the two groups. After arthroplasty 15 per cent of patients collapsed with systemic hypotension, and most of these showed the clinical features of cardiac failure which occurred in 13 per cent. It was usually transient and responded to treatment in the short term. Nevertheless it was a grave prognostic sign, for 43 per cent of patients who had had an episode of early post-operative cardiac failure subsequently died, often within days or weeks.

FIG. 1

Age distribution of 107 patients treated by Thompson's arthroplasty in the primary treatment of displaced subcapital fractures of the femur.

The incidence of hypotension after nail-plate fixation was low (4 per cent), as was the incidence of heart failure.

Surprisingly, the susceptibility of the arthroplasty group to hypotension and heart failure after operation was not reflected in an overall difference in mortality: 13

TABLE I

COMPARISON OF THOMPSON'S ARTHROPLASTY WITH NAIL-PLATE FIXATION

	Thompson's hemi-arthroplasty	Nail-plate fixation	P*
Total	107	107	
Per-operative hypotension	29	19	>0.10
Per cent	(27.1)	(17.8)	
Post-operative hypotension	16	4	<0.01
Per cent	(15.0)	(3.7)	
Cardiac failure	14	4	<0.02
Per cent	(13.1)	(3.7)	
Cerebrovascular incident	7	3	>0.10
Per cent	(6.5)	(2.8)	
Myocardial infarction	4	3	—
Per cent	(3.7)	(2.8)	
Death	14	16	>0.10
Per cent	(13.1)	(14.9)	

*The two groups are compared by a χ^2 test for statistical significance and the relevant P value is shown.

per cent of patients died after Thompson's arthroplasty and 15 per cent after fracture fixation, the difference being not statistically significant.

There was also no significant difference in the incidence of myocardial infarction (4 per cent and 3 per cent) after the two procedures, and though cerebrovascular incidents were more common after arthroplasty (7 per cent) than after nail-plate fixation (3 per cent) the difference was not statistically significant.

Comparison of Thompson's arthroplasties with and without the use of methylacrylic cement (Table II) Methylacrylic cement was used in eighty-three (78 per cent) of the 107 arthroplasties. Because of the low incidence of myocardial infarction (4 per cent) and cerebrovascular incidents (5 per cent), statistical analysis is not possible. Nevertheless there was no obvious difference in the incidence of these complications attributable to cement.

A fall in systemic blood pressure, during operation, occurred in 27 per cent of patients in the group as a whole, 27 per cent in the group in which cement was used and 29 per cent in the group in which it was not used. Thus cement was not responsible for the hypotension observed. Similarly the incidence of hypotension after operation could not be attributed to the cement.

There was an apparent difference in the incidence of cardiac failure after operation. Thirteen of the

TABLE II

COMPARISON OF THOMPSON'S ARTHROPLASTIES WITH AND WITHOUT METHYLACRYLIC CEMENT

	Cement	No cement	P*
Total	83	24	
Post-operative hypotension	22	7	>0.10
Per cent	(26.5)	(29.2)	
Cardiac failure	13	3	>0.10
Per cent	(15.7)	(12.5)	
Cerebrovascular incident	4	3	—
Per cent	(4.8)	(3.6)	
Myocardial infarction	3	1	—
Per cent	(3.6)	(4.2)	
Death	11	3	>0.10
Per cent	(13.3)	(12.5)	

*The two groups are compared by a χ^2 test when there are sufficient numbers for the test to be applicable.

TABLE III

RELATIONSHIP BETWEEN OPERATIVE HYPOTENSION AND SUBSEQUENT MORBIDITY AND MORTALITY

	Thompson's arthroplasty	P	Nail-plate	P
Total	29		19	
Post-operative hypotension	9	<0.05	2	>0.10
Per cent	(31.0)		(10.5)	
Cardiac failure	9	<0.02	0	—
Per cent	(31.0)		—	
Cerebrovascular incident	2	>0.10	1	—
Per cent	(6.9)		(5.3)	
Myocardial infarction	0	—	0	—
Per cent	—		—	
Death	5	>0.10	2	>0.10
Per cent	(17.2)		(10.5)	

fourteen incidents of heart failure occurred after operations in which cement was used. This represents an incidence of 16 per cent in the cement group, contrasting with a rate of 4 per cent in the cement-free group. These figures do not reach statistical significance.

Relationship between operative hypotension and subsequent morbidity and mortality (Table III)

There is clearly no relationship between hypotension during the operation, as recorded in this study, and subsequent myocardial infarction or cerebrovascular incidents. These complications were no more frequent in patients sustaining an episode of operative hypotension than in the comparable, normotensive group. The mortality was also not affected significantly by a fall of blood pressure during operation.

There is however an effect. Hypotension and heart failure were both more common after an arthroplasty during which there was a fall in blood pressure. This was not seen in the nail-plate group. Thus if blood pressure falls during a Thompson's arthroplasty there is a 31 per cent chance of a hypotensive event after operation and a 31 per cent chance of heart failure. Both are significantly higher than in the Thompson's group as a whole.

DISCUSSION

The operation of Thompson's hemi-arthroplasty, when used in the primary treatment of femoral neck fractures has a notable post-operative mortality. Estimates of 22 per cent (Gresham *et al.* 1971) and 14 per cent (Chan and Hoskinson 1975) are representative, variations being related to differences in the length of the post-operative

period and in patient selection. This high mortality, and presumably an associated greater morbidity, has been used as an argument in favour of internal fixation (Hunter 1969) for the immediate treatment of the subcapital fracture. Yet the population sustaining this fracture is aged, predominantly female and often infirm. Any statement of morbidity and mortality must take into account the frailty of the patient, and any survey, whether retrospective or prospective, must be adequately controlled. Comparisons of two groups of patients with subcapital fractures, one treated with internal fixation and one by replacement arthroplasty, have often been inadequate and misleading. There has been bias in relation to patient selection. Hunter (1974) in his series stated that "prosthetic replacement was favoured in the elderly, poor risk patients", and subsequent comparison shows that the group submitted to prosthetic replacement was substantially older, had a higher incidence (49 per cent) of intercurrent disease and showed a different sex distribution than the group treated by internal fixation. Gresham *et al.* (1971) showed a similar bias.

TABLE IV
MORTALITY AFTER INTERNAL FIXATION AND AFTER PROSTHETIC REPLACEMENT

Age (years)	Mortality (per cent)	
	Internal fixation	Replacement arthroplasty
<65	1	0
65-74	4	8
75-84	8	7
>85	20	24

When mortality figures are broken down into age groups the differences between internal fixation and prosthetic replacement become smaller. Table IV compares mortality figures produced by Barnes, Brown, Garden and Nicoll (1976) for internal fixation operations with those of our series of Thompson's arthroplasty. In both groups the mortality increases with increasing age of the patient. While the subgroups of our series are too small to allow interpretation of minor

differences the overall mortality figures are remarkably similar.

In terms of morbidity we reach a similar conclusion. With elimination of bias introduced by age we have failed to confirm that Thompson's arthroplasty is a particularly hazardous operation. We accept that femoral head replacement and nail-plate fixation are not clinical alternatives in the context of the subcapital fracture, and, therefore, the relevance of this study to the clinical situation is indirect. Our experience shows that Thompson's hemi-arthroplasty is no more hazardous than a routine equivalent operation.

Further analysis failed to demonstrate any statistically significant effect of the cement on morbidity, including the incidence and pattern of hypotension during operation and the overall mortality. It is probable that the difference in the incidence of heart failure after operation is a real one and that the figures would reach significance if the groups were larger.

Another correlation is between operative hypotension and subsequent heart failure. When the blood pressure falls during nail-plate fixation the chances of subsequent heart failure are no greater than in those patients who remained normotensive throughout the operation. If, however, a patient experiences a hypotensive episode during a Thompson replacement the chance of heart failure developing after the operation increases to 31 per cent. This seems to suggest that different causative factors produce operative hypotension in the two groups.

Conclusion—The high morbidity and mortality of Thompson's hemi-arthroplasty is due primarily to the aged and infirm population subjected to the operation. The incidence of hypotension during operation, and of cerebrovascular incidents and myocardial infarction after the operation are not significantly greater than that associated with nail-plate fixation, nor is there any difference in the mortality of the two procedures. Thompson's hemi-arthroplasty carries a higher incidence of cardiovascular collapse after operation, characterised by hypotension and clinical evidence of heart failure. These episodes tend to be transient and seem to be related to the use of methylacrylic cement.

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