chest x-ray examination, which together with screening of the aortic valve with a high-resolution caesium-iodide image intensifier identified 90% of the patients, and echocardiographic examination of the aortic valve, which disclosed abnormal echoes from the valve in all five patients in whom the valve was seen. It is therefore mandatory to carry out lateral chest x-ray examinations in patients with heart failure of unknown origin and to proceed to screening if the film does not show aortic valve calcification. The heart may be satisfactorily screened for calcification with equipment available in most general hospitals.

ECG evidence of left ventricular hypertrophy or strain, although occurring in patients with other conditions—for example, those with cardiomyopathy or end-stage hypertension—is also a clue to the diagnosis, but, more importantly, lack of such evidence must not be regarded as excluding the diagnosis. The echocardiogram as well as being helpful is also potentially misleading. The left ventricle was invariably dilated and showed poor contraction, which is also the case in congestive cardiomyopathy (table II), and in fact in two patients these echocardiographic appearances had led to the mistaken diagnosis of congestive cardiomyopathy being made at the referring hospital. More careful inspection, however, usually allows this mistake to be avoided, since in all patients with congestive cardiomyopathy the interventricular septum was of normal or less than normal thickness whereas it was thickened in all patients with aortic stenosis. This distinction is particularly important as echocardiography becomes more widespread as a screening investigation in general hospitals.

Once the true diagnosis has been established the important question is whether such diagnostic efforts are rewarded by acceptable results of surgery. Previous studies have shown that aortic valve replacement in patients with good left ventricular function has a mortality of about 5%¹⁻³ and that good results

may be obtained even when left ventricular function is compromised.^{4,5} The present series is the only one reported in which all the patients had initially unsuspected aortic stenosis. In view of the extremely poor preoperative state, left ventricular function, and long-term outlook of these patients the mortality of 38% is acceptable, particularly as all five survivors returned to normal lives. Interestingly, two of the three patients who died had severe coexistent coronary artery disease, which others have found may make the operation hazardous.^{4,5}

These cases emphasise that occult aortic stenosis should be suspected in all patients with severe cardiac failure of unknown aetiology; that lateral chest x-ray examination, screening of the heart for aortic valve calcification, and echocardiographic inspection of the aortic valve may all provide clues to the diagnosis; and that even in patients in their 70s and 80s satisfactory surgical results may be obtained despite seemingly poor preoperative left ventricular function.

We thank Dr R Gibson, Dr M Honey, Dr D Gibson, Mr M Paneth, Mr S Lennox, and Mr C Lincoln for permission to report these cases.

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CONDENSED REPORT

Variation in hospital stay after inguinal herniorrhaphy

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Summary and conclusions

A study was carried out of 1086 men aged 16-65 inclusive who were admitted under nine consultants to eight hospitals in Wessex for elective repair of an inguinal hernia. The mean postoperative stay was $5.7 \pm \text{SD } 2.7$ days. For different consultants operating at any one hospital the mean postoperative stays were similar, whereas for consultants who operated at more than one hospital they were significantly different. The postoperative stay was also significantly related to the size of the hospital, development of postoperative complications, time spent on the waiting list, type of repair used, bilateral herniorrhaphy, and the use of convalescent facilities.

The hospital therefore appears to exercise a greater

influence in determining the mean postoperative stay than does the individual consultant.

Introduction

We chose to study patients undergoing elective inguinal herniorrhaphy as this is a relatively standard surgical procedure that nevertheless produces a considerable variation in the duration of postoperative stay and sickness absence. The postoperative stay varies between hospitals¹ and consultants,² but the possible interaction between these two factors requires further study. Inguinal hernia is common; the diagnosis is certain or easily disproved at operation; operation is the treatment of choice; and the condition is accompanied by a low mortality. Semmence¹ investigated various factors associated with inguinal herniorrhaphy at two teaching hospitals. The present study included different types of hospitals and several consultants who operated at more than one hospital.

Patients and methods

We studied men aged 16-65 inclusive who were admitted to eight hospitals in Wessex for elective repair of an inguinal hernia during

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1970-1. Day cases were excluded. We obtained a list of patients from the Hospital Activity Analysis data and checked and supplemented this by reference to the operation books at the individual hospitals, which added a further 246 patients. Permission was obtained from each consultant to include his patients in the study. The following data were extracted from the case notes: age; occupation; hospital; consultant; medical history, including recorded evidence of respiratory disease; previous operations; type of hernia (diagnosed at operation); grade of surgeon; type of repair; time spent on the waiting list; use of convalescent facilities; smoking habits; marital state; duration of preoperative stay (day of admission to day of operation); and duration of postoperative stay (day of operation to day of discharge).

Of the hospitals, 1 and 2 were teaching hospitals in the same urban community; 3 and 4 were district general hospitals; 5 and 6 smaller units with resident junior medical staff; and 7 and 8 hospitals where the day-to-day management of the patient is conducted by the general practitioner. All patients were admitted under nine consultants, six of whom operated at more than one hospital.

We used analyses of variance to calculate the significances in all cases.

Results

Out of the 1309 patients who underwent elective inguinal herniorrhaphy, nine were excluded because of a more serious concurrent illness, 206 because their case notes could not be traced, and a further eight because essential information was unavailable. Thus 1086 patients (83.0%) remained in the study, of whom 107 underwent bilateral herniorrhaphy. A total of 1193 herniorrhaphies were therefore carried out.

The postoperative stay varied from one to 23 days (table I), with a mean of $5.7 \pm \text{SD } 2.7$ days. Table II gives the mean postoperative stay for each hospital (1-8) and consultant (A-I). There was a highly significant difference in mean postoperative stay between consultants, the means varying from 3.5 to 7.9 days ($P < 0.001$). A highly significant difference was also apparent between hospitals, the means varying from 3.8 to 9.3 days ($P < 0.001$). The patients of each of the six consultants who operated at more than one hospital had significantly different postoperative stays at each hospital (table III). The mean postoperative stays for patients of different consultants operating at the same hospital were similar ($P > 0.05$; not significant (NS)) in five out of six hospitals (table IV). Preoperative stay did not vary significantly from hospital to hospital or depend on the consultant. The mean preoperative stay, for hospital and consultant, varied between 0.8 and 1.2 days.

In table II the hospitals are arranged in descending order of size based on the number of surgical beds. We found that the smaller the hospital the longer was the mean postoperative stay. Factors that had a significant effect ($P < 0.05$) on the mean postoperative stay were recorded evidence of postoperative complications, bilateral herniorrhaphy, type of repair, time spent on the waiting list (the longer waits being associated with shorter postoperative stays), and con-

TABLE III—Mean postoperative stay (in days) for consultants operating at different hospitals

Consultant	Hospital							
	1	2	3	4	5	6	7	8
C	3.8					8.0		
D		4.5					7.9	
E		4.1				6.7	13.0	
F			4.9	6.3	7.3			
H				6.6				9.3
I			4.9		7.0			

TABLE IV—Mean postoperative stay (in days) for different consultants operating at same hospital

Hospital	Consultant								
	A	B	C	D	E	F	G	H	I
1	3.5	4.3	3.8						
2				4.5	4.1				
3						4.9			4.9
4						6.3	5.8	6.6	
5						7.3			7.0
6			8.0		6.7				

valescent facilities (hospitals 1 and 2 only). Further details of these analyses are available on request. Factors having no significant effect on mean postoperative stay were age, occupation, previous operations, type of hernia, grade of surgeon, smoking habits, and marital state.

Discussion

The duration of stay after elective inguinal herniorrhaphy (table I) was influenced more by the hospital to which the patient was admitted than by the consultant firm that managed the care of the patient (table II). In an earlier study of the duration of postoperative stay for normal maternity care³ investigation was made into whether doctors within the same hospital were able to maintain their different practices. Results of the present study support the conclusion that the administrative procedures of the hospital imposed a similar stay on patients under the care of different consultant firms at that hospital. In a study of patients undergoing appendicectomy, in which the catchment areas of hospital management committees were compared, the mean postoperative stay varied significantly between the different areas.⁴ The present study showed that the

TABLE I—Distribution of postoperative hospital stay for patients undergoing elective inguinal herniorrhaphy

Stay (days)	..	..	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Unknown
No of patients	..	..	9	124	152	126	127	171	83	143	84	35	9	7	6	3	1	1	1		1		1		1	1

TABLE II—Mean postoperative stay (in days) by hospital and consultant. (Number of patients in each group given in parentheses)

Hospital	Consultant									Total	Probability
	A	B	C	D	E	F	G	H	I		
1	3.5 (133)	4.3 (50)	3.8 (80)							3.8 (263)	>0.05; NS
2				4.5 (87)	4.1 (123)					4.2 (210)	>0.05; NS
3						4.9 (23)				4.9 (58)	>0.05; NS
4						6.3 (36)	5.8 (61)	6.6 (39)	4.9 (35)	6.2 (136)	>0.05; NS
5						7.3 (64)			7.0 (54)	7.1 (118)	>0.05; NS
6			8.0 (94)		6.7 (124)					7.3 (218)	<0.01
7				7.9 (47)	13.0 (1)					8.0 (48)	
8								9.3 (35)		9.3 (35)	
Total	3.5 (133)	4.3 (50)	6.1 (174)	5.7 (134)	5.4 (248)	6.5 (123)	5.8 (61)	7.9 (74)	6.2 (89)	5.7 (1086)	<0.001
Probability			<0.001	<0.001	<0.001	<0.005		<0.001	<0.005	<0.001	

NS = Not significant.

mean postoperative stay increased as the size of the hospital decreased. Heasman and Carstairs² found a shorter mean postoperative stay in Scottish teaching hospitals than non-teaching hospitals. They also suggested that the duration of postoperative stay at smaller hospitals might be related to periodic visits by a consultant from another hospital. In hospitals 5 and 6, and particularly in 7 and 8, the duration of postoperative stay was related to operating days and the days of consultant visits.

West and Roberts⁴ suggested that increased pressure on hospital facilities had shortened the mean postoperative stay for a hospital management committee area. One measure of pressure on facilities is the length of waiting lists, and patients at the larger hospitals (with short postoperative stays) did wait longer for their herniorrhaphies than patients at the smaller hospitals. Hospital 2 had a longer waiting list than hospital 1 (14.3% compared with 3.4% of patients waited more than two years). Hospital 2 sent more patients to the convalescent home than did hospital 1 (29.1% compared with 12.6%). Despite these two findings, the postoperative stay in hospital 2 was longer than that in hospital 1.

As expected, the development of postoperative complications significantly increased the mean postoperative stay. Ashley *et al*⁵ found comparisons between hospitals hard to make because of the unstandardised nature of clinical records. In the present study more postoperative complications were recorded at the larger than the smaller hospitals. This may simply reflect a difference in recording in the case notes.

The results of this study emphasise the extent of the variation in stay after elective inguinal herniorrhaphy. Assuming that a shorter mean postoperative stay is economically desirable and has no detrimental effects on the patients,^{6,7} our results strongly suggest that changes in hospital organisation⁸ rather than consultant attitudes will be required.

We thank the consultants who gave permission for their cases to be studied; the medical records staff for their help; and the Department of Health and Social Security, who funded the study.

Further details on factors having a significant effect on postoperative stay may be obtained from WEW.

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SHORT REPORTS

Sphygmomanometers: errors due to blocked vents

Inaccuracies in the performance of mercury sphygmomanometers are widely reported. Sources of error include design,^{1,2} operation,^{3,4} and maintenance.⁵ Despite reported inaccuracies few attempts have been made to measure the actual errors produced at different rates of fall of the mercury column. These errors occur when the chamois leather vents at the top of the glass tube and mercury reservoir become partially blocked.⁵ We have checked the performance characteristics of 32 ward sphygmomanometers in a teaching hospital and report here the results.

Methods and results

The instrument under test was disconnected at the tubing between mercury reservoir and cuff. The open ends of the tubing were then connected to two limbs of a metal T-piece. The third limb of the T-piece was connected to a properly functioning mercury column. The two mercury columns were

Numbers of sphygmomanometers in each error range taken at a true pressure of 120 mm Hg. All errors are positive

Rate of fall (mm Hg/s)	Error range (mm Hg)							
	0-	2-	4-	6-	8-	10-	15-	25-35
2	8	13	6	4	1			
5	7	7	10	6	1	1		
10	6	5	7	8	4	2		
20	5	3	6	6	4	3	4	1

aligned in the viewfinder of a TV camera connected to a video recording system. The cuff from the instrument under test was wrapped around a rigid tube and the two mercury columns pressurised to 180 mm Hg. The pressure was released at various rates, including 2, 5, 10, and 20 mm Hg/s. The descent of the mercury columns was recorded on videotape. Stop-action

images on the video monitor were then used to check errors at pressures of 150, 120, 90, and 60 mm Hg. The 32 sphygmomanometers were also checked for scale zeroing and other deterioration.⁵

The table shows the relation between the rate of fall and the error. A correction was applied for errors resulting from poor zeroing. A + sign indicates that the instrument under test gave raised pressures. Eleven sphygmomanometers had zeroing errors of +1 mm Hg or more. Thirteen had leaks, five defective control valves, and 12 other functional defects—for example, damage to hinges, which prevented the mercury column being positioned vertically. Fourteen of the instruments were wall-mounted.

Comment

The combination of lack of maintenance and excessive rate of fall produced large errors. The errors were caused by a deterioration in the frequency response owing to debris blocking the vents in the glass tube and reservoir. Only five instruments produced results the same as the reference instrument. All others gave pressures exceeding the true value. Twenty-four of the sphygmomanometers produced errors of between +2 and +10 mm Hg at the slowest rate of fall. The error increased at faster rates. The worst result was an error of +33 mm Hg. By following recommended practice of a rate of fall of 2 mm Hg per heart beat such a large error may be avoided. But such an error can occur when the operator inflates the cuff and then lets the mercury column fall quickly until it seems to be close to the expected systolic value.

The table gives results obtained only at a true pressure of 120 mm Hg. Similar errors are produced at lower pressures. The median error for a rate of fall of 5 mm Hg/s at a true pressure of 120 mm Hg was +5.0 mm Hg; at a true pressure of 60 mm Hg it was +4.5 mm Hg. Half of the instruments produced errors of between +4.5 and +14 mm Hg at a true reading of 60 mm Hg and deflation rate of 5 mm/s.

In the hospital concerned faulty sphygmomanometers are returned to the manufacturer for repairs, this action being initiated by the user. All sphygmomanometers tested were in regular use, and no complaints had been made about their performance.

These findings reinforce the need to make adequate arrangements