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DURATION AND COSTS OF HOSPITALISATION BECAUSE OF ORTHOPAEDIC INFECTIONS AND PROPOSED COOPERATION BETWEEN ORTHOPAEDIC DEPARTMENTS AND DEPARTMENTS OF INFECTIOUS DISEASES

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The infections at present treated at orthopaedic clinics in Sweden frequently offer therapeutic problems, and as orthopaedic surgeons are rarely experienced in the management of infections the diseases are often treated in cooperation with specialists in infectious diseases. This sometimes raises the question whether the patient should remain at the orthopaedic clinic or be referred to a department for infectious diseases. The decision depends mainly on three factors: (1) whether the patient is a source of infection; (2) whether the patient's stay in hospital will presumably be long; (3) whether the lesion requires personnel specially experienced in the treatment of orthopaedic diseases or of infections. At many orthopaedic clinics infected patients are not isolated, and it is often difficult to change this situation because of the lack of isolation rooms or of personnel trained in the care of infected patients.

The composition of the infected clinical material during the years 1963–1967 at the Department of Orthopaedic Surgery, Malmö General Hospital was reported in a previous paper (Lidgren & Lindberg 1972). The purpose of the present investigation was to analyse the same series of patients regarding the number of days the patients spent in hospital and the costs incurred, in order further to elucidate the demands placed by "orthopaedic infections" on hospital facilities.

MATERIAL AND METHODS

The material consisted of all 357 cases of orthopaedic infections in patients admitted to the Department of Orthopaedic Surgery, Malmö General Hospital, in 1963–1967. All data related to the infections in question had been processed in a computer. From this pool of data relevant information was extracted and analysed.

Orthopaedic infections are to be understood here as infections of the skeleton, joints, and surrounding soft tissues. Infections of the urinary tract, airways, gastro-intestinal infections, etc., were thus not included. Patients with diabetic or arteriosclerotic gangrene of the lower limbs were also excluded. The material was divided into two groups according to the severity of the infection, major and minor infections. 214 infections were recorded as major and 143 as minor. For details on the material, reference is made to Lidgren & Lindberg (1972).

The duration of hospitalisation was studied for any variation with sex, age, origin of infection (haematogenous, traumatic and postoperative) and type of infection (major or minor). For reasons connected with the data processing system the infected and the uninfected series of patients could be compared only for the years 1965–1967 (Lidgren & Lindberg 1972).

The data were analysed statistically in cooperation with Peter Vorwerk, Department of Mathematical Statistics, University of Lund. The statistical analysis is based on chi-square tests.

FINDINGS

Duration of Hospitalisation (in days)

The distribution of the mean duration of hospitalisation among sex and age of patients with and without infections during the years 1965–1967 is given in Table 1. The difference in duration of hospitalisation between non-infected and infected patients was significant ($p < 0.001$). The number of hospital days for the infected patients was about 4 times that of the non-infected. The mean duration of hospital time of patients with minor infections was 2.5 times the normal average, while that of patients with major infections was fivefold.

In all the age groups the infected patients spent a significantly longer time in hospital than the non-infected ($p < 0.001$). In the non-infected group the number of hospital days increased significantly with age from 25–44 years to 75 years and older ($p < 0.001$). Also in the infected group the number of hospital days increased from about 50 in group 25–44 years to about 100 in the groups 65–74 and 75 years and older. The random error of the figures given was large, but the difference was nevertheless significant ($p < 0.05$).

Of the non-infected patients, the number of hospital days was significantly higher for females ($p < 0.001$). The range of the age distribution, however, differed with sex. In the infected group the range of variations was so wide that no difference could be shown.

Table 1. Mean number of hospital days for infected and non-infected patients (1965-1967).

Age	Men						Women						Total			
	Non-infected			Infected			Non-infected			Infected			Non-infected		Infected	
	Pat.	m	SE	Pat.	m	SE	Pat.	m	SE	Pat.	m	SE	m	SE	m	SE
0-1	33	8.1	1.9	0			24	11.1	3.1	0			9.4	1.7		
1-4	62	13.2	1.7	0			34	17.6	4.1	0			14.8	1.8		
5-14	206	13.6	1.2	2			115	12.6	2.0	2			13.2	1.0	15.8	4.4
15-24	365	10.6	0.8	10	52.9	14.2	137	13.2	1.6	3	29.0	20.5	11.3	0.7	47.4	11.9
25-44	807	11.6	0.6	23	42.7	11.7	387	11.9	0.7	10	55.3	13.7	11.7	0.5	49.9	9.0
45-64	1088	15.9	0.8	34	56.6	9.7	845	19.2	0.8	24	61.5	8.7	17.4	0.6	58.6	6.7
65-74	347	28.9	2.1	15	104.3	26.5	473	30.2	1.7	23	103.6	15.6	29.6	1.3	103.9	13.9
≥ 75	224	36.5	2.8	9	110.9	31.4	661	35.9	1.6	45	85.6	9.1	36.0	1.4	89.7	9.1
All patients	3132	16.8	0.5	93	68.3	7.7	2676	23.6	0.6	107	78.4	5.9	19.9	0.4	74.1	4.8
													Major infections		96.3	7.5
													Minor infections		48.0	4.4

m = arithmetic mean of hospital days.

SE = Standard error.

Table 2. Costs (in Swedish crowns) incurred by care of patients at the Department of Orthopaedic Surgery, MAS, 1963-1967.

Year	Mean costs per patient per day	Normal average cost per patient	Mean cost per infected patient	No. of infected patients	Total extra costs for infected patients per year
1963	91.20	2,410	5,424	89	268,239
1964	107.53	2,779	11,864	51	463,301
1965	130.16	2,665	11,316	73	631,516
1966	139.75	2,991	11,944	89	796,852
1967	166.11	3,395	17,601	55	781,316
Total extra costs for infected patients 1963-1967					2,941,224

Costs for Hospitalisation

The hospital costs for infected patients is compared with that for non-infected patients in Table 2. The increase in hospital costs by infection of the patients can be estimated from the difference between the mean hospital costs for non-infected and for infected patients.

Table 3. The costs (in Swedish crowns) of antibiotics in orthopaedic infections 1963-1967.

	Quantity	In patients Cost* (Swedish crowns)
"Ordinary" penicillins:		
injection	10,718,000 IU	} 12,400
per os	768,000,000 IU	
Semisynthetic penicillins:		
injection	1417 g	} 136,650
per os	12162 g	
Tetracyclins	2984 g	12,650
Erythromycin	284 g	1,600
Fucidic acid	2662 g	58,350
Lincomycin	330 g	1,800
Other antibiotics and sulphonamides	—	17,250
Total		240,700

* Approx., calculated according to prices in 1965.

Special Costs

The distribution of the amounts and costs of various antibiotics among inpatients with orthopaedic infections is given in Table 3. The table shows that the antibiotic most widely used was semisynthetic penicillin (cloxacillin). This is because in most cases the infections were due to penicillinase-producing staphylococci, because no primary or acquired resistance to this agent was observed at the orthopaedic clinic in Malmö, and because the frequency of side effects was low. These advantages were considered to outweigh the relatively high price of the preparation.

The total costs for antibiotics and sulfonamides consumed in 1963–1967 in the treatment of inpatients were 438,345 Swedish crowns. This also includes preparation given for non-orthopaedic infections, i.e. infections of the airways, urinary tract, etc.

From the data available a variety of details could be studied. It might be mentioned that in the years 1963–1967 direct diagnosis and follow-up of infections of inpatients with orthopaedic infections required measurement of the E.S.R. on about 3,900 occasions, the C-reactive protein was determined on 1,700 and antistaphylolysin titer on about 1,700. Culture for growth of bacteria and for determination of resistance was performed on about 1,500 occasions.

The direct burden placed on the operation department is reflected in the fact that about 350 operations were performed to control infections. To this of course must be added the extra time incurred at every operation on an infected patient, e.g. special cleaning of the operating theatre and instruments.

DISCUSSION

The costs per patient per day at the orthopaedic clinic have increased since the end of the present investigation. In 1968 it was 205 Swedish crowns, in 1969 it was 230 crowns and in 1970 it was 361 crowns (see Table 2, 91 crowns in 1963). This means that with the same number of infections the extra costs for the infected patients at the clinic will now be considerably more than one million crowns per year.

Many of the infected patients have been treated ambulant, and this has reduced the expenses. Since the recent introduction of the new system of payment of drugs, i.e. no outpatient need pay more than 15 crowns for all drugs and medicines noted in a single prescription, ambulant treatment no longer offers any problems. With regular daily

dressings of the wound by a district nurse, for example, and regular follow-up at the orthopaedic outpatient department, the system has worked satisfactorily.

Co-Operation with Department for Infectious Diseases

The composition of the cases of infection seen at the Department of Orthopaedics in the years 1963 to 1967 has been reported previously (Lidgren & Lindberg 1972), and the number of hospital days of patients with orthopaedic infections and the costs thereby incurred have been accounted for above. These two investigations may serve as a basis for planning cooperation between departments of orthopaedics and departments for infectious diseases. Since many details of such cooperation will naturally differ from one hospital to another, it may be sufficient to give a broad outline of our experience from the two hospitals from which this article emanates.

At the two orthopaedic departments under discussion the care of infected patients was organised in two different ways:

1. In Malmö all inpatients with infections were confined to a special orthopaedic ward where the personnel was specially trained in the care of infected patients. The beds in this ward could also be used for patients requiring non-operative treatment. Patients to be operated upon or who had just been operated upon were not admitted to this ward. Once a week the ward round was made jointly by the orthopaedic surgeon and a bacteriologist. Infected patients referred to the department from outside were admitted directly to this ward, as were patients with suspected infections from other wards. Patients constituting a source of infection could therefore be isolated immediately and given adequate treatment without delay. The disadvantage of such a system, however, is that it requires an orthopaedic surgeon interested in infectious diseases.

2. In Lund there was no special orthopaedic ward for infected cases. When infection was suspected in any inpatient at the Department of Orthopaedics, samples from the infected lesion were obtained and cultured for growth of bacteria and, when possible, the patient was transferred to a single room. If culture gave growth of *Staphylococcus aureus*, the inpatient was transferred to the Department for Infectious Diseases, where he remained until he was no longer a risk of infection, after which he was referred back to the Department of Orthopaedics. Once a week an orthopaedic surgeon accompanied the epidemi-

ologist on his rounds at the Department for Infectious Diseases. An advantage of this system is that all infected cases are treated by epidemiologists and trained personnel, and the orthopaedic condition by an orthopaedic surgeon. A disadvantage is the shortage of possibilities of isolating a suspect patient at the department of orthopaedics for the 3–5 days necessary to confirm the diagnosis of infection.

On the basis of the above observations, we suggest the following principles of cooperation between the department of orthopaedic surgery and the department for infectious diseases:

The department of orthopaedics should include a special ward where air sluices and washing facilities, UV light, etc., could be installed in some rooms without incurring unduly high costs. Infected in-patients from other orthopaedic wards should be referred to such a special ward without delay. Cooperation between the orthopaedic surgeon in charge of such a ward and the epidemiologist may be arranged in the way described above. This cooperation should enable both the orthopaedic surgeon and the personnel to acquire the knowledge necessary for adequate care of most infected patients. Such an organisation would markedly reduce the risk of spreading infections at departments of orthopaedics.

SUMMARY

A series of 357 patients with orthopaedic infections admitted to an orthopaedic department during 1963–1967 was analysed regarding the number of days the patients spent in hospital and the costs incurred and in certain respects compared with an uninfected series. The mean number of hospital days for non-infected patients was 20 days and for infected 74. The mean duration of hospital time of patients with minor infections was 2.5 times the normal and that of patients with major infections was fivefold. As the mean cost per day and patient has increased from 91 Swedish crowns in 1963 to 361 Swedish crowns in 1970, the extra costs for infections at the clinic today are probably considerably more than one million Swedish crowns per year. The amounts and costs of antibiotics are analysed.

The experience gained by cooperation between the departments of orthopaedic surgery and of infectious diseases is discussed.

REFERENCES

- Lidgren, L. & Lindberg, L. (1972) Orthopaedic infections during a 5-year period. Analysis of a patient material from an orthopaedic clinic 1963–1967. *Acta orthop. scand.* XXXXX.

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