

The Effect of Postoperative Exercises and Massage on the
Incidence of Pulmonary Embolism at Chelsea
Hospital for Women

BY

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FOR many years the high incidence of pulmonary embolism caused anxiety among the members of the medical staff at Chelsea Hospital for Women. This increased considerably when, in 1936, 50 per cent of the deaths following operations were due to pulmonary emboli.

It was therefore decided at the beginning of 1937 to establish a massage department which was placed under the supervision of one of us (I.C.S.). The duties of the members of the massage team were to instruct and supervise postoperative exercises, and to carry out massage in all cases after abdominal operations and operations for the repair of genital prolapse. The routine following minor operations remained unaltered, and special exercises and massage were not given after such procedures as curettage, insertion of radium, insufflation, etc.

Originally it was intended that the problem be reviewed after 3 years and the incidence of embolism compared in the years preceding and following the introduction of the massage department. Unfortunately the war intervened and detailed study of results was not made. However the experiment was considered a success, as not only did the number of cases of embolism decrease, but the general condition

of the patients on discharge from hospital was obviously greatly improved.

The purpose of this paper is to study the effect of postoperative exercises and massage on the incidence of fatal pulmonary embolism. Non-fatal embolism has not been included as it was found that satisfactory details were not always available in the case notes.

A 14-year period is reviewed and is divided into 2 sections. The first, 1930 to 1936, consists of the 7 years before, and the second, 1937 to 1943, the 7 years after the institution of the massage department.

It is also intended to consider the deaths from embolism collectively and to study such factors as age, type of operation, etc. In addition some details of the type of exercises and massage now being employed at the hospital will be given.

INCIDENCE OF FATAL PULMONARY
EMBOLISM FOLLOWING ABDOMINAL
OPERATIONS.

A. 1930-1936. In this period there were 4,596 abdominal operations followed by 19 deaths from pulmonary embolism, i.e., the mortality from pulmonary embolism was 0.415 per cent or 1 fatal embolism followed every 240.5 abdominal opera-

tions. None of these deaths took place during operation.

B. 1937-1943. In this period there were 3,436 abdominal operations with 9 deaths from pulmonary embolism. In 3 of the 7 years there were no deaths from this cause.

Of the 9 deaths 2 may be excluded for the following reasons. The first, in 1938, took place on the 6th day after operation, but owing to a temporary shortage of staff the patient received no postoperative exercises or massage. The second, in 1943, is excluded as the embolism occurred during the operation.

Excluding these 2 cases the mortality from pulmonary embolism after abdominal operations from 1937 to 1943 was 0.203 per cent, or 1 death followed every 490.5 operations.

The incidence of fatal embolism after abdominal operations was therefore reduced by more than half following the introduction of postoperative exercises and massage.

INCIDENCE OF FATAL PULMONARY EMBOLISM FOLLOWING OPERATIONS FOR THE REPAIR OF GENITAL PROLAPSE.

In each of the 7-year periods there were 2 deaths from pulmonary embolism following roughly equal numbers of operations for prolapse.

Although postoperative exercises and massage have not reduced the number of fatal emboli following these operations, we have been impressed by the marked improvement in muscle tone and posture in this group of patients.

In 1938 Fletcher Shaw and Rickards¹ investigated the incidence of fatal pulmonary embolism after gynaecological operations during a 12-year period at Manchester Royal Infirmary, where exercises are carried out as a routine, and at St. Mary's Hospital, where exercises are not included in the postoperative treatment.

Fatal embolism was found to be 5 times more common in the latter hospital. The authors do not differentiate between abdominal and other operations, and details of the exercises employed are not given.

GENERAL REVIEW.

During the 14-year period 1930 to 1943 there were 21,066 operations at Chelsea Hospital for Women followed by 202 deaths. Of these 202 deaths 40, or 19.8 per cent, resulted from pulmonary embolism, i.e. the incidence of fatal embolism was 0.19 per cent, or 1 such death occurred in every 526 operations. Matas² found that the general prevalence of fatal pulmonary embolism in Europe and America in 2,196,834 operations from 1913 to 1931 was 0.27 per cent or 1 death from embolism in approximately every 500 operations.

According to Henderson³ at the Mayo Clinic during the 10-year period ending in 1927, 6 per cent of all deaths following operation were due to pulmonary embolism. In our series 19.8 per cent of the deaths were due to pulmonary embolism, a much higher figure. This may be due to the fact that a high proportion of the operations (38 per cent) were abdominal.

Of the 40 deaths due to embolism 28, or 70 per cent, followed abdominal operations. Figures from similar series quoted in the recent literature are as follows: Graves,⁴ 65.3 per cent; Henderson,³ 80.7 per cent, Patey,⁵ 86 per cent; Petren,⁶ 88 per cent.

AGE INCIDENCE.

The 40 cases of fatal embolism can be grouped with regard to age as in Table I.

TABLE I.

Age group	Deaths from embolism
20 to 29 years	2 or 5 per cent
30 to 39 "	4 or 10 "
40 to 49 "	11 or 27.5 "
50 to 59 "	15 or 37.5 "
60 to 69 "	8 or 20 "

Five hundred consecutive cases admitted to hospital for operation in 1943 were grouped in a similar way according to age, (Table II).

TABLE II.

Age group	Percentage
20 to 29 years	24.4
30 to 39 "	37
40 to 49 "	22.6
50 to 59 "	10.2
60 to 69 "	4

With the aid of Table II correction was made and an approximate idea of the true incidence according to age was obtained.

From Table III it can be seen that post-operative fatal embolism becomes progressively more common in the higher age groups with a maximal incidence between 60 and 69 years. The average age of the patients was 50.5 years. In Henderson's³ series of 313 fatal cases of embolism the

TABLE III.

Age group	Corrected incidence
20 to 29 years	1.9 per cent
30 to 39 "	2.6 "
40 to 49 "	11.7 "
50 to 59 "	35.4 "
60 to 69 "	48.2 "

average age was 53.2 years and Graves⁴ found that in a series of 194 cases the most common age of occurrence was in the decade 61 to 70 years.

NATURE OF OPERATION.

A. *Abdominal operations.*

In Table V the abdominal hysterectomies for the two 7-year periods are listed. It is of interest to note the increase in the proportion of total hysterectomies in the 2nd period and the decrease in numbers of the Wertheim operation.

TABLE IV.

Operation	Number of cases of fatal embolism		
	1930-36	1937-43	Total
Subtotal hysterectomy with or without removal of appendages	5*	5	10
Total hysterectomy with or without removal of appendages ...	6	1†	7
Wertheim's hysterectomy	3	0	3
Laparotomy for malignant disease	2	1	3
Ventral suspension	1	0	1
Laparotomy for innocent conditions	0	1	1
Myomectomy and ovarian cystectomy	1	0	1
Ovariectomy and ventral fixation	1	0	1
Repair of ventral hernia	0	1	1

* In one case perineorrhaphy was also performed.

† Embolism occurred during the operation.

TABLE V.

Operation	1930-36	1937-43	Total
Subtotal hysterectomy with or without removal of appendages	1338	930	2268
Total hysterectomy with or without removal of appendages ...	793	948	1742
Wertheim's hysterectomy	144	61	205

Incidence of death from pulmonary embolism after:

Subtotal hysterectomy with or without removal of appendages, 0.449 per cent.

Total hysterectomy with or without removal of appendages, 0.401 per cent.

Wertheim's hysterectomy, 1.46 per cent.

There is no marked difference in the incidence of fatal embolism following the subtotal and total operations, but as might be expected it is much higher after Wertheim's hysterectomy.

B. Non-abdominal operations.

In the 14-year period there were 12 deaths from embolism following 13,061 non-abdominal operations or 1 death occurred in every 1,088 operations. It is of interest to note that 4 of the deaths followed the insertion of radium, 3 for malignant disease and 1 for an innocent condition.

NATURE OF DISEASE.

Of the 40 fatal emboli 13 followed operation for malignant disease, 10 abdominal and 3 non-abdominal operations.

TIME OF OCCURRENCE OF PULMONARY EMBOLISM.

Of the 39 emboli which occurred in the postoperative period 17 occurred in the 1st week (all between the 3rd and 7th days), 11 in the 2nd week, 11 in the 3rd, and 1 in the 4th week. The nature of the operation, abdominal or non-abdominal, did not affect materially the time of onset of the embolism. Thus following abdominal operations there were 10 deaths in the 1st week, 7 in the 2nd, 9 in the 3rd, and 1 in the 4th week.

PRESENCE OF PYREXIA PRECEDING EMBOLISM.

In a series of 146 fatal cases Robertson⁷ found unexplained moderate fever in 18 per cent during the postoperative period. In

our series of 40, only 32 temperature charts were still available. In 25 of these, or 78.1 per cent, some elevation of temperature was present during the 3 days immediately preceding the fatal embolism. This generally took the form of a mild intermittent pyrexia ranging from 99 to 100.5°F.

BRIEF OUTLINE OF THE EXERCISES AND MASSAGE EMPLOYED.

The main aims of treatment are as follows:

1. Increased respiratory excursion resulting in improved venous return to the heart.

2. Improvement of the circulation and maintenance of muscle tone in the limbs.

3. Strengthening of the abdominal and perineal muscles and later the development of correct posture.

Abdominal operations.

The patient receives instruction in breathing exercises on the day before operation. These are commenced on the day following operation and she is encouraged to carry out active foot exercises, namely bending, stretching and rolling of the foot. On the 3rd day quadriceps contractions, gluteal contractions and more extensive foot movements are added and gentle massage of the legs is begun.

After the abdominal clips have been removed abdominal and gluteal contractions are introduced, and adduction exercises to improve the tone of the muscles of the pelvic floor.

Later the exercises are carried out with the patient's legs over the side of the bed, and trunk rotation, flexion and extension are begun. Eventually the standing position is adopted during the exercises and care is taken that the correct posture is being achieved. The patient leaves hospital with instructions to continue the exercises at home for at least a further 2 weeks.

Operations for the Repair of Prolapse.

A similar routine is employed, but perineal exercises are not introduced until after the 10th day to avoid unnecessary discomfort from stitches.

DISCUSSION.

Much useful work has been carried out in recent years in an attempt to discover the aetiology of postoperative thrombosis and embolism. Perhaps the most productive has been the investigation of the constituents of the blood, particularly those taking part in the process of coagulation. Among others Atkins⁸ has shown that there is a fall in the platelet count after operation followed by a sharp rise beginning on the 7th day and reaching a maximum about the 10th day. Robertson⁷ found that the coagulation time was shortened and the sedimentation-rate increased. As these changes take place after every operation it is unlikely that they are the only factors leading to embolism.

Infection may play a part, and we have shown that in 78 per cent of our fatal cases some elevation of temperature was present during the 3 days preceding the embolism. As both Robertson⁷ and Bonney⁹ have pointed out, frank thrombophlebitis rarely precedes pulmonary embolism since the clot then is so adherent to the inflamed vessel wall that it cannot readily break loose. The infection is therefore probably of a mild type, insufficient in itself to produce an obvious phlebitis, yet of some importance in the production of thrombosis and embolism.

Most authorities are agreed that one of the principal contributory factor is venous stasis. This results from the relatively immobile position of the patient in bed, from obstruction such as that produced by the

knee pillow and from diminished respiratory excursion. The venous return to the heart is dependent largely on the negative pressure in the thorax during inspiration and, at the same time, on the increased abdominal pressure resulting from descent of the diaphragm. In the limbs contraction of the muscles encourages movement of the blood in the veins.

In the past various types of prophylactic treatment have been suggested, many directed against the changes in the constituents of the blood. Thyroid extract, a diet low in fat and proteins, and anticoagulants such as heparin have been used with varying success. The most profitable lines of treatment however have been those directed to combating venous stasis. The simple expedient of raising the foot of the bed several times daily may be of some value, but we are of the opinion that stasis can best be prevented by active exercises and massage. Breathing exercises, abdominal massage and pressure applied particularly during inspiration, and active movements of the limbs encourage venous return to the heart. These should be commenced as soon as possible after operation, as in our series 43.5 per cent of the cases of fatal embolism occurred in the 1st week.

At Chelsea Hospital those who have undergone abdominal operations or operations for the repair of prolapse are the only patients who receive the benefits of postoperative exercises and massage. We believe that these could be extended advantageously to selected cases after minor procedures. We agree with Snell¹⁰ who says "It is probable that there is a group of patients over 50 years of age, obese and with a normal or subnormal blood-pressure, who are particularly susceptible to pulmonary embolism as a postoperative complication," and we would add that this is even more likely in the presence of malignant pelvic disease.

SUMMARY.

Postoperative exercises and massage were introduced at Chelsea Hospital for Women in 1937 in an attempt to reduce the incidence of pulmonary embolism.

The incidence of fatal embolism following abdominal operations fell by more than 50 per cent in the subsequent 7-year period.

The deaths from embolism are reviewed with regard to general incidence, age of patient, type of operation, etc.

Some details of the exercises and massage employed are given and are followed by a short discussion with references to recent literature.

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