LECTURES

ON

HOSPITALISM: AND THE CAUSES OF DEATH AFTER OPERATIONS.

Delivered at University College Hospital, London.

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LECTURE I.—ON THE RATE OF MORTALITY AFTER AMPUTATIONS.

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In the Introductory Address which I delivered at the College opposite on the 1st of October last, I laid down the following propositions.

1. That surgery, in its mechanical and manipulative processes, in its art, in fact, was approaching, if it had not already attained to, something like finality of perfection.

2. That the so-called science of surgery had not advanced proportionately with the art.

3. That the results of those operations by which life was imperilled were by no means so satisfactory as they should be; that the skill in the performance had far outstripped the success in the results of such operations; that the mortality was excessive after some operations, especially amputations; that it had not diminished of late years; that this mortality was particularly great in hospital practice, and was probably dependent on removable causes, and hence might be materially reduced if these could be determined and their occurrence prevented.

The first two propositions I illustrated at some length in that lecture (*Modern Surgery: its Progress and Tendencies*. Lewis, Gower Street). To the third, my time would not allow me to do more than advert; nor, indeed, had time allowed, would the delivery of an introductory address have been a fitting occasion to discuss so wide and important a question as this. The subject, however, is so interesting and so important, that I gladly take an early opportunity to direct your attention to it, to bring forward some facts in support of the statements I have made, and to give you the impressions that I have formed from a study of the whole question.

There are, in all probability, few subjects in surgery of greater interest, and certainly none of greater importance, than that which relates to the cause of death after an operation; for on its consideration necessarily depends the success, in its ultimate issue, of any operative procedure that we may undertake.

Since July 1st, 1870, up to December 1st, 1873, there have been in this hospital eighty amputations of the limbs, without including the minor and partial ones of the hand and foot. These cases have been taken as they came; they have not been in any way selected. None have been rejected in which it has been supposed that, by operating, the patient's prospects of recovery would, in any way, be improved. Every case has been most faithfully recorded by the surgical registrar, and they have either been published, or are in the course of publication, in the statistical records of the hospital. Of these eighty amputations, twenty-one have died, being in the proportion of about twenty-six per cent. of the whole. Although eighty cases of amputation is far too small a number upon which to found any general deductions, I may take these as a fair specimen of the general results of amputations that have occurred in this hospital since it was opened thirty-five years ago. [See Table A.]

I have been in the habit of publishing, in the successive editions of the *Science and Art of Surgery*, the results of all the amputations that have been performed in my wards. They amount to a grand total of 307 cases; of these, 79 have died, being a mortality on the whole of as nearly as possible 25 per cent. The rate of mortality in the amputations in my wards in University College Hospital has been very uniform for the last twenty years. Thus, up to 1857 (2nd edition), it was

23.5 per cent.; in 1864 (4th edition) it had risen slightly, being 24.3 per cent.; in 1869 (5th edition) it had fallen to 24 per cent. The present rate again shows a slight increase. If we add the 80 cases in Table A to the 307 just referred to, we obtain a total of 387 major amputations at University College Hospital with exactly 100 deaths, or a mortality of 25.8 per cent. These are continuous unselected cases. They include all that have been done in my wards and by Mr. Liston, or from the foundation of the hospital to the present time (a period of thirty-seven years), and all that have been done in the hospital since July 1870; but they do not include the amputations done by the other surgeons between 1848 and 1870, of which I have no record. As they stand, I believe I am correct in saying that no other series of amputations of equal number, extending over an equal length of time, has ever been published in this country with an equally low rate of mortality. These amputations are primary and secondary—for injury and for disease; but include no partial ones of the hand or foot. As the mortality of the eighty cases that I shall take as my text corresponds, as nearly as possible, with the general mortality of the whole preceding amputations, I think we may consider them, in all respects, to be a fair specimen of these operations; and I prefer using them for our present purpose, on account of the care with which the causes that have led to the death of twenty-one of the patients have been worked out by the surgical registrars, Messrs. Beck and Godlee; for, although the general numbers that I have above given are as nearly as possible, if not absolutely, correct, I have not sufficiently accurate data of the causes that led to the death of the 79 out of the 307 cases for statistical purposes. Now, a general mortality for many years of from 24 to 26 per cent. in all amputations of the limbs for all causes, may be considered as a very satisfactory result, although there can be no ques-

TABLE A.—*Table of 80 consecutive Cases of Amputation (excluding all partial amputations of hand and foot) performed in University College Hospital from July 1, 1870, to Dec. 1, 1873.*

Amputations.	Total.	Cured.	Died	Cause of Death.
<i>Primary—</i>				
Hip-joint	1	0	1	Shock.
Thigh (above middle).	2	0	2	Shock in both.
Thigh (below middle).	3	2	1	Pyæmia.
Knee	1	0	1	Erysipelas.
Leg (upper half).....	2	1	1	Exhaustion third day.
Leg (lower half)	5	4	1	Pyæmia.
Foot	2	2	0	
Arm	3	2	1	Died of internal injuries in a few hours.
Forearm	3	3	0	
Multiple amputations..	3	2	1	Exhaustion.
Total primary	25	16	9	36 per cent.
<i>Secondary—</i>				
Thigh (below middle).	4	3	1	Exhaustion fifth day.
Knee	1	1	0	
Leg	2	2	0	
Shoulder-joint	1	0	1	Pyæmia.
Forearm	3	1	2	Pyæmia; tetanus.
Total secondary	11	7	4	36.3 per cent.
<i>For Disease—</i>				
Hip-joint	2	2	0	
Thigh	14	12	2	1 died of Bright's disease, 1 pyæmia & amyloid liver
Knee and condyles ...	6	4	2	Pyæmia in both.
Leg	7	6	1	Pyæmia.
Foot and ankle	4	4	0	
Shoulder-joint	1	1	0	
Arm	5	4	1	Pyæmia
Forearm	5	3	2	Exhaustion in both cases; old people, with destruction of wrist and cellulitis.
Total for disease ...	44	36	8	18.1 per cent.
Total of all cases ...	80	59	21	26.2 per cent.*

* Or, if we omit the case in which death resulted from internal injuries, and not from the operation, 25.2 per cent.

tion that it is one that admits, and that ought to be susceptible, of very great improvement. If we compare it with the results that have been obtained elsewhere, it is one of which we need not be ashamed.

Sir James Simpson, as is well known, has collected an enormous mass of statistics in connexion with the subject of amputation-mortality.

These statistics are divisible into two distinct and separate sets of figures: one referring to amputations in town hospitals; the other, to the results of amputations in country and private practice. The accuracy of these latter has been seriously impugned. With that question I have nothing to do at present. The accuracy of those relating to hospital practice has been admitted by all—even by his most determined opponents, for they have been derived from statistical returns furnished to him by the surgeons and registrars of the various hospitals to which they relate. The mortality attendant upon these is 1 in 2.4, or 41.6 per cent. The lowest mortality in any of the metropolitan hospitals referred to by Sir James Simpson is 34.4 per cent.; the highest, 47.3 per cent. These statistics are carried down to the year 1868; they may consequently be looked upon as modern. I have collected, from various sources, others which will show that there has been, with one exception, no material improvement since they were published, and that the same, or indeed a much higher, rate of mortality prevails in some other countries than in this. Thus, for instance, if we take the published records given in the reports of four of the largest London hospitals, containing together nearly 2000 beds (Table B), carried down as late as last year, we find that out of a gross number of 621 amputations, 239 have died, or 36.7 per cent. (*vide* Table B); at the Edinburgh Infirmary, 43.3 per cent.; and at the Glasgow Infirmary, 39.1 (Simpson). The American returns are very good: thus I find that, at the Pennsylvania Hospital, the reports of which have been most accurately published for a long series of years—from 1831 to 1860—the average mortality is very low, being only 24.3 per cent. (Norris); whilst at the Massachusetts General Hospital, Boston, out of 692 amputations, there were only 180 deaths, or a mortality of 26 per cent. (Chadwick). These figures correspond, as nearly as possible, with those of University College Hospital.

The mortality in the Parisian hospitals, on the other hand, is far greater than that in London. As given by Malgaigne and Husson, Holmes and Bristowe, it amounts to about 60 per cent. Billroth, when at Zurich, performed 163 amputations between the years 1860 and 1867. Of these, 75 died, or 46 per cent. Thus it will be seen that a mortality of from 25 to 30 per cent. is considerably below the average of most metropolitan hospitals in this country, and far below that on the Continent.

In the consideration of the various questions connected with hospital mortality, as in all other matters that are alone determinable by vital statistics, it is necessary to attend to certain general conditions. In the first place, it is necessary that the numbers from which deductions are made should be sufficiently large not to be influenced by accidental circumstances, and also that they should extend over a sufficiently long space of time. The fact is well known to all surgeons, that surgical practice is peculiarly liable to what is often incorrectly and possibly irreverently termed "runs of luck", good or bad. Thus it is well known that in lithotomy, or in herniotomy, there may be long runs of successful or unsuccessful cases in the practice of the same surgeon or the same institution. If a surgeon have had a run of good luck, he may think that he has at last mastered the secret of operating with success in any given disease. If, however, he go on long enough, the "Nemesis of numbers" will certainly punish him for his presumption, and the wave of success on which he has been carried will at last break and land him on the barren shore of the usual average. The man who boasts that he never loses a case after this or the other operation, works at last for averages. He thinks more of his own credit than of his patient's good. He rejects, as unfit, those cases that are not likely to be successful, and reminds one of that sportsman who always hit his bird by taking good care never to shoot at one that there was a possibility of missing. These "runs of luck" have been well illustrated by the history of amputations. Lawrie (*Medical Gazette*, 1840) makes the remarkable statement that at the Glasgow Infirmary, between the years 1794 and 1810, there were 30 amputations for disease, of which 29 recovered; but on taking the central numbers from the register, he found that they showed a proportion of 11 deaths to 19 cures; and of the last 30, 22 recovered and 8 died. The general percentage of deaths after amputation in this institution was 39.1 per cent. In the Edinburgh Infirmary, of the first 99 cases, according to Simpson, only 8 died. At the Hospital D (Table B), there was in 1870-71 a run of 18 major amputations without a single death; whilst in 1867, '68, and '69, there had been a total of 25, with a mortality of 12. And Simpson gives the details of two remarkable runs of success at St. Bartholomew's Hospital, during which two periods there were in all 49

amputations, with only 2 deaths; yet, on continuing the record, the average mortality amounted to 1 in 2.9. In the Pennsylvania Hospital, in the years 1838-9, of 24 amputations, out of which 11 were primary, only 1 died. At the Worcester Hospital, there had occurred at one time 30 primary amputations in succession without a single death. Carden, operating with the long flap, had 17 consecutive cases of amputation of the thigh without a single death; but of the next 14, he lost 5. These "runs of luck", then, have not been uncommon in amputations. The reverse will also sometimes happen. I see by the reports of one of the London Hospitals, that in one year all the amputations except two died in that institution, whilst fourteen out of fifteen cases of strangulated hernia recovered after operations. It would be as unfair to deduce any inference with regard to the average mortality in that hospital from such instances, as it is from the runs of success that I have just mentioned.

The causes of these "runs of luck" appear to me not to have been investigated with the care they deserve. The run of success is usually attributed to "chance". This no doubt is operative in many cases; and doubtless in surgical operations, just as in games of chance, we may have a long series of uniform events develop themselves as a consequence of conditions that are in themselves most uncertain. It is, no doubt, quite possible that eleven operations out of a series of twelve may succeed or may fail, on the same principle that, if a shilling be tossed a dozen times, it may come down heads or tails for eleven times in succession. But, admitting the possibility of "chance" in determining the result of operations—and I dislike much to use that word in so momentous a question as this—I believe that, in order to explain these "runs of luck", we must, in the majority of cases, go somewhat farther and deeper into the consideration of the causes that determine events.

One great cause in many cases is, I believe, the prevalence or absence of epidemic septic influences at any given period. There are in all hospitals healthy and unhealthy seasons and periods—times in which every operative case, of whatever kind, does badly, from the influence of certain injurious epidemic conditions; others in which epidemics that are adverse to the success of operations are absent. To this I shall advert more fully in a subsequent lecture; I merely state the fact now.

But, besides this, there is another condition that influences materially these "runs of luck"; I mean the personal care and supervision exercised by the surgeon. This is especially the case when new methods of operating or of treatment are introduced, in the success of which the originators take a special personal interest. Thus we commonly find that new methods of amputating—as by long or rectangular flaps, for instance—have been attended by a run of success in the early cases, which have been carefully selected and personally attended to by the surgeons who, having introduced the methods, were peculiarly anxious about their success. We find the same in the early cases of any new treatment, to which great attention is paid by an enthusiastic originator. The cases succeed, not because the method of operating or of treatment is superior to any that have preceded it, but because the surgeon who is personally interested in its success devotes more time and more attention to his cases than those who take less interest in the method. And it is easy to understand how a possible combination of these three causes—chance, absence of epidemics, and personal care—may lead to a long run of that success which is most wrongly ascribed to "luck". In order to neutralise the effect of these runs of success, it is necessary to employ large numbers of cases. But, in consequence of this very necessity of employing large numbers, it becomes imperative, in an inquiry like this, to go beyond the possible experience of any one man, and to draw one's deductions from reliable results that may be obtained from the published records of large hospitals. These will be found in Table B.

Next in importance to large numbers is, undoubtedly, a similarity of the condition either in the patient operated upon or in the operation that is practised. Thus, it is not fair to compare the results of the same operation at different periods of life. This is well illustrated in the history of lithotomy, in which, as is familiarly known to every surgeon, the mortality increases almost proportionately to the age of the patient. So, also, it is impossible, with any degree of accuracy or of utility to compare the results of dissimilar operations with one another; as, for instance, of amputations with lithotomy, herniotomy, or ovariectomy. In all probability, ovariectomy presents more uniformity in respect to the conditions under which it is performed, than any other operation in surgery. Hence, the statistics that we can obtain from it are of greater value in reference to the amount of mortality under the varying conditions in which the patient is placed, or in reference to the causes that lead to death, than can be obtained by an examination of statistical results of any other operation; for in ovariectomy there is a similarity, not

only in the seat of operation, but in the nature of the disease, and in the sex of the patient. In amputations, on the contrary, there is in all probability, more variety than in any other operation in surgery. There are not only those varieties that are common to most dependent on age, sex, constitution, and condition of the patient; but there are the varying conditions that are inseparable from dissimilarity of cause for which the operation is practised. Thus, it may be done for injury, and that injury may be of any extent, from the perforation of a joint to the complete smash of a limb. It may be done at any period after the infliction of the injury, within an hour or two or not for months. Then, again, when amputations are practised for disease, that disease may either be simple or malignant, may affect the bones, or the joints, or the soft parts.

TABLE B.—Summary of Results of Amputations in four Metropolitan Hospitals, in which Deaths from Pyæmia and Shock are recorded.

Hospital and Years.	Total.	Died.	Pyæmia.	Shock.	Percentage of Deaths.
<i>Primary Amputations.</i>					
A. 1866-70	21	13	4	6	62
B. 1861-72	140	67	24	8	46.4
C. 1869-70	18	8	2	5	44.3
D. 1867-71	8	2	0	2	37.5
Total primary	187	91	30	21	48.6
<i>Secondary Amputations.</i>					
A. 1866-70	20	16	9	2	80
B. 1861-72	53	30	10	1	56.5
C. 1869-70	5	1	1	0	20
D. 1867-71	6	3	2	0	50
Total secondaries	84	50	22	3	59.5
<i>For Disease.</i>					
A. 1866-70	89	31	15	0	34.9
B. 1861-72	215	56	16	0	26
C. 1869-70	17	5	0	0	29.5
D. 1867-71	29	6	3	0	20.6
Total for disease	350	98	34	0	27.4
Total of all amputations.	631	239	86	24	37.8

As it is very far from my wish or intention to institute anything like a comparison between the results of operations in different hospitals, I have omitted the names of the institutions mentioned in Table B, and have designated them by letters. I ought, however, to observe that these four hospitals contain amongst them above 1,800 beds; and that, taken with University College Hospital, they together constitute about one-half of the accommodation in the eleven general London hospitals. They are the only hospitals in the reports of which the causes of death after operations have to my knowledge been published, except in the case of St. Bartholomew's Hospital, for the recent statistics of which I would refer to Mr. Callender's very interesting papers, lately published in this JOURNAL, and in the Reports of that hospital. It is but right to observe, that in this great institution the death-rate after amputation has, since the year 1869, been lower than that of any other hospital with the statistics of which I am acquainted, and that the amount of pyæmia appears to be extremely small; but from the way in which the returns have been published, I have not been able to make out with accuracy the exact amount of this and other causes of death.

Thus, although amputations on account of the frequency of their performance, the uniformity of skill with which they are practised, and the readiness with which their results are determinable, have usually been taken as the test operation, from the result of which the salubrity of a hospital is determined and statistical deductions can be most easily made; they are, in point of fact, those operations from which it is most difficult to arrive at accurate conclusions with absolute certainty, unless the numbers employed are so large as to equalise the varying and disturbing conditions under which the operation is performed. In determining, therefore, the results of operations, and more especially of amputations, it becomes necessary, above all, to employ large numbers, and the experience or practice of any one man is scarcely adequate to furnish these. As, however, we have by far a greater mass of statistics in connection with amputations than with any other operation in surgery, it is, notwithstanding the objections just stated, more easy to

discuss some of the principal causes of death after operation in connection with amputations than with any other surgical procedure, and this is the more easy, inasmuch as the operation of amputation does not, in itself, interest or implicate any necessarily vital part of the body.

It is a little curious and not uninteresting to trace these accumulations of amputation—statistics which have, during the last thirty years, grown to a gross total of very many thousands; and in doing so we are enabled to form a comparative estimate of the rate of mortality after these operations at the present and in former days.

Statistics of amputations were in this country first furnished to the profession by the army surgeons, who published the results of the experience obtained in the Peninsular war; and Guthrie's statistics of the result of amputations after gun-shot injuries continue to be amongst the most valuable and interesting that we possess. At a later period, Sir Rutherford Alcock, the present minister in Japan, published the results which he obtained when surgeon-in-chief to General Evans's army in the Carlist war of 1835 and following years. The first statistics in civil surgery that were published in this country, were collected by Benjamin Phillips who, in 1837, read a paper on the subject before the Royal Medical and Chirurgical Society.

Amongst other conclusions at which he arrived was this, that the mortality after amputation of the thigh, deduced from a body of statistics collected in England, France, Germany, and America, amounted to about two in five cases; and that the average mortality after all amputations taken collectively was 23.7 per cent. This and similar conclusions, which subsequent experience has proved to be decidedly under the mark, were considered by the Council of the Society to be so untrustworthy that they refused the publication of the paper in the *Transactions*, on the ground that some source of error must have crept into the statistics, which showed so unfavourable a result. Phillips subsequently published extended statistical inquiries, the result of which was that the average mortality after amputations amounted to 35.4 per cent., or 5.6 per cent. less than Simpson's estimate in 1868—viz., 41 per cent. His example was followed by Lawrie of Glasgow, who, in the *Medical Gazette* for 1840, published very extended statistics of amputations in the Glasgow Infirmary, showing a mortality of 36 per cent. The surgeons of the Royal Infirmary at Liverpool, and of the Northern Hospital in the same town, followed his example, which was then taken up and very generally adopted throughout the profession. The largest collection of statistics that have been made on this subject will be found in the first volume of Cooper's *Surgical Dictionary*, published in 1861, and collected by J. Lane; and in Simpson's works, carried down to 1868. The result from these is that, taking all amputations of all the four limbs in eleven of the largest general hospitals of this country, there is an average mortality, as has already been stated, of 41.6 per cent. In the report of Simpson's statistics, you will find that University College Hospital is omitted. The way in which this omission occurred is as follows, and ought to be mentioned, as it is a proof of the care with which Simpson compiled his statistics. When Simpson was constructing his tables, he wrote to me requesting to be furnished with a return of amputations from our hospital. I replied that all the amputations that had been performed in my wards had been published in successive editions of my work *On the Science and Art of Surgery*, and that I was unable to furnish him with any statistics from the practice of my colleague. He very properly declined to publish a partial return from one institution, whilst he was giving full returns from all the others; and consequently omitted all statistics from University College Hospital.

From the preceding observations, then, I think we are fairly justified in concluding:—1. That the rate of mortality after amputations in hospital practice still continues to be very high; 2. That it has not decreased since the publication of the first amputation statistics in civil practice about thirty-five years ago.

The next question that we shall have to consider is, as to the causes of this continued high rate of mortality.

THE GLASGOW MATERNITY OR LYING-IN HOSPITAL.—From the thirty-ninth annual report of this hospital, for the year ending November 1873, it appeared that, in the total number delivered—1265, there were ten deaths; eight of these being among the three hundred and twelve confined within the hospital. Three of them were due to puerperal septicæmia and peritonitis. Isolation of the patients affected, and dismissal of the other patients at the earliest period consistent with safety, were successful in arresting and preventing the further spread of the disease. Cleansing and fumigation of the wards were subsequently resorted to, and no recurrence of the disease took place, though puerperal fever was more than usually prevalent in various quarters of the city.