Original article

Nineteenth century amputations at the Royal Berkshire Hospital, Reading

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Aim: To describe 19th century amputations carried out at the Royal Berkshire Hospital, Reading.

Methods: A retrospective analysis of hospital archives.

Results: Details of 276 amputations were analysed. The majority (86%) were in men and boys. The median age was 33 years. The ratio of leg:arm amputation was 2:1. Trauma accounted for 58% of amputations. Of 52 arm amputations, 42 were due to trauma, compared with 37 of 110 leg amputations ($P < 0.001$). Mortality was higher following amputation for trauma than for disease ($P < 0.01$). Mortality following leg amputation was 16% compared with 3.8% after arm amputation ($P < 0.05$). Death rate following compound fracture was 23%.

Conclusions: Compared with today, the population undergoing amputation and the indications for amputation in the 19th century differ significantly. However, it is apparent that in those patients who were selected to undergo amputation acceptable survival figures could be achieved.

Key words: 19th century amputations

Most early reports of amputation have centred around trauma from land or sea warfare. Series of amputations in civilian practice have rarely been described.

The Royal Berkshire Hospital was opened in May 1839. The first admission, who underwent the first operation in the hospital, was George Earley a 15-year-old worker on the Great Western Railway line. He presented with a compound, comminuted fracture of the humerus.¹ The arm was amputated at the shoulder joint using a partial flap technique. Operation was undertaken without benefit of aseptic technique, sterile instruments, gowns, masks, gloves or an anaesthetic. Despite this, the patient survived and left hospital 9 weeks later.

The aim of this study is to review amputations carried out at the Royal Berkshire Hospital, Reading during the period 1839–1879. During this time, major changes in

practice took place. Ether anaesthesia was introduced in 1846, chloroform anaesthesia in 1847 and Listerian principles of antisepsis in 1867.

Patients and Methods

A retrospective audit of data available in the archives of the Royal Berkshire Hospital, Reading was undertaken. Royal Berkshire Hospital Reports include annual figures on the number and type of operation performed. The Daily Admission of In-patients contains details of names, ages and outcome. The House Surgeon's Reports provide an annual review of the numbers of out-patients and in-patients seen. Information was obtained on amputations carried out during 1839–1879. Also noted were the total number of surgical procedures carried out in each year.

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Detailed information was obtained for the years 1839–1852 and 1864–1870. No information was available for 1856–1859. For the remaining years, only the number of operations performed was found. The number of operations other than amputations was unavailable for 1862.

Statistical analysis was undertaken using Chi squared test or Mann-Whitney U-test as appropriate.

Results

In the first 12 months of the hospital's opening, 304 patients were admitted. In 1879 there were 1029 admissions. During the 40 years of this study, a total of 29,241 patients were admitted to the Royal Berkshire Hospital.

Figure 1 shows the total number of operations carried out in each year. Table 1 shows details of the 276 amputations

where full information was obtainable. The median age of the amputees was 33 years (range, 2–71 years). There were 47 children. Only 38 (14%) amputations involved women or girls. A high incidence of finger and thumb amputations meant that there were more amputations on the upper limb than on the lower (147 versus 129, respectively).

Reason for amputation

Trauma accounted for 160 amputations (58%). The remainder were due to disease of the affected limb. Little information is recorded on type of disease encountered. The majority are listed as 'disease of leg', 'disease of knee', *etc.* Popliteal aneurysms are mentioned in two cases. Of 52 arm amputations, 42 (81%) were due to trauma compared with 37 of 110 (34%) leg amputations (Chi squared 31.4, df 1, $P < 0.001$). The

Table 1 Demographic details and outcome of different amputations

	Fingers/ thumb	Arm (including shoulder)	Toes	Foot	Leg (including hip)
Number	95	52	13	6	110
Female	8	8	2	2	18
Age in years (median range)	34 (2–71)	33 (14–58)	22 (14–37)	18 (15–50)	32 (5–64)
Injury					
Unknown	14	9	0	0	8
Burn	1	4	0	0	0
Crush	32	3	4	0	9
Laceration	13	9	5	2	7
Gunshot	4	5	0	0	0
Compound fracture	5	12	1	0	13
Total	69	42	10	2	37
Disease	26	10	3	4	73
Deaths	1	2	0	0	18
Length of stay in days (median range)	30 (2–118)	48 (14–174)	38 (17–89)	77 (44–105)	71 (21–293)

Figure 1 Total number of operations in each year from 1839–1879 is given by the full height of each bar. Of these, the number of leg amputations (including above or below knee and through hip amputation) is given by the height of the black fill, and total no. of amputations carried out is given by the height of the grey bar. No data were available for 1856–1859. (amput. = amputations)

majority of fingers and toes were amputated as a result of trauma (79 of 108; 73%).

Hospital mortality

A total of 21 patients died. Mortality following major leg amputation was 18 of 110 patients (16%). Mortality following major upper limb amputation was only 2 of 52 cases (3.8%) (Chi squared 5.1, df 1, $P < 0.05$). Following trauma, mortality was 18 of 142 cases (13%) compared with 3 of 116 cases (2.6%) for disease (Chi squared 8.0, df 1, $P < 0.01$). Mortality was greatest in those patients who had sustained a compound fracture. When the nature of the injury was known, 7 of 31 (23%) patients with a compound fracture died compared with 7 of 98 (7.1%) in the others (Chi squared 5.8, df 1, $P < 0.02$). Little information exists as to cause of death. 'Tetanus' is listed in two cases following crush injury to the hand and 'exhaustion' following an above knee amputation for popliteal aneurysm in another.

Length of stay

Following major lower limb amputation, the median stay was 71 days compared with 48 days after an upper limb amputation ($P = 0.0036$).

Discussion

The majority of major limb amputations carried out today are performed for peripheral vascular disease.² About two-thirds are carried out on men whose average age is about 70 years.³ The population of amputees in the 19th century is clearly different. They were younger (average age 33 years) and few were women or girls (14%).

Over half of the amputations were carried out for trauma. This is similar to a series of amputations performed during 1852–1857 in The London Hospital where 84 of 142 amputations (59%) were carried out for trauma.⁴ This compares with 400 of 4070 (9.8%) patients who underwent amputation for trauma and were referred for limb fitting in 1998/99.⁵ Much of the trauma in the 19th century would have been due to industrial injuries. By 1861, the population of Reading had risen to 25,045 compared with 22,175 10 years before.⁶ About 80% of those aged more than 20 years were industrial, agricultural or domestic workers. Of the first 35 amputations carried out at the Royal Berkshire Hospital, 28 were due to trauma.⁷ Twenty patients listed 'labourer' as their occupation, six working on the Great Western Railway. A further man listed as a 'railroad worker' was shot in the hand and wrist. It is not stated whether this was sustained at work! The importance of the Great Western Railway in the growth of Reading and the work of Royal Berkshire Hospital is manifest.

There is little information recorded on the nature of the 'disease' which resulted in amputation. Septic arthritis or osteomyelitis accounted for 71% of non-trauma-induced amputations in a similar period at The London Hospital.⁵ Similar numbers are likely in Reading. There is a description of a case presented before the Reading Pathological Society in the 1841/42 session of an above knee amputation for uncontrollable bleeding from a knee joint abscess.⁸

Of major limb amputations, about one third involved the arm. Upper limb amputations today are far less common. Of 172 new referrals to the Prosthetic Service in Oxford in 2001, only 15 (8.7%) involved the arm (Dougal Morrison, personal communication, May 2002). The increased proportion of upper limb amputations for trauma compared with lower limb would suggest either increased numbers of injuries to the arm or a reluctance to operate on trauma to the legs. Clearly, data not available in the present study were the number of injuries treated conservatively.

The overall mortality in this series of 16% following major leg and 3.8% following major arm amputations is only slightly higher than one might expect today. It is lower than other contemporary series when mortality rates of 36–70% have been reported for major lower limb amputations and 17–56% for arm amputations.^{4,9,10} These results are taken from civilian and military practice (Crimea and the American Civil War). Unfortunately, little information is available on cause of death. In the series from The London Hospital, two-thirds of deaths (when the cause of death was known) were due to sepsis or shock. Then, as now, sepsis was a significant cause of morbidity and mortality following amputation.

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