MEDICAL PRACTICE

*Contemporary Themes***Treatment of burns casualties after fire at Bradford City football ground**

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Abstract

On 11 May 1985 the main stand of Bradford City Football Club caught fire. Within four minutes the stand was alight from end to end. Fifty three people were burnt to death and about 250 injured; 83 required admission to hospital, and 55 of these were treated by primary excision of their burns and skin grafting.

In such disasters the help of staff from other hospitals and areas is essential. Patients should be assessed to see whether they have burns that will ultimately be fatal; if they have they should not be sent to regional burns units, where they would take up beds that could be used for patients with treatable burns. All districts should ensure that their plans for accidents in which burns injuries predominate are adequate.

Introduction

On Saturday 11 May 1985, just before half time in the end of season football match between Bradford City and Lincoln City, the main stand on the east side of the football ground, which was made of wood, caught fire. There was a crowd of about 10 000, of whom 3000 were in that stand. It was a cold, bright day, and almost all of the

spectators were well wrapped up in overcoats and scarves. The fire is thought to have started in rubbish that had accumulated under one corner of the stand. It spread extremely rapidly, so that within four minutes the stand was alight from end to end (fig 1); in addition, the bitumen coating of the roof melted and dripped down in large splashes. Fifty three spectators tried to escape through the turnstiles but were trapped and immediately burnt to death. The remainder of the crowd spilled forward on to the football pitch. The match was abandoned.

Casualties

About 250 spectators sustained injuries that were not immediately fatal, most of which were burns of exposed areas caused by radiant heat from the

FIG 1—The burning stand.

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intense source of the fire; in some cases clothing was ignited by the heat, but direct contact with the flames did not occur except in those people who were burnt to death on the spot. A few injuries were sustained from contact with molten bitumen. Nine patients, mainly elderly, had burns of their body, their clothes having ignited; the elderly clearly had more difficulty in escaping quickly from the source of the heat. The remainder had burns of the backs of their hands or the back of the scalp, or both, and a few had small burns on their backs or backs of the legs. Casualties began to arrive at Bradford Royal Infirmary within a few minutes of the start of the fire by taxi, private car, and ambulance and on foot; within half an hour 190 patients had arrived together with relatives and friends.

In addition to the 190 patients admitted to Bradford and three admitted direct to the regional burns centre, eight were admitted to Batley General Hospital (eight miles away), having been taken there direct from the football ground on the instructions of the police. Of these, three were subsequently transferred to the plastic surgery department at Pinderfields Hospital and four to St James's Hospital, Leeds. All eight had burns of the hands or scalp but no major burns of the body. Two spectators with burns who went to Halifax (eight miles away) were admitted to the Royal Halifax Infirmary, and some 50 patients with smaller burns received their primary treatment at hospitals in Dewsbury, Airedale, Wharfedale, Halifax, Huddersfield, Batley, and Harrogate but were not admitted to hospital.

Roughly three hours after the accident all patients had either been admitted to hospital or had their burns dressed before being allowed to go home, and the casualty department at Bradford Royal Infirmary was empty, ready to resume normal weekend service.

Primary management

The injured began to arrive at the casualty department of Bradford Royal Infirmary before any word of the fire had reached the hospital, as police radio frequencies were jammed by the volume of information being relayed by the officers at the ground. The duty senior house officer on call for plastic surgery was summoned by the casualty officer and a major accident emergency declared. By this time large numbers of hospital staff at all levels were making their way to the hospital as the fire was shown live on television. In accordance with major accident routine non-urgent non-burns patients already in the casualty department were sent home and advised to see their own doctor or to return the next day; the number of beds available for admission of casualties (of which there were many as it was the weekend) was augmented by sending home as many patients as possible from two of the wards; and senior plastic surgery staff were contacted.

Very few patients had injuries other than burns, and thus priorities could be quickly assigned. Patients with burns of more than 5% of the body surface (47) had their burns covered with a sterile dressing and were sent to the ward for admission and further assessment. Patients with burns of more than 10% of the body surface (20) were treated with infusion of intravenous Haemaccel (immediately available in the casualty store cupboard) before being transferred to the ward; this treatment was greatly facilitated by the availability of the anaesthetic staff, who happened to be attending a departmental meeting at the time of the accident and came at once to the casualty department. Patients with burns of less than 5% of the body surface (147) who had no other reason for admission were judged fit to go home. The physiotherapy gymnasium was opened as a dressing station for these patients, who were given analgesia as necessary and had their burns dressed with chlorhexidine acetate (Bactigras), gauze, and crepe bandages before being discharged with instructions to attend in 48 hours' time (Monday).

Further assessment of inpatients was carried out by a plastic surgeon and an orthopaedic surgeon during the first hour after admission, and intravenous infusions were continued for those who needed them. The number of vacant beds remaining at the regional burns centre was determined, and the four most severely burnt patients were transferred there; the largest of the burns in the patients remaining at Bradford covered 23% of the body surface. One patient died shortly after admission from acute left ventricular failure, and two patients were seriously ill with respiratory distress due to inhalation of smoke. Management of burns shock was monitored by serial readings of packed cell volume without particular incident. Three patients with injuries other than burns (one dislocated elbow, one fractured tibia, and one dislocated ankle) were treated by operation on the first day.

Subsequent management (Bradford patients)

REASSESSMENT

The next morning (Sunday) all the inpatients' dressings were changed and the extent of the burns reassessed. The depth of the burns was assessed from the clinical appearance and by the pinprick test, accepting its known

imperfections. Most were burns of limited extent on the backs of one or both hands and on the vertex of the scalp, of deep dermal type. A decision was made to treat the burns by early excision of burnt tissue and immediate skin grafting (tangential excision).

A meeting of the medical, nursing, and administrative staff was called, at which arrangements were made.

Firstly, accommodation at St Luke's Hospital (where the plastic surgery department is situated) was obtained by clearing the plastic surgery ward (24 beds) of all except four patients and cancelling admissions; the five day ward was opened and staffed, and admissions were cancelled; and the ward immediately above the plastic surgery ward (rheumatology and chest diseases) was taken over, patients from this ward being accommodated on the general medical wards. The three wards, each with upwards of 20 patients with burns (the original number of patients admitted having been

FIG 2—One of three wards at St Luke's Hospital filled with patients with burnt hands.

considerably augmented by outpatients who subsequently required admission and late attenders), were thus geographically close and could be managed as one unit; two patients were children and were accommodated on the children's surgical ward, which was also near by.

Secondly, operating time was obtained by the chairman of the hospital unit management team, who negotiated the cancellation of all admissions of patients on the waiting list for the next week and the exclusive use of all three operating theatres by the plastic surgery staff for the next three days (tangential excision being inadvisable more than five days after burning). The anaesthetists who were scheduled for those operating sessions were asked to make themselves available for the planned burns surgery.

Thirdly, some nurses from wards whose admissions had been postponed were redeployed to help with routine care, especially at mealtimes as most patients were disabled by having one or both hands out of action.

Fourthly, extra trained surgical staff was obtained by contacting surgical colleagues of the plastic surgery departments in Leeds, Manchester, and Newcastle, who readily agreed to help.

Fifthly, British Telecom put in extra telephone lines to the three wards (no mean feat on a Sunday afternoon); some surgical equipment to enable three plastic surgery lists to be run simultaneously was borrowed from surrounding hospitals.

Finally, a press conference was held when the administrative decisions had been made to give reassurance about the patients' general state of health and proposed early treatment.

SURGERY

Of the 63 patients admitted to St Luke's Hospital, 10 were not treated by primary surgery, five of these because of pre-existing medical conditions and five because surgery was not thought to be necessary. Fifty three patients were operated on on days 3, 4, and 5 after the accident, 20 on the Monday (day 3), 17 on the Tuesday, and 16 on the Wednesday. Three operating theatres were used simultaneously, and for the more extensive burns three surgical teams worked on one patient at a time. The shortest operating time was 30 minutes and the longest three hours; a total of 80 hours of operating was required. This large volume of operative work was made possible only by the specialist plastic surgery help from colleagues from Leeds, Manchester, and Newcastle.

POSTOPERATIVE CARE

Most of the patients were completely disabled for the first seven to 10 days after operating, as one or, in most cases, both of their hands were bandaged, immobilised, and raised (fig 2). A large number of nurses was required for routine nursing care, but no particular skill in plastic surgery was required for most of the patients until the first dressing.

The first dressing of the five day old skin grafts, which began on the seventh day after the accident, required careful planning as expert nurses were needed and each dressing took about an hour. The nursing staff trained in plastic surgery was augmented by three senior nurses who had been on the staff for many years before retiring or taking other nursing posts. The dressings were done without general anaesthesia, but patients were sedated with lorazepam and pethidine or morphine sulphate tablets given two hours beforehand and supplemented in a few cases with inhalation of nitrous oxide and oxygen (Entonox). Fifteen dressings were done on each of the next four days in four dressing rooms (figs 3 and 4).

FIG 3—Deep dermal burn of back of hand before operation (third day after burning).

FIG 4—Result of tangential excision and skin grafting (14 days after burning).

Neither infection nor crossinfection posed any real problem, and no special routines were used other than proper clinical methods. Three patients acquired haemolytic streptococcus group G and were treated with erythromycin; two of these patients subsequently acquired *Staphylococcus aureus*, which was resistant to methicillin and gentamicin; in none of these patients was the acceptance of skin grafts affected. Antibiotics were avoided in all other patients. Second and subsequent dressings were scheduled without too much difficulty as the time and skill required became progressively less. All three wards were at full stretch for three weeks; patients began to be discharged during the third week. The five day ward reverted to normal use after three weeks and the borrowed rheumatology ward after six weeks.

Results

In the 53 patients who underwent primary surgery (table I) primary healing was obtained in 57 (81%) burnt hands but only eight (33%) burnt scalps. The reasons for the poor results of primary surgery of the scalp were inadequate depth of excision in some cases and formation of haematomas in others. By contrast, because some of the second operations for burnt hands were done for patients who were having second grafts to their scalps and not because it was essential, good healing could be said to have been obtained in over 90% of the burnt hands.

TABLE I—Details of 53 patients undergoing primary surgery

Site of burn	No of patients	No showing primary healing	No needing second skin graft
Hand	47 (70 hands)	34 (57 hands)	13 (13 hands)
Scalp	24	8	16
Legs	3 (5 legs)	2 (4 legs)	1 (1 leg)

Of 15 patients who underwent secondary surgery, 11 were admitted in the second or subsequent weeks for skin grafting on granulating areas after primary conservative treatment in Bradford or elsewhere; surgery was to the scalp in 11 patients, hands in five, back in two, face in one, and legs in two. One patient refused skin grafting (for burns of the scalp), and his burns remain unhealed. Patients began to be discharged during the third week, and four remained in hospital on 25 July. It is unlikely that secondary reconstructive surgery will be required for any of the remaining patients at Bradford (table II).

TABLE II—Inpatients remaining during the 10 weeks after the fire

Week:	1	2	3	4	5	6	7	8	9	10
(%) Of inpatients remaining:	97	95	46	43	43	30	19	11	8	6

AFTERCARE

Patients at St Luke's Hospital

Many of the patients' burns were completely healed on discharge from hospital; some patients required care by the district nurse, and some continued to attend the ward for dressings. A weekly follow up clinic was set up (in the antenatal department), which all those who had been inpatients attended until discharged from hospital care; they then attended for follow up at three months. It was possible to close this special follow up clinic at the end of July, 12 weeks after the accident.

Patients with major burns

Table III shows the outcome in the 11 patients with major burns admitted to the regional burns centre.

TABLE III—Details of 11 patients admitted to regional burns centres

Case No	Age (years)	Sex	Extent of burn (%)	Probability of death	Outcome*
1	74	M	72	1.0	Died 13 May
2	72	M	49	1.0	Died 19 May
3	73	M	40	1.0	Died 11 July
4	57	M	32	0.4	Discharged 26 July
5	70	M	30	0.9	Discharged 26 July
6	33	M	26	0.1	Discharged 16 July
7	58	F	18	0.2	Discharged 19 June
8	56	F	18	0.2	Died 4 June
9	79	F	11	0.5	Discharged 15 July
10	72	M	10	0.3	Died 4 June
11	60	M	10	0.1	Discharged 7 June

*Date of fire 11 May.

Outpatients

Patients with burns of less than 5% of the body surface were allowed to go home on the Saturday but were to return for review two days later. Twenty five patients, however, attended the day after the accident, either because plasma had soaked through their dressings or for the first time because they had not realised that their burns would require treatment; nine of these were admitted to the ward.

The first major outpatient clinic was held on the second day, and specific indications for surgery or dressings had been decided beforehand. It was realised that this would be a big clinic, and four plastic surgeons attended; nurses experienced in such dressings were available by arrangement with the accident department and the dermatology department, and some were retired members of the nursing staff. The clinic was organised on a one way system with removal of dressings in one place, surgical assessment in another, and fresh dressings in a third, before the patient passed through the exit for admission or discharge. The clinic took four hours to complete. Subsequent attendances by patients who did not require admission were arranged at the (augmented) routine burns clinics, which are held three times a week.

Records and photography

The maintenance of adequate records for such a large number of similar injuries required special arrangements. In the initial assessment the only records taken were of the site and size of the areas burnt. After admission diagrams of the burns were drawn and notes dictated to a secretary; junior members of the hospital staff from all specialties helped with routine physical examination. All the injured areas were photographed at the time of operation and again at the first dressing. A special form was devised so that the results of early surgery and comparison of the different methods used by individual surgeons could be assessed later; the completed forms and the photographic appearances will be essential for final analysis of the results.

Discussion

It proved possible to provide optimum or near optimum care for burns of this size in this large number of casualties without having to send patients outside the area¹; this would be feasible only in a town or city where there is an established plastic surgery department with a specialist burns centre close by.

Surgery for this large number of patients was completed within the time limit, despite the administrative difficulties; times to healing, especially for burns of the hands, were much shortened for most patients. A striking feature of the whole incident was the splendid cheerfulness that all the patients displayed through their ordeal, and we believe that early surgery contributed to this. The patients with major burns were all middle aged or elderly (presumably because they found it more difficult to escape from the fierce heat than did younger people); of the six patients admitted to the regional burns centre with burns of more than 20% of the body surface, three survived; the original probability of death of these six patients, calculated from Bull's probability table,² was 4.4. The outcome of the incident therefore resembles that of other major burns disasters of recent times, which include the camping gas explosions at Los Alfaques in 1978 and the circus fire at Bangalore in 1981.^{3,4} Although the Bradford fire occurred out of doors and inhalation injury was rare, the outcome for those with serious burns was the same. It was fortunate that the crowd was warmly clothed, otherwise there would have been many more life threatening injuries.

MASS CASUALTY PLANNING

All planning for the treatment of mass casualties is difficult as the circumstances of each major incident differ in important details, making a plan that worked well in one situation inappropriate or impossible to implement in another. Nevertheless, we think that in an incident in which there are mass burns casualties patients' injuries can be divided into four main groups and plans made in view of the proportion of patients in each group.

Inevitably fatal—The fact that a burn is too extensive for a patient to survive may not be immediately obvious except to surgeons with long experience of inpatient care of patients with burns. Accom-

modation with special treatment facilities is not necessary for these people.

Although in the event only two such patients were sent by the staff of the rescue services direct to the regional burns centre, it is easy to imagine a situation where all the special accommodation might immediately be used up; the Bradford incident was over so quickly that the site medical officer of the major accident team had not arrived at the football ground before all the casualties had been evacuated.

Life threatening but not necessarily fatal—Purpose built accommodation with appropriate provision of airconditioned treatment rooms and a high ratio of staff to patients is essential for optimum treatment of these extensive injuries and must be reserved for them.

Disabling but affecting less than 20% of the body surface—Ordinary hospital accommodation suffices for these patients as infection and crossinfection are unlikely to be a serious hazard.

Small burns that do not necessitate immediate admission to hospital—These patients require several weeks of moderately specialised outpatient care.

Individual plans for treatment of patients with burns in incidents where there are mass casualties should, therefore, concentrate on the need for accurate initial assessment of the extent of the injury, the identification of surgical staff in the area competent to undertake this, and potential accommodation for the fatally injured and for those with disabling but not dangerous burns, for whom no special facilities are required. If life threatening but survivable injuries were numerous patients would have to be dispersed outside the region and suitable departments in the United Kingdom would need to be contacted.⁵

We think that realistic planning for the care of mass burns casualties should take account of these facts; thus routines for accommodation and surgical treatment of patients with burns of limited extent should be established together with acceptance of the limitations of useful treatment of patients with extensive injuries. It is also important to identify senior surgeons with experience of burns competent to take difficult clinical decisions in consultation, where possible, with others of similar experience as individual life and death decisions would be inappropriate in a catastrophe in which there were hundreds of serious casualties. Planning the reception and treatment of casualties in the event of a total national catastrophe in which the hospitals and transport facilities have been destroyed is obviously meaningless. No one, however, can forecast how a future conflict would evolve; in the event of a limited disaster the treatment facilities would need to be reserved for simple surgery for non-major casualties, and secondary skin grafting for disabling burns of the hands would have a high priority. We are sure that civil defence planners are aware of this.

We suggest that district and regional committees concerned with planning for mass casualties should anticipate civilian accidents in which burns injuries predominate and make provision for the sharply differing special needs of patients with major and those with less severe injuries.

We thank all the many people both in and outside the health service who helped to provide care for the victims of the fire at Valley Parade, particularly the nurses and ancillary staff, who just put on their uniforms and came. We wish to record our special thanks to Sister B Stow, sister in charge of the plastic surgery department at St Luke's Hospital; to our surgical colleagues, Mr D S Eastwood, Mr F S C Browning, Mr M Dickson, and Mr M Timmons (Leeds), Mr A Logan and Mr S Knight (Newcastle), and Mr S Watson, Mr S Kay, and Mr P Luthera (Manchester), who came to help us with the early surgery; to Dr D A G Newton and Dr J Staniland for caring for the medical problems of the patients; and Mr K Jepson for orthopaedic help. We also thank Mr C A Hirst, district administrator, and Mr J Sharp and Miss P Bradley, directors of nursing services, for their great administrative support.

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