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Occasional Survey

The Summerland Disaster

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Summary

The reception, admission, and subsequent management of casualties from the Summerland fire are described. A senior member of the staff assessed priorities and directed casualties to different prearranged teams, and a nurse was allocated to each patient to aid continuity of treatment and documentation.

Though regular revision and discussion of major accident procedures with all members of the hospital staff and co-ordination with other rescue workers is helpful expensive rehearsals are of limited value in a civilian incident.

Introduction

Some confusion is apt to occur in a non-specialized hospital when even a few patients with moderately serious burns are admitted as an emergency. The special care they need can impose considerable strain on the staff and the available facilities.

Noble's Hospital in Douglas is a general hospital which serves the 56 000 residents of the Isle of Man as well as the 500 000 yearly visitors. Of the 200 beds seven are in an intensive care unit formed six years ago. There is no separate burns unit as the number of seriously burnt patients treated is normally small. During the period August 1972 to August 1973 155 patients with recent burns or scalds were treated in the casualty department and 12 were admitted. None needed resuscitation with intravenous fluids, and only two needed skin grafts.

On the evening of 2 August 1973 about 3000 people, mostly holidaymakers, were enjoying the facilities of the Summerland leisure complex. A fire, started in an adjacent kiosk, spread within minutes to engulf the whole building. During the rush towards the exits many were injured by being crushed or trampled upon, and others tried to jump to safety. Some were burnt as they tried to leave the building, and others inhaled smoke when returning to find lost relatives. Within minutes of the alarm being given casualties started to arrive at the hospital,

brought by taxis and private cars as well as by ambulance. In response to radio appeals blood donors also arrived and the roads to the hospital were severely congested.

Reception of Casualties

The initial problems were to mobilize the necessary staff and equipment and sort out the patients as they arrived at the casualty department. The telephone operator called both resident and non-resident staff in accordance with the emergency regulations, which fortunately had recently been revised. Indeed there was shortly more help than could be used as all the medical and nursing staff and many volunteers offered their services. Blood donors were assembled in a nearby hall and 44 pints of blood collected. Most of the patients and their relatives arrived within 20 minutes of the alarm being given and nearly all within an hour. The large number of people in the casualty department caused some confusion and made it difficult for the hospital staff to keep in contact and work effectively together.

Fatal Injuries

Forty-eight people were dead on arrival at the hospital. The main causes of death were suffocation, carbon monoxide poisoning, burns, and multiple injuries from falling. A high proportion of the tracheae and bronchi contained soot. The 48 bodies were taken to the hospital mortuary and then to a nearby church hall where more space was available. They were labeled by letter, and necropsies were performed over the next three days. The process of identification continued over the following week, during which time the bodies were preserved without refrigeration in a polythene tube tied at both ends. The tube contained 200 ml of 4% formaldehyde and a similar quantity of formaldehyde injected intraperitoneally. Only 12 of the bodies were visually identifiable.

Positive identification was obtained in all cases but presented considerable problems. Property, such as jewellery and necklaces, was sometimes helpful. The final identification was by a combination of sex, approximate age, teeth (dentures or dental charts), and operations such as hysterectomy or caesarean section.

Non-fatal Injuries

As they arrived at the hospital soon after the incident even the extensively burnt patients were not severely shocked. Intravenous infusions were set up in the casualty department and

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intravenous morphine or pethidine given where indicated. A nurse was allocated to each patient to help with documentation and continuity of treatment. Altogether 104 beds were made available, including five in the intensive care unit, by moving patients to day rooms. These patients were later discharged or accommodated elsewhere in the hospital.

Seventy patients with minor burns, fractures, lacerations, and emotional stress were treated and followed up as outpatients.

A total of 32 patients were admitted to hospital. Fourteen had a variety of injuries to the chest, abdomen, or limbs, including three with pelvic fractures. None of these injuries were serious. Most were admitted primarily for their burns.

ASPHYXIA

Three patients were admitted to the intensive therapy unit with asphyxia.

Case 1.—A 51-year-old man had a long history of bronchitis and smoked 60 cigarettes daily. He was admitted direct from the fire semi-comatose and very restless. He was deeply cyanosed, severely dyspnoeic, and wheezy. A chest x-ray examination showed bilateral pulmonary oedema. His PCO_2 was 5.9 kPa (45 mm Hg).

Case 2.—A man aged 18 had lost consciousness during the fire. He was trapped in a room near the top of the building for four hours after the start of the fire. His friend in the same room died but he had sat under a dripping tap with his jacket over his head. He was treated for apparent cardiac arrest on arrival at the casualty department and his circulation soon improved. He was deeply cyanosed with dyspnoea, pulmonary oedema, and bronchospasm. Chest x-ray examination showed bilateral pulmonary oedema. His PCO_2 was 5.5 kPa (41 mm Hg).

Case 3.—A 56-year-old woman who had a history of chest trouble after influenza in 1971 had returned to her hotel after the fire, but the next day she became progressively wheezy and was admitted to hospital 18 hours later. A chest x-ray examination showed nothing abnormal and her PCO_2 was 5.9 kPa (45 mm Hg).

Management

Hydrocortisone 100 mg intravenously was given every four to six hours. We felt that the need to relieve bronchospasm was greater than the need for any anti-inflammatory action of the steroid. Initially ampicillin was used as a broad-spectrum antibiotic but sputum was cultured daily for each patient and the drug changed when indicated. One patient (case 1) became infected with pseudomonas, and was treated with carbenicillin intravenously and by inhalation using an ultrasonic nebulizer.

Oxygen was given by facemask in an attempt to reduce the arterial desaturation. Sedation was necessary to relieve the initial restlessness in two of the patients. Diazepam 5 mg intravenously was given for its lack of respiratory depressant effect.

Blood gases were estimated often during the early stages. The PCO_2 in case 1 rose from 5.9 to 10.7 kPa (45 to 80 mm Hg) on the day after the fire. The patient was intubated and ventilated by intermittent positive pressure ventilation (I.P.P.R.). A tracheostomy was performed on the second day and I.P.P.R. continued for four days.

Vigorous chest physiotherapy was begun as soon as the patient became sufficiently co-operative. During their four sessions daily the three patients expectorated large quantities of black carbonaceous sputum for several days.

Progress was satisfactory in all three patients. One patient (case 3) was discharged after 14 days, one (case 1) after 17 days, and the last (case 2) after 19 days. Their subsequent respiratory progress continued to be satisfactory but at least one patient was troubled with recurrent nightmares of the disaster.

SURFACE BURNS

Twenty-four patients were admitted with surface burns, three

of whom were children (table I). Intravenous fluid requirements were based on an assessment of the area burnt, using the rule of nines. A more accurate estimate was made later with the help of a pictorial chart.

TABLE I—Degree of Burns in 24 Patients admitted with Surface Burns

Body surface burnt (%):	<10	10-20	30	40-50	55	65
No. of patients	11	5	4	2	1	1
Outcome	Recovered	Recovered	Recovered	Recovered	Died 9th day	Died 9th day

Fluid Replacement

Reconstituted plasma was used as colloid replacement, and a total of 110 pints was used. Patients with burns over 15% were infused, and the five most extensively burnt were given blood transfusions during the first 48 hours. One child with 6% partial-thickness burns needed intravenous rehydration as she became shocked 12 hours after the incident with a pyrexia of 37.8°C and a poor urinary output. Fluid requirements were calculated from the product of the patient's weight (kg) and the percentage of body surface burnt (% B.S.B.) as the volume in millilitres of plasma required in the first 24 hours. Normal fluid requirements were given in addition either orally or intravenously. Oral fluids were encouraged from the start.

The regimen was kept under continuous review, and altered where necessary according to the following criteria:

(a) the clinical condition, based on nursing observations and frequent ward rounds. We found it helpful to conduct joint rounds with the pathologists and laboratory staff; (b) urine output, measured accurately from the start. In seven patients a urethral catheter was passed and the hourly output of urine recorded, providing a useful guide to the adequacy of fluid replacement; (c) laboratory findings—haemoglobin, packed cell volume (P.C.V.), plasma proteins, and electrolytes were estimated in all patients. It was not feasible to estimate the haemoglobin and P.C.V. more than twice daily even in severely burnt patients so we relied heavily on a combination of all criteria in assessing the fluid replacement; central venous pressure readings, which were taken on the three patients treated in the intensive care unit, were additionally helpful in these serious cases.

Though the initial assessment of the area burnt was almost invariably an overestimate there was only one case of over-hydration. The tendency suggested by serial haemoglobin and P.C.V. readings was of underhydration corrected over several days. There were no deaths during the first 48 hours though three patients became hypotensive and oliguric. They responded to more rapid infusion of plasma.

Antibiotic Treatment

All patients were given tetanus vaccine and a course of antibiotics for five to seven days. Erythromycin, cloxacillin, or ampicillin were the initial drugs used. Gentamicin, carbenicillin, or cephaloridine were used in the most extensively burnt patients where indicated.

Isolation

Two wards of one- and four-bed units on the same floor as the theatre suite were used as a burns unit. These new wards had been in use for only three months, mainly for gynaecological cases, and there had been no cross-infection. A ratio of one nurse to each patient in the burns unit was maintained day and night. This was made possible by recruiting help from the list

of retired and married trained nurses and the cancellation of all but emergency admissions to the hospital. One of the main operating theatres was used exclusively for all burns dressings.

Local Care

Initially the burns were dressed with framycetin sulphate (Sofra-Tulle), but after 24 hours a supply of 1% silver sulphadiazine (Flamazine) was obtained and used for all subsequent dressings. Daily application gives the best results,¹ but this was not possible with the number of patients under treatment. Therefore most dressings were done on alternate days except where excessive soakage occurred, when they were done more frequently. After toilet of the burnt surface lengths of gauze on which a 3- to 5-mm layer of the cream had been smeared were applied. The gauze was covered with wool and held in place with crepe bandages or Netelast. General anaesthesia was used for dressings only in the children. All other patients were given a premedication of diazepam 10 mg intramuscularly, and further sedation with intravenous pethidine and diazepam was given in theatre under the supervision of an anaesthetist. With this regimen the patients tolerated the dressings well and had no pain on application of the cream.

Results

Of the 24 patients admitted with burns two died.

Case 4.—A 54-year-old woman had 65% B.S.B., almost all full thickness. She also had a fractured pelvis, and her initial haematuria was attributed to this. A subsequent cystogram showed the bladder and urethra to be intact. She became anuric within 24 hours, after methaemoglobin and oxyhaemoglobin had been shown in the urine. There was no response to mannitol and frusemide. She became dyspnoeic on peritoneal dialysis, and after careful consideration, haemodialysis was started. A blood culture on the fourth day grew a non-haemolytic streptococcus, and she was treated with ampicillin and gentamicin. She died on the ninth day and was found at necropsy to have acute tubular necrosis with haemoglobin casts.

Case 5.—This 35-year-old woman had 52% B.S.B., over half full thickness. The burned areas seemed clean, but a blood culture on the fourth day grew *Staphylococcus aureus*, which was treated with cephaloridine. The patient was fit for transfer to Scotland after 10 days, where her condition continued to fluctuate and she became increasingly catabolic. She died of bronchopneumonia on 30 September 1973, almost two months after the burn.

Morbidity

We were impressed by the absence of overt local infection, the usual yellow exudate being odourless and sterile. This accorded with the general well-being of the patients and the results of swabs which were taken from the burned surfaces. In extensive burns several swabs were taken from different areas of the body. Blood cultures were taken when septicaemia was suspected (table II).

TABLE II—Analysis of Positive Cultures from Burn Swabs. Results are Numbers of Cultures

Days after burn:	0-3	4	5	6	7	8	9	10	11	12-28	Total
Non-haemolytic streptococcus	0	1*									1
<i>Staphylococcus aureus</i>	0	1*									2
Coliforms	0		2		2			1	2	2	9
<i>Pseudomonas pyocyanea</i>	0				1			2			3
<i>Candida albicans</i>					1						1

*Blood cultures.

burnt surfaces. There were 56 swabs which showed no growth. The positive coliform swabs were all taken from the buttocks or legs, and presumably resulted from faecal contamination of the burnt area. As silver sulphadiazine is maximally effective against Gram-negative organisms² we were surprised by the infrequency of *Staph. aureus*, particularly since the positive swabs were all taken from two patients between two and four weeks after the burn. During the second week the burnt surfaces became covered with a soft yellow adherent slough. Histological examination of this slough excised on the 25th day from one patient showed, "a layer of necrotic connective tissue, lying upon a viable layer. The latter contains a few oedematous spaces with young capillaries, and a few lymphocytes. Surprising absence of inflammation." The slough was slow to separate, presumably owing to the absence of proteinase-producing bacteria.³ This may have caused a delay in skin grafting but was compensated by the reduction of infection.⁴ The reports we had on the subsequent progress of these patients were favourable.

EMOTIONAL EFFECTS

In addition to two patients admitted primarily for emotional distress many others showed the effect of being involved in such a tragic incident. The effects included persistent vomiting, incontinence of urine, and mental withdrawal. Some patients were worrying about missing relatives, and two had lost their whole families. In spite of well-meaning attempts by relations to conceal the facts we felt it best to tell them the truth as soon as their condition permitted. With the sympathy and understanding of the nursing staff there were no major psychological crises during the period the patients were under our care.

Discussion

A major accident can occur at any time without warning, and prior thought and consultation between the emergency services involved is important. Rehearsal of such incidents are of limited value in our opinion, being expensive and disruptive of the normal routine and probably less useful than a regular discussion of the hospital emergency procedures and their publication among new members of staff. We had fortunately reviewed the emergency procedures some weeks earlier because of recent major alterations in the geography of the hospital which had made the previous regulations outdated.

The incident was unusual because of the large number of casualties and relatives who arrived at the hospital within 20 minutes of the warning being given. Though there was at first an element of chaos as the result of this large influx on the whole the casualties were dealt with in an efficient and humane manner. This is not to say that we were fully satisfied with our efforts, and were we to be presented with the same situation again we would pay particular attention to the following points.

Firstly, if circumstances permitted each casualty on arrival should be seen and assessed by a senior person to decide priority of treatment and then allocated to separate teams set up to deal with each type of case. Secondly, we found it useful and would certainly repeat the arrangement of allocating a nurse to each patient. This made for efficiency of communication, documentation, and treatment and also provided a large measure of comfort to each patient. Medical staff time was saved by the nurse writing brief notes at the dictation of the doctor. Finally we discovered the importance of adequate telephone lines to the hospital. There were no ex-directory lines and the switchboard was jammed rapidly by incoming inquiries. As a result essential outgoing calls to external staff and requests for extra supplies were held up. We feel that every hospital should have a number of ex-directory lines to cope with this sort of situation.

In treatment of major burns the first problem facing the non-specialist is that of fluid replacement. There are divergent views

Tests to show "carry-over" of the antibacterial agent on to the culture medium¹ were negative, indicating that the high proportion of sterile swabs was a true index of the state of the

on both the volume and nature of the fluid to be used. Some regimens leave out colloid infusions altogether and emphasize the replacement of sodium and the correction of acidosis.⁵ The diversity of opinions is confusing and we chose to stick to one regimen and modify it according to our basic knowledge of fluid replacement and the clinical state of the patients, which was assessed by frequent ward rounds. The management of the fluid requirements demands intensive care and we found that the time spent on ward rounds calculating fluid balance and adjusting the fluid regimen paid considerable dividends in the overall management of the patients. In most cases a urinary output greater than 2 litres a day was achieved and there were no serious biochemical disturbances.

In the local treatment of burns the application of antibacterial agents has been shown to have clear advantages in limiting infection.¹ Our experience with silver sulphadiazine has confirmed other reports of its effectiveness and lack of toxicity. After their transfer to other centres we had encouraging reports on the progress of the patients treated initially with silver sulphadiazine. We were particularly struck by the absence of infection and odour of the burns.

All three patients admitted with asphyxia had a relatively normal PCO_2 , though they were deeply cyanosed. We were unfortunately unable to estimate PO_2 at the time of the disaster, but it can be assumed that it was very low in each case. A rising PCO_2 , however, supported the clinical assessment of the need for I.P.P.R. Endotracheal intubation should be avoided unless indicated by the retention of secretions or the necessity for

I.P.P.R. since it is particularly prone to produce tracheal ulceration in cases of asphyxia. There remains considerable controversy regarding the use of steroids in these patients. In our opinion the serious degree of bronchospasm that occurred made the use of steroids mandatory. We did not use them locally as an aerosol, but there is some evidence that this may be beneficial and perhaps avoid the need for systemic steroids.

We found diazepam carefully titrated by intravenous injection to be useful and safe for controlling restlessness, which can further aggravate respiratory distress. The use of carbenicillin by inhalation using an ultrasonic nebulizer as well as intravenously was very effective in the patient with pseudomonas infection.

We thank every member of the hospital staff and the many volunteers who worked so hard to help the victims of the disaster. We are also indebted to Miss A. Lees for preparation of the typescript.

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Hospital Topics

Anaemia of Pregnancy: The Changing Postwar Pattern

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Summary

A population survey covering over a quarter of a century has shown clearly the improvement in haemoglobin levels in women attending antenatal clinics at the Glasgow Royal Maternity Hospital. Various influences have helped to bring this about, foremost among these being routine early prophylaxis with combined iron and folate supplements. Indeed, a time-space relationship between changes in prophylactic therapy, rates of improvement, and the incidence of megaloblastic anaemia can be shown. The women at risk are still essentially the same except for a new group of young, unmarried girls, who must be watched.

In our view the withdrawal of routine prophylactic therapy in pregnancy would be a retrograde step.

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Introduction

Records of anaemia in women attending the antenatal clinic at this hospital have been kept since the mid-1940s. Over the years the average booking haemoglobin level has risen appreciably though not always consistently. Periods of more-rapid improvement have occurred and it was felt that it might be interesting to analyse these changes more closely to see how far they could be related to altered social habits and standards and to discover to what extent improved medical care and treatment had played their part.

Methods

Haemoglobin readings were made on venous samples until 1970, when preliminary capillary testing was introduced to have results immediately available to the obstetrician. Patients with haemoglobin values below 10 g/dl, and from 1973 all those with values below 11 g/dl, had blood sent to the laboratory for a full count.

Methods of haemoglobin estimation were strictly controlled. In 1946-7 a Sahli haemoglobinometer standardized with acid haematin was in use. By 1957 the ammonia method for oxyhaemoglobin had replaced this and the results were read in a photoelectric colorimeter standardized against a whole blood