Helicopter mountain rescue of patients with head injury and/or multiple injuries in southern Switzerland 1980–1990

R. L. Malacrida, L. C. Anselmi, M. Genoni, M. Bogen and P. M. Suter

1Intensive and Emergency Care Unit, San Giovanni Hospital, Bellinzona, and REGA Ticino and 2Division of Surgical Intensive Care, University Hospital, Geneva, Switzerland

Introduction

The ability to bring a trained physician quickly to the scene of an accident saves precious time in the treatment of patients with serious brain injuries (Raxt and Moody, 1987). For accidents in mountain areas, the use of a helicopter equipped with a winch seems an ideal means of transporting both the doctor and the necessary material to the patient. The main purpose of bringing the physician to the scene of the accident is to control and assist respiratory and cardiovascular function in order to prevent secondary injury. Inadequate cerebral perfusion, hypoxia and hypercarbia are particularly frequent in the patient with multiple injuries (Rosner and Doughton, 1990). Treatment at the scene of the accident aims to ensure (a) adequate respiration, (b) good haemodynamic function, (c) appropriate sedation and analgesia, (d) neck fixation for protection in suspected neck injury. When necessary, for instance in a comatose patient, orotracheal intubation should be performed to provide ventilation and oxygenation and to prevent aspiration of gastric content or blood into the bronchial tree. When it is impossible for the helicopter to land at the scene of the accident, the physician and the medical equipment can be lowered to the injured patient with a 30–46 m cable using a winch.

Following life support measures, the patient is loaded into a rescue net, which can also be slid under the patient if space is limited, or to keep movement of the patient to a minimum. The net has been specifically designed to carry and evacuate patients with spinal injuries. The patient, lying completely horizontally in the net, is hooked on to the winch cable underneath the winch. The physician, to the nearest landing area, here the patient is placed onto a stretcher and fixed using a vacuum mattress, then loaded on the stretcher in the helicopter, and flown to an appropriate hospital.

In areas with steep rocky peaks, deep narrow valleys, tall trees, etc., it is frequently necessary to lengthen the winch cable up to 46 m to reach the patient. Night-time and/or unfavourable weather conditions such as wind, snow or rain obviously make this type of rescue operation difficult and dangerous, but only fog or extremely turbulent winds render it impossible.

While suspended under the helicopter in the net, the patient cannot receive active treatment, and the physician has to be prepared for this (e.g. venous line, good sedation and analgesia, neck fixation, intubation, already taken care of at the scene of the accident). During air rescue artificial ventilation in non-intubated patients in the net or the helicopter is very difficult and can be inefficient.

Patients and method

Southern Switzerland, known as Canton Ticino, has approximately 270 000 inhabitants and is known for its pleasant climate, lakes and soaring mountains, which attract more visitors and tourists than any other region of Switzerland. Mountain accidents are therefore frequent, and rescue and transport without a helicopter is difficult and time-consuming.

The Swiss Air Rescue (REGA) undertakes about 3000 primary rescues each year by helicopter. From 1980 to 1990, 1653 rescues were carried out in southern Switzerland, and 462 (27.9 per cent) involved the use of the winch.

Of the 462 patients rescued by winch during a 10-year period (1980–1990), 57 (11.5 per cent) had sustained severe multiple injuries or head injuries while in remote mountain areas.
All patients were treated using the same protocol, consisting of (a) prompt intubation at the scene of the accident if judged necessary, and mechanical hyperventilation with a high inspired concentration of oxygen, (b) restoring and maintaining a mean systemic arterial pressure of 80 mmHg, (c) analgesia with intravenous morphine if pain was present and sedation with midazolam intravenously if the patient was intubated or agitated. All intubated patients were also given muscle relaxants. Performance of this protocol took an average of 20 min.

All patients had neck fixation before rescue by winch; the horizontal net was specially designed for rescue of patients with spinal column fractures.

The rescue was then achieved by means of a horizontal net attached, together with the physician, to the winch of the helicopter, and transported for a few minutes to the nearest possible landing place (Figure 1).

Here patient and physician were transferred into the helicopter, and the patient fixed in a vacuum mattress. Despite the limited space in the cabin, intensive therapy including mechanical ventilation, intravenous administration of drugs, and other therapeutic measures were carried out. The patient was flown to the nearest hospital equipped with computerized tomography and a neurosurgical division. Standard hospital treatment includes continuous measurements of intracranial pressure, systemic arterial and central venous pressure.

At 6 months after the accident, a follow-up neurological examination was performed in the 50 survivors of the 57 patients rescued by helicopter.

Results

During the study period, 47 (82 per cent) male patients and 10 (18 per cent) female patients were rescued, with an average age of 40.4 years. Of these patients, 13 (25 per cent) suffered only head injuries, whereas 44 (75 per cent) had associated injuries, including serious injuries of the chest and abdomen.

Most were mountaineering accidents (55 per cent), followed by aviation accidents (12.5 per cent), and mountain-worker accidents (7.5 per cent).

Contacting the helicopter service by the patient’s relatives or companions took an average of 45 min, whereas the helicopter reached the scene of the accident at the latest 15 min after the alarm (Table I). The treatment of the patient (clinical rating, instillation of infusions on a peripheral vein, intubation, fixing the settling in the horizontal net) took an average of 20 min. The average flying time to this hospital was 10 min.

The severity of the brain injury was assessed at the scene of the accident with the Glasgow Coma Scale (Changaris et al., 1987): 39 patients (68 per cent) had a score between 10 and 12, 18 (32 per cent) between 4 and 9 and, of these, six patients (11 per cent) had a Glasgow Coma Scale score of 4. The indication for intubation before transport was a GCS score of less than 10.

The NACA (National Advisory Committee for Aeronautics 1960, rev. 1980) Gravity Index was 4 or more in 91 per cent (Figure 2), indicating a high-risk population.

Of the 57 patients rescued, two were transported by helicopter directly to a specialized hospital in northern Switzerland. Of the others, four were taken to a specialized hospital later the same day, after diagnosis and initial treatment in the nearest hospital (one case of traumatic aortic aneurysm, one spinal injury, one child of 3 months, and in one case at the request of parents). No technical or medical mishaps occurred during the rescue missions and helicopter transfers.

The results of the CT scan were: 10 patients with cerebral contusion and intracerebral bleeding of variable size; one case of extra-dural haematoma; two cases of subarachnoid haematoma and three cases of cerebral oedema. In the other cases the CT was normal.

The mortality rate was 7/57 (12 per cent); four patients died before reaching the ICU, and three patients (5 per cent) died in the ICU. The causes of death were head injury on the first day, ARDS on the 7th day, and pulmonary embolism on the 22nd day. The mean ICU stay was 5.5 days.

A follow-up examination 6 months after the accident showed a normal neurological state in 44 patients, whereas the other six survivors had mild neurological deficiencies; no persistent coma or vegetative state was recorded.

Table I. Rescue times (mean (SD))

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Mean Time (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between accident and alarm</td>
<td>45 (18)</td>
</tr>
<tr>
<td>From alarm to arrival of the helicopter</td>
<td>30–150</td>
</tr>
<tr>
<td>From accident to treatment for transport</td>
<td>20 (13)</td>
</tr>
</tbody>
</table>

Figure 1. The rescue helicopter.

Figure 2. NACA index, evaluated by the emergency physician at the scene of the accident.
Discussion

It would seem that appropriate treatment by a qualified physician at the scene of the accident reduces mortality of patients with severe brain injuries (Stocchetti et al., 1986) and improves the prognosis of the patients who survive beyond the first 2 days (Gelpke et al., 1983). Fast transport directly to a hospital equipped with a computerized tomograph and a neurological division saves precious time (Phair et al., 1991).

In the literature, hospital mortality varies considerably for isolated brain injury; between 17 per cent and 35 per cent (Klauber et al., 1985; Luce, 1986; Colohan et al., 1989). If other injuries are present, mortality increases to 20–58 per cent (Williams, 1984; Sefrin and Sellner, 1991). In our series, the mortality rate was 12 per cent (7 of 57 patients), and 88 per cent (44 of 50 patients) of the surviving patients showed a good neurological outcome; only 12 per cent had mild neurological deficiencies and no persistent coma was recorded. These results are similar to other reports in the literature (Martin et al., 1990; Markus, 1991).

The low mortality rate in the series reported suggests that fast rescue by a helicopter equipped with a winch, plus optimal treatment at the scene of the accident in order to ensure adequate ventilation and circulation, can improve prognosis in injured patients in areas where access by other means of transport would take much longer or would be impossible.

References


Requests for reprints should be addressed to: Roberto Malacrida MD, Intensive and Emergency Care Units, Hospital S Giovanni, 6500 Bellinzona, Switzerland.