Helicopter Emergency Medical Services are continuing to grow in Australia and NSW's Careflight is one system that is quite different from the ictorian Air Ambulance helicopter. *Dr Blair Munford*, Careflight's Deputy Medical Director, discusses the unit's background and operation.

CAREFLIGHT

TAKING THE HOSPITAL TO THE PATIENT

A man is trapped in an industrial accident with severe crush injuries to the lower limbs. A child, with suspected epiglottitis is admitted to a hospital lacking specialist anaesthetists or intensive care facilities. A head injured patient with a Glasgow Coma Score of 8 is brought to a district hospital. A 50 year old woman in a country hospital CCU develops heart block with bradycardia and hypotension - temporary pacing is indicated. A bushwalker down a cliff following a fall has suspected spinal injuries and respiratory distress. These actual patient stories represent examples of the cases, where the services offered by NRMA CareFlight may be indicated.

CareFlight was established in 1986, by a group of doctors, administrators and pilots with experience in helicopter EMS work dating back to 1971, to provide a medically optimised and directed rescue and retrieval service. The service with its medical arm, the NSW Medical Retrieval Service, is a non-profit company and registered charity, whose sponsors include NRMA and Channel 9. It is based at Westmead Hospital, right at the demographic centre of Sydney and the major referral centre for Sydney's western suburbs - the fastest growing area in Australia.

The "CareFlight Philosophy" is that critically ill and injured patients should have rapid access to definitive care; best achieved by despatch of teams via appropriately rapid transport, to stabilise, triage and transport these patients to definitive critical care facilities. This philosophy has been summarised as "taking the hospital to the patient at 240kmh".

Commitment to this philosophy has seen CareFlight expand from helicopter retrieval only, to also offering teams for road and fixed wing retrieval, and from local service to statewide, interstate and even international retrieval. It has also seen NRMA CareFlight/NSW Medical Retrieval Service become the first, and so far the only, non-hospital organisation to be accredited for specialist medical training by any of the Australian colleges (for registrars in anaesthesia, intensive care and emergency medicine); also the first program outside North America to be granted provider membership of the Association of Air Medical Services (AAMS formerly ASHBEAMS).

THE AIRCRAFT

CareFlight initially began their operations with a single engine Squirrel helicopter capable of taking a crew of three; pilot, crewman and doctor, and capable of only transporting one patient. In 1988 this was replaced with its larger stablemate, the SA365C Dauphin, offering greater patient capacity, more space, more power, and a faster cruise speed (240 kmh). Three Dauphins were already operating in Australia in the general and ambulance roles with the Victorian Police Air Wing, however, the CareFlight aircraft represented the first fully dedicated two patient medical and rescue helicopter in Australia. The Dauphin is an excellent EMS aircraft, and with the acquisition this year of three Dauphins by the Surf Life Saving Association in NSW, appears likely to become the standard medical helicopter in Australia. Features of the NRMA CareFlight's current (C2 model) Dauphin include the ability to carry two intensive care level of patients with three medical crew including seating at the head of each patient in the vital airway control position. A blackout curtain can be used at night to isolate the brightly lit cabin from the pilot and rescue crewman in the front cockpit, while a specially developed communications system isolate the flight and medical crews. This is especially valuable during IFR (instrument) flights with one or more patients aboard as it allows free conversation between medical crew and between flight crew without each disturbing the other. Other features of the communications system include a comprehensive range of radios, and an integrated cell phone.

> CareFlight was established in 1986, by a group of doctors, pilots and administrators with experience in helicopter EMS work dating back to 1971.

In addition, the Dauphin also offers the following features desirable in an EMS aircraft:

- A high main rotor clearance (more than 3.3m), and an enclosed fenestron tail rotor, both conferring increased safety for landing at unimproved sites.
- An excellent engine reliability record.
- An auto pilot with heading and altitude hold, which reduces pilot workload significantly.
- Single pilot instrument flight rating
- Low noise output in cruise flight, allowing the aircraft to be certified to use light helicopter transit lanes.

THE STRETCHER BRIDGE

NRMA CareFlight's medical fit is based on one or more 'Stretcher Bridge' mobile intensive care modules, attaching to the stretcher over the patient's thighs. The concept arose from the recognition of the major limitations imposed by medical equipment mounted in the helicopter, when much of the time involved in retrievals is spent beyond the confines of the aircraft. The module essentially functions as the adult equivalent of a neonatal isolette, with patient, stretcher and bridge forming an integral unit. It was designed by CareFlight medical staff and the

The Dauphin is an excellent EMS aircraft, and appears likely to become the standard medical helicopter in Australia.

Department of Biomedical Engineering at Westmead Hospital.

The stretcher bridge includes a ventilator, with a CareFlight developed ventilation alarm (high and low pressure), and oxygen and suction provided via a Twin O Vac system. For compactness and light weight, the system does not incorporate its own oxygen supply, rather a 3m oxygen hose with standard (DISS) fitting allowing utilisation of aircraft, ambulance, portable or hospital oxygen.

A selection of monitors include ECG, pulse oximetery, invasive and/or non invasive BP; with temperature and capnography (CO_2 monitoring) on some models. Two syringe pumps are also fitted to allow precise infusions of drugs such as inotropes. The unit is wired to allow monitors to run off aircraft power, and audible alarms to be fed into the medical crew intercom panel.

Recently, the system has been adapted to allow its use in fixed wing and road ambulance transports, which form a significant part of the NSW Medical Retrieval Service's workload. The value of the stretcher bridge concept has been shown by its adoption by other groups performing retrieval; and also by the requirements for the proposed new NSW Ambulance universal stretcher, which includes the ability to mount a stretcher bridge system. It has further been described in the medical literature[1].

Most of the remaining medical equipment is carried in a Thomas Transport Pack, including ; adult and paediatric intubation and ventilation equipment, full range of ALS drugs, IV infusion equipment including central venous cannulae, chest drain set-ups, and basic surgical pack. Other items, such as a defibrillator, are aircraft mounted but detachable. Various option packs including pacemaker kit, obstetrics pack, and a burns bag are carried as needed.

CareFlight crew "hot unload" a critical patient at the Westmead trauma centre helipad, only metres from the resusitation area.

PRIMARY RESPONSE AND RESCUE OPERATIONS

To date, of just over 1800 patients treated by CareFlight, only 242 have been from scene calls. These missions essentially fall into one of two categories; scene response to the critically ill or injured; and rescue extrications, usually from the beautiful but rugged Blue Mountains area, which comes alive with bushwalkers, climbers, abseilers and campers during the holiday season.

RESCUE EQUIPMENT

NRMA CareFlight's Dauphin is fitted with an Air-Equip electric winch which has a 130ft/600lb cable and capacity. While this winch has proven adequate for rescue to date, it is being upgraded to a 300ft/600lb model.

A Ferno Washington split stretcher is carried on all rescue missions. This is easily winched aboard the aircraft or can be carried out by a ground party, if required.

A rope pack contains 100 metres of 13mm Kernmantle rope with descending devices, gloves and carabiners. In the event that winching is not possible, medical crew can abseil from the aircraft, or they can be off loaded at a staging point and then abseil to the patient in conventional fashion. A 24 hour survival pack is permanently located in the aircraft. It contains equipment and supplies to keep four people sheltered and provisioned should an overnight stay in the bush be required.

Equipment for water rescue includes a US Coast Guard two-person rescue basket and 5mm dive suits with inbuilt flotation devices.

TRAINING FOR RESCUE

The ability to operate both smoothly and effectively as a team during actual rescue missions requires constant training and the development of standard operating procedures to cover most scenarios. Training, therefore, takes a high priority and CareFlight's commitment to safety and a high operational standard was shown with 71 separate training flights, or one every five days, being conducted during the past year. In addition, a large currency board displayed in the operations base, reminds all crew when they must undergo further training, including fitness checks.

SCENE RESPONSE TO THE CRITICAL PATIENT

In contrast to the lightly injured patients found in the typical rescue, patients retrieved from the pre hospital environment are predominantly severely injured or critically ill, such patients have

In a situation of limited resources, helicopter retrieval teams can be used in transferring critical patients between regional facilities.

a high requirement for medical intervention. In a recent study by NSW Medical Retrieval Service[2], of 126 cases of trauma retrieved directly from the scene, 104 (85%) benefited from the skills offered by a critical care experienced doctor (usually an anaesthetist), additional to those of paramedics.

Interventions performed included elective intubations, chest drain placements, blood transfusions and regional anaesthesia; in addition, diagnostic skills and the capability of triaging patients straight to appropriate hospitals were identified as important benefits conferred by a medical team.

INTERHOSPITAL RETRIEVAL

Retrieval essentially refers to the despatch of a medical team to transfer a patient or patients between medical facilities of varying capabilities.

Retrievals are initiated by either referring or receiving hospitals and co-ordinated through the NSW Air Ambulance. The routine crew of pilot, doctor, rescue crew officer and paramedic enables double patient movement, which can be most advantageous in scenarios such as remote hospitals dealing with multiple trauma patients.

We can identify factors indicating a helicopter retrieval as:

a. Resuscitation Required:

A patient, in a peripheral facility with insufficient resources to deal with a critical condition. The retrieval team can resuscitate and stabilise prior to delivering a patient to a definitive hospital destination.

b. Specialist Care Required:

Neurosurgical, spinal, burns, cardiac, vascular or paediatric patients from hospitals not privileged to have specialist facilities and staff in these areas, to an appropriate destination. Interim stabilising care can be continued or initiated by the retrieval team.

c. Urgent Transfers:

Though less common now than when rescue/medical helicopters first hit the scene (so to speak), this is still a valuable and relevant task for rotary wing aircraft when patients face delay in transfer between facilities by other means.

d. Logistics:

In a situation of limited resources, helicopter retrieval teams can be used in transferring critical patients between regional facilities. Such networking, as pioneered by neonatal intensive care units, enables a small number of specialist beds to cover a larger workload.

The retrieval process must take note of the needs of the referring hospital. The actual retrieval team is the most visible part of a complete retrieval system including major hospitals networked by a bed finding system. Ideally, a referring hospital busy with a critical patient should be able to make a single phone call which will: find an appropriate receiving hospital/unit, despatch a retrieval team and provide advice on interim management[3,4]. Discussion of the patient with the referring team has been an important part of the service offered by the NSW Medical Retrieval Service. Attention to this aspect of the retrieval has seen a steady rise in the proportion of patients presenting for transport who are well resuscitated and prepared by arrival of the retrieval team. This aspect of retrieval has become easier with the advent of cellular telephones, enabling retrieval teams to keep in regular contact with both referring and receiving hospitals.

While primary rescue will no doubt remain a media magnet, interhospital retrievals will almost certainly continue to dominate the hours flown by medical helicopters.

AMBULANCE OFFICER SECONDMENT

There are currently four NSW Ambulance Paramedics, one below establishment, on permanent secondment with the CareFlight Rescue Helicopter. These officers all have extensive road experience with the average of 12.5 years of service. They are also full time members of the Special Casualty Access Team (SCAT), a highly organised, trained and disciplined group within the NSW Ambulance Service.

The Service developed the SCAT capability in response to the markedly increased level of interest in outdoor activities by the general public. This participation in potentially dangerous areas, has been reflected in a number of casualty situations the Service has had to respond to. As of December 1990, SCAT

Two patients and stretcher bridges can be carried in the Dauphin, with medical crew seated at both heads, plus a third attendant.

The paramedics seconded to CareFlight have brought with them a wide variety of practical experience and now have become an integral part of the flight crew.

officers have been activated to just over 300 cases in the metropolitan, urban and wilderness areas of the State.

There are 25 officers who commenced their specialised training by first obtaining a high level of fitness. They then proceed in two groups to the basic and advanced roping skills. On the successful completion of this, officers then proceed to field skills modules, dependent on area and Service requirements. These include:

1. Airborne rapelling
2. Speleology skills
3. Canyoning techniques
4. Helicopter medical crew training
5. Self contained breathing apparatus
6. Mines rescue medical support training
7. Scuba dive training
8. Aquatic skills
9. Violent situations and tactical support training
10. Four wheel drive techniques

The paramedics seconded to CareFlight have brought with them a wide variety of practical experience and now have become an integral part of the flight crew.

The paramedics have both medical and operational duties as part of their role with NRMA CareFlight. Duties may include: to control the load/unload procedure, assist doctor with medical procedures, check and load drugs and fluids, monitor equipment and displays, assist flight crew with clearances and radio calls as required.

In addition, in multi casualty situations such as the primary response to a road accident, the paramedic may function as the triage officer, establishing priorities for helicopter and road evacuation; freeing the crew doctor to treat the most critical patient(s).

In the rescue situation, the paramedic may be despatched to the scene along with the doctor for significantly injured or multiple patients. Alternatively, he may be despatched solo, to either complete the rescue, or assess the need for medical intervention.

CONCLUSION - ROLE OF THE MEDICAL HELICOPTER SERVICE

Since its inception in 1986, CareFlight/NSW Medical Retrieval Service has treated and transported over 1800 patients.

Perhaps more importantly, the Service has been a focus for development of ideas and philosophy of retrieval.

Many of NRMA CareFlight's innovations in equipment, medical staffing, and operational procedures have now been adopted as standards in New South Wales.

One of the most successful innovations has been the joint initiative by the NSW Ambulance Service and CareFlight to have SCAT trained paramedics as additional crew. The authors believe the combination of a critical care doctor and a paramedic has proven itself in a wide variety of scenarios.

Every ambulance officer is familiar with the problems that can arise with junior or inappropriate doctors in the pre and interhospital setting. Consequently, advocacy of wider utilisation of doctors in this setting has often had a cool reception, despite overseas precedents such as Germany's acclaimed Luftrettung EMS network. CareFlight/NSW Medical Retrieval Service has attempted to overcome this problem by utilising senior medical staff with appropriate skills and experience.

The addition of senior paramedics has further enhanced the capabilities of the medical team, especially the ability to smoothly assume care of the patient from ambulance officers and paramedics at the scene. Studies both overseas[4,5] and recently by NSW Medical Retrieval Service[1] have shown improved outcomes for trauma patients with use of medically staffed EMS helicopters.

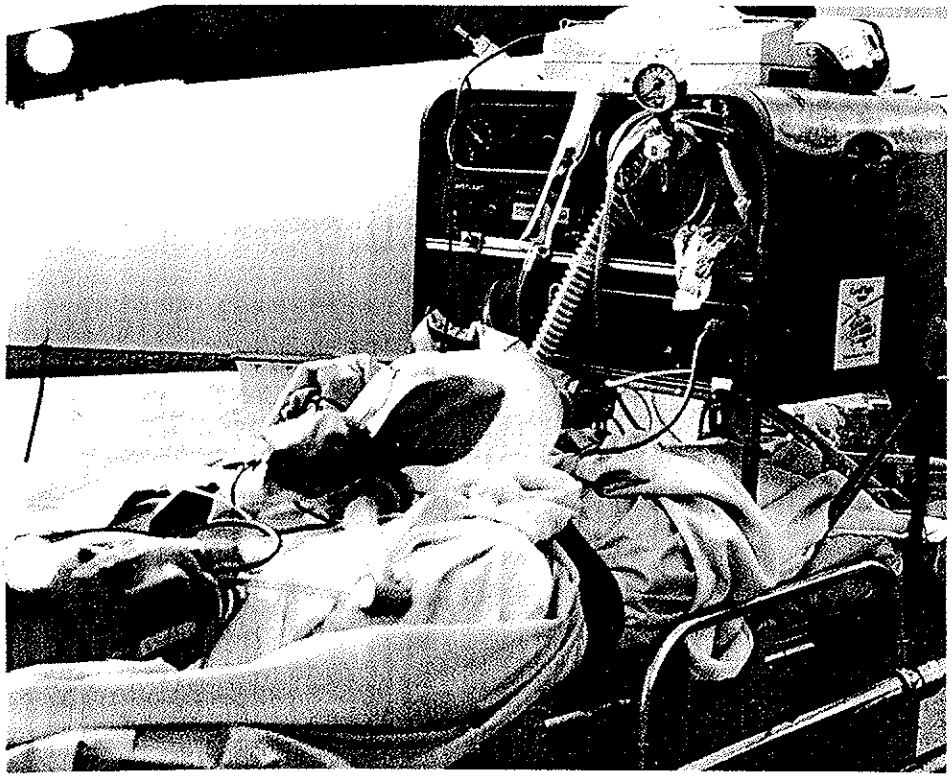
So, in what situations is a medical team, such as from NRMA CareFlight, desirable on scene? Our experience suggests the following should be included:

i) Multiple casualities (eg Goulbourn and Kempsey bus crashes, Brooklyn train crash, Newcastle earthquake - all of which CareFlight rendered assistance at). With a transport platform and medical team on around the clock standby, the helicopter-borne medical team is one of the most rapidly available resources.

ii) One or more of the patients with

(continued on page 49)

The "stretcher bridge" module enables full IC monitoring and support equipment accompany the patient uninterrupted.



RESEARCH PAPERS

Each issue, Ambulance World will review current papers from relevant Journals, which have specific interest to pre-hospital emergency care.

Compiled by Greg Sassella.

PREHOSPITAL DATA ENTRY BY PARAMEDICS

Tucson, Arizona is a city of 400,000 people and has a Fire Department based paramedic system. A computer based data entry system is an integral part of the Service's quality assurance programme.

The Tucson Fire Department implemented a Data Entry Compliance evaluation programme in an effort to assess the accuracy of the information entered by the paramedics.

It was felt that as the number of invasive techniques and the number of drugs a grew as well as the associated escalating costs of providing this level of care, it was important to obtain accurate data as to the efficacy of the care and treatment provided in the prehospital environment.

A three tier system was established, consisting of Paramedic Supervisors, a Research Co-ordinator and a Medical Director.

The Paramedic Supervisor reviewed each case sheet and verified any discrepency on the sheet with the crew. This process either validated what was entered on the sheet or altered it in an effort to ensure that what was entered was in fact what was done.

The Research Co-ordinator and the Medical Director then compared the paramedics diagnosis and their subsequent treatment with the receiving Emergency Department. This then provided a method of evaluating any discrepancies between patient condition and data entry.

Finally, time related data such as response time, at scene time and transport time were added to the evaluation process.

The combination of this data and the process and personnel involved is a great form of Quality Assurance in that it provides information for those outside the paramedic system to objectively assess the efficacy of the programme on an on-going basis. It also provides good educational information for paramedics and their supervisors.

The information gathered is important on a world wide scale as well. There is still no clear cut evidence of the impact of ALS care in the trauma patient for example, and therefore if accurate information is gathered it may provide supportive data. In doing so, the issue of drugs and protocols can be examined in a valid and scientific manner.

This article is a good example of a data base being used in a quality assurance programme and should be read by anyone who has a data base collection system or is involved in establishing a paramedic system.

Valenzuela, T.D. et al: "Prehospital Data Entry Compliance by Paramedics after Institution of a Comprehensive EMS Data Collection Tool", Annals of Emergency Medicine, 19: 1270-1272, 1990.

CAREFLIGHT *(continued from page 00)*

the following:

- Head injury with a GCS 10 or less
- Major chest injury
- Multi system injuries
- Shock persisting after initial fluid resuscitation
- Diving injuries, especially if hypotensive or respiratory compromise
- Major burns
- Amputation, crush injury, or trapped patient
- Compromised airway or respiratory failure
- Significant envenomation

iii) Any other condition at the discretion of the ambulance personnel on scene.

The above indications are guidelines only and should be viewed in light of operational and geographic factors. Over short distances, medical team despatch by road may be most appropriate. Whatever the mode of transport, a medical team scene response should be an option available to ambulance officers and their (most critical) patients.

In NSW parlance, the medical team should be the Level 6 response (Level 4 = advanced care officer, Level 5 = paramedic) - called least often, but always available, always considered.

The adoption of guidelines for minimum standards for medical staff, along clinical indicators for medical scene response, and combination medical staff/ ambulance officer teams should produce less inter-professional rivalry, more appropriate utilisation of medical teams, and benefits to the patient.

The authors, and NRMA CareFlight/ NSW Medical Retrieval Service, look forward to continuing development and innovation in medical retrieval and rescue, in co-operation with ambulance services.

About The Authors

Station Officer Daniel Ferguson and Officers Brian Deen, Steve Fraser and Chris Lees are senior NSW Ambulance paramedics from the Special Casualty Access Team. For the past two years they have been on secondment to CareFlight.

Dr Blair Munford is a specialist anaesthetist with intensive care experience, working half time for NRMA CareFlight/NSW Medical Retrieval Service. He is currently the Service's Deputy Medical Director.

References

1. Wishaw KJ, Munford BJ, and Roby HP. *The CareFlight Stretcher Bridge, a compact mobile intensive care module.* Anaest Int Care(1990) 18:234

2. Munford BJ, Middleton PO, et al. *Medical Scene Response to Trauma - Is there a need for this?* (Presentation at Royal Australian College of Surgeons GSM Road Trauma Section) May 1990.

3. Gilligan JE. *Transport of the Critically Ill.* Intensive Care Manual, 3rd Ed, edited TE Oh. Butterworths 1990.

4. Munford BJ. *Formulating a Blueprint for Retrieval.* Aust Dr Weekly, Feb 9th, 1991 :37.

5. Boxt WG, Moody P. *The Impact of a Physician as part of the Aeromedical Prehospital Team in Patients with Blunt Trauma.* JAMA (1987) 257:3246.

6. Carraway RP, Brewer MG, et al. *Why a Physician? Aeromedical Transport of the Trauma Victim.* Journal Trauma (1984) 24:650.

7. Rhee KJ, Strzeski M, et al. *Is the Flight Physician needed for the Helicopter Emergency Medical Services.* Ann Emerg Med (1986) 15:174.