Chapter 1

History of Aeromedical Transportation

Beginnings

Since earliest times, men have sought the gift of flight. As creatures grounded by nature, man’s imagination took the form of gods drawn across the sky by chariots of fire or heroes borne to battle or their Valhalla on winged stallions. Mortals seldom experienced the power of flight. The Chinese Emperor Shun was said to have escaped his captors by ‘donning the work clothes of a bird’. The Greek architect Daedalus (designer of the Maze of the Minotaur) and his son Icarus fled the isle of Crete by soaring to freedom on wings made of feathers and wax. Icarus was also the first aviation fatality. Enraptured by the joys of flight, he neglected the warnings of his father and flew too close to the sun, melting the fabric of his wings and plummeting down into the sea.

Myth became reality in 1783 when the first terrestrial creatures took to the air in a Montgolfier balloon. These pioneer aeronauts ascended to a height of 1700 feet. Upon landing, one of the aeronauts (Montauciel, a sheep) was noted to be calmly munching grass, while one colleague (a duck) was cowering in a corner and the other (a rooster) suffered a broken wing from being kicked by Montauciel prior to lift-off. As faith in the ability of living creatures to tolerate air travel had been vindicated, the first manned ascent was crewed by the French physician Pilatre de Rozier and the Marquis d’Arlandes in November of the same year.

One of the first balloon ascents was witnessed by Benjamin Franklin, American envoy to France. When a sceptic in the crowd noted that the balloon was, ‘interesting, but what use is it?’, Franklin remarked, ‘What use is a newborn baby?’ It was a portent of things to come, for in 1903 the owners of the Wright Cycle Factory in Dayton, Ohio, piloted the first successful heavier-than-air craft across the sand dunes at Kitty Hawk.

Less than a century later, aircraft and air travel have become part of our daily world. The phenomenon of flight has shrunk the globe and pushed back the frontiers of space. It is hardly surprising that aeromedical services form an integral part of the modern emergency care system.

Origins of aeromedical transportation

For many years it was popularly believed that the very first aeromedical flights evacuated patients from the besieged city of Paris during the Franco-Prussian War
in 1870. However, contemporary records of the 67 balloons known to have left Paris during the siege make no mention of the carriage of any sick or wounded. The origin of this popular myth is unclear, but may have resulted from an error in the translation of the original French reports. Many of the balloons were under contract to the French postal service and carried letters, government dispatches, homing pigeons, and passengers on governmental or war related business. Like many other myths, perhaps the fabled medical evacuation flights should have happened, but there is verifiable documentary evidence that they did not. Some 20 years later a Dutch military doctor by the name of DeMooy proposed that casualties might be evacuated by horse-drawn tethered balloons but, again, there is no evidence that such flights actually took place.

The history of aeromedical transportation is therefore not quite as long as the history of flight itself, but certainly does not lag far behind it. Despite the statement reported in a French medical journal (*Le Caducée*) in 1912, that ‘the use of the aeroplane for (medical) evacuation is, for the moment, in the realm of fiction’, the first aeromedical flights were not long in coming. In fact, the earliest recorded evacuation of wounded casualties by aeroplane took place during the first world war, when Serbian patients were carried in an unmodified French fighter plane. In 1916, Dr Chassaing persuaded the French government to build an aircraft capable of carrying two stretchers. A year later it was being used successfully to evacuate the wounded from the battlefield at Amiens. As aviation technology progressed, the potential value of aircraft as airborne ambulances became obvious.

The first recorded British air ambulance flight took place in 1917 when a soldier in the Camel Corps in Turkey who had been shot in the ankle was flown to hospital in 45 minutes, thus avoiding a three-day journey on the ground. In the same year, the Reverend John Flynn, a Presbyterian minister with the Australian Inland Mission, conceived the idea of combining ‘wireless’, aviation, and medicine to produce a ‘mantle of safety’ across the outback. Over the next ten years, with the assistance of inventors, radio technicians, doctors, philanthropists and fellow missionaries, Flynn saw his dream literally take off. Although sporadic medical flights had been occurring for at least a year, the Inland Mission’s Aerial Medical Service was the first organized program. The first official flight was from Cloncurry in Queensland on 17 May 1928; the aircraft was a de Havilland DH50 biplane, on secondment from the infant Queensland and Northern Territory Airline Service (now QANTAS, Australia’s national carrier). The first communications network started out of Cloncurry at the same time, utilizing pedal powered radios developed by Alfred Traeger. Without radio, the Aerial Medical Service (AMS) would have been rendered worthless for want of a means of dispatch; it was to take the advent of microwave transmissions to make telephones widely available within the outback. Although it was initially a one-year experiment, flying continued for twelve years at Cloncurry and, until 1934, it was the sole AMS base.

Another vital component of Flynn’s ‘mantle of safety’ was a network of Inland Mission hostels and hospitals staffed by nurses throughout the outback. The first hostel opened in 1912 at Oodnadatta. Within 14 years, ten hostels/hospitals had been
established, all staffed by registered nurses. With few doctors in the outback, the concept of flying nurses was also developed. In 1939 a young nurse, Meg McKay flew from Cloncurry to Bulia to assist with immunisations and surgery, and the concept of a flying nurse was firmly established. The name of the organization was changed to the Flying Doctor Service (FDS) in 1942 and, by the end of the second world war, the military flight nurse concept was well proven. In 1945, the Victorian, South Australian, and New South Wales sections of the Flying Doctor Service jointly funded an experiment of a flying nurse based at Broken Hill. The FDS was probably the first aeromedical organization to train and employ flight nurses. By the time of Flynn’s death in 1951, his concept had grown to a federation of six sections and a dozen bases. Its value to the people of the outback was recognized in 1955 with the granting of the ‘Royal’ prefix and it remains a vital part of outback Australian life to this day.

Between the wars, both the British and French employed aircraft for the transportation of casualties resulting from colonial conflicts. The Royal Air Force (RAF) first used aircraft in the casevac role in Somaliland, in 1919, when three patients were moved 175 miles on stretchers strapped to the fuselage of a de Havilland DH9 aircraft. A few years later, the French evacuated several thousand injured soldiers in confrontations with the Berber and Riffian tribesmen in Morocco.

Meanwhile, throughout the 1920s, military aeroplanes were used for disaster relief missions in the USA and, during the same period, the RAF operated an air ambulance service within a 100 mile radius of an airfield near to London. In 1933 the first UK civilian air ambulance service was instigated. Serving the Scottish Isles, the descendant of this service still operates today, carrying the sick and injured from the remote islands of Scotland to the mainland. Long distance, high altitude, aeromedical evacuation, however, was pioneered by the Luftwaffe. During the Spanish civil war (1936-41) they used trimotor Junkers JU 52 aircraft in missions lasting up to ten hours and flown at an altitude of 18 000 ft.

It was the Second World War, though, which heralded rapid advancement and created much work for the newly formed military casualty evacuation (casevac) organizations. Initially, the aeroplane supplemented ground and ship-borne evacuation of casualties but, in the latter years of the conflict, more than 90 per cent of allied casualties were evacuated by air. As more spacious aircraft became available, there was sufficient room for patient care to be continued in flight. In 1942 the US military began training flight transport personnel for the specific purpose of medical escort duties, and the first dedicated aeromedical unit (the 38th Medical Air Ambulance Squadron) was formed. Using transport aircraft such as the Douglas C-47 Skytrain and the C-54 Skymaster, over a million sick and wounded soldiers were airlifted to the United States during the last three years of the war.
The military continued to dominate the growth and development of aeromedical transportation in the immediate post-war period, a steady stream of conflicts and minor wars ensuring their interest. During this same period, other notable advances had a marked effect. The development of rotary wing aircraft was of particular significance because of their ability to operate in confined spaces. In fact, a helicopter was first used in the search and rescue (SAR) and casualty evacuation (casevac) role in Burma during the latter stages of the second world war. Lt Carter Harman, of the US Army Air Force, transported several wounded airmen near Mawlu in Burma on 23 April 1944. Details of this flight are not clear, but this WWII combat zone mission is believed to be the first time a helicopter was actually used to rescue and transport a trauma patient. However, the origin of the first helicopter SAR unit in January 1945 is well documented.

In an historic episode, a Sikorsky YR-4 helicopter (Figure 1.2) was dismantled at Wright Field, Dayton, Ohio in the USA, and flown half way around the world to Myitkyina, Burma where it was reassembled and flown over jungles and 5000 ft (1500 m) mountain peaks to accomplish its first mission. Although the original mission was to rescue downed aircrew, in the few days taken to airlift the helicopter and crew to Burma, these aircrew had already been rescued by ground forces.

However, soon after their arrival in Burma, news came in of a soldier who had accidentally shot himself through the hand with a .30 caliber machine gun while on duty at a weather station located on a mountain in the Naga hills, 160 miles northwest of Myitkyina. The soldier’s hand was rapidly becoming infected and no experienced medical personnel were available to treat it. It would have taken approximately ten days for the man to walk from the station to a location where he could have medical care. The possibility of parachuting a medical officer on to the mountain had been...
considered but the nature of the terrain would have made it virtually impossible to get him down alive.

So it was on 26 January 1945 that the first mission took place. The helicopter had no radio and, since the American pilots, Capt Peterson and Lt Steiner, were unfamiliar with the country, it was decided that they would be escorted by two light fixed wing aircraft (L-5) of the Air Jungle Rescue Unit. The mission necessitated refuelling stops en route and personnel of the Royal Air Force provided support at a remote jungle clearing. The helicopter flew at tree top level with an average air speed of about 60 knots while that of the L-5s was 30 to 40 knots faster. Consequently, the L-5 pilots were forced to circle continuously to keep the helicopter in sight.

Figure 1.2  Sikorsky YR-4 en route to the first helicopter casevac in Burma, 1945

Source: US AAF, from the National Air and Space Museum archives, Washington DC.

The patient was a 21 year old soldier, Private Howard Ross, of North Tonawanda, New York. Although he had received a radio message that help was on the way, he had absolutely no idea in what form it would take. Little was he to know of his notable role in the history of helicopter rescue. Contemporaneous reports state that ‘His hand was considerably swollen, but he was highly excited at his rescue. His recovery was uneventful.’ (Holmes, 2005).

After this proving mission, Capt Peterson and Lt Steiner returned to Myitkyina and began to instruct the Air Jungle Rescue Unit personnel in the operation and maintenance of the helicopter, thus forming the first ever dedicated helicopter SAR and casevac unit.

The British later used helicopters in the casevac role in Malaya, immediately after the cessation of WWII hostilities, but the first real large scale evacuation of wounded soldiers by helicopter occurred during the Korean war. The Bell-47 and Sikorsky
S-51 were used to ferry patients from battalion aid stations to waiting hospital units. Patients were strapped to litters outside the aircraft, and covered with a canopy to prevent injury from wind or rotor wash. Over 20,000 wounded servicemen were transported in this fashion.

However, the Vietnam War was the definitive showcase for demonstrating the efficacy of helicopter medical transport in improving care for the injured. Under the codename ‘Operation Dustoff’, and using dedicated squadrons of Bell UH-1 Iroquois (‘Huey’) aircraft (Figure 1.3), over 400,000 patients were airlifted to hospital during the conflict. For the first time, casevac helicopters were used for the rapid removal of injured troops from close to the point of wounding. Casualties were then transported rapidly to nearby expert and specialist medical care for definitive treatment. This concept was called ‘scoop and run’, and may have accounted, at least partly, for the much lower mortality rate of those wounded in this conflict when compared with those injured in previous wars.

Figure 1.3  Bell UH-1 Huey, first used in the casevac role in Vietnam

Civilian applications

The success of the military approach to casualty evacuation during the Korean and Vietnam wars, and the immediacy of television news coverage, brought the aeromedical helicopter much public attention. It was soon realized that the helicopter might have an important contribution to make in civilian medical practice. Closely following the well-publicised wartime successes of helicopters, a dramatic rescue occurred in New York during the summer of 1951. A steeplejack fell on to the roof of St. John’s Cathedral and refused to be lowered to the ground by ropes. Captain Gustav Crawford of the New York Police Aviation Bureau landed his helicopter on
the roof of St John’s and the casualty was strapped to the outside of the aircraft and flown to nearby Riverside Park where he was transported by ground ambulance to hospital.

The helicopter’s ability to retrieve the injured from remote, inhospitable or difficult terrain is now well known, but probably the first of all of the world’s civilian helicopter air ambulance services was the Swiss Air Rescue Association (known as REGA). REGA was using a piston powered helicopter for limited medical use in 1952 and, in 1968, added turbine powered helicopters to provide better performance in the mountainous terrain.

A later development was the use of helicopters in the rapid retrieval and transportation of the sick and injured in urban environments. Belgium was one of the first countries to realize the importance of helicopter air ambulances in 1963, but they used military helicopters. The same lessons were being learnt in the USA and, by 1965, the Helicopter Emergency Lifesaving Patrol (HELP) project was set up in Philadelphia. At the time, HELP was unique in that its air ambulance service to the Delaware Valley area was achieved by matching medical personnel from a local Hospital (Lankenau) with a commercial (Atlantic Refining Company) traffic reporting helicopter. However, by late 1967, Superior Ambulance Service in Westland, Michigan had started a dedicated commercial helicopter ambulance service using a Bell 47 to support local hospitals.

Two years later, the first combined emergency services helicopter unit was formed in the USA. In 1969, the Maryland State Police and the University of Maryland began a police/rescue/HEMS (helicopter emergency medical service) service covering their entire state. It is said that the helicopters were first introduced to improve patient outcome in what was called the ‘neglected disease of modern society’. This phrase was coined in a report by the US National Research Council which revealed that accidents were the leading cause of death in those under 37 years of age. During this time, federally funded projects were conducted through the United States Department of Transportation’s National Highway Traffic and Safety Administration to study the feasibility of civilian aeromedical transport programs. Several problems in establishing these services were identified, including tenuous economic viability, the need to dedicate the aircraft to a medical configuration, and the need to integrate the programs into the ground emergency medical systems (EMS). Concurrently, civilian law enforcement agencies and fire departments were developing aviation components to assist in their primary missions. Though not initially designed for air medical duties, these public service programs were occasionally providing the means for such flights.

Europe was following suit and it was the Federal Republic of Germany that was the first country to instigate a major, nationwide service in 1970 (known as ADAC). During the same year the United States Departments of Defense and Transportation began a pilot program called Military Assistance to Safety and Traffic (MAST), first implemented at Houston in Texas, its raison d’être was to provide air medical transportation to rural traffic.
The first of the dedicated hospital based helicopter systems (in which the aircraft is leased or owned by a hospital or consortium) was formed at Saint Anthony Hospital in Denver, Colorado in 1972. This service was called ‘Flight for Life’ and was the model for what ultimately became the largest type of HEMS service in the world. By 1978 there were still fewer than 20 hospital based helicopter programs in the United States. Second generation programs blossomed in the early 1980s amidst increasing governmental interest in aeromedical transport and driven by the cost of aircraft and medical technology. Most programs operated at a loss, and initial data regarding the impact of transport by air began to appear. What had been a predominantly trauma oriented field was expanded to include neonatal, obstetric, and cardiac patients. As a result the number of interhospital flights increased significantly. Since then, there has been a dramatic growth in emergency medical helicopter systems with 170 programs reported in 1992. Collectively, these services have transported 728 000 patients over 92 million miles. A conservative estimate notes that 73 000 patients in the United States owe their lives to helicopters. It has also been estimated that over the past 40 years, a million lives have been saved as a result of all types of aeromedical transport.

Figure 1.4 Britain’s first helicopter air ambulance, First Air in Cornwall (courtesy Cornwall & Isles of Scilly Ambulance Service)

In Europe, too, the lessons learned from battlefield casualty evacuation were put to good use. The Service d’Aide Médicale Urgente (SAMU) was created in the 1960s by French anesthesiologists aware of the high prehospital mortality rate of multiply injured patients. The governments of Switzerland and Germany financed studies to determine the feasibility of incorporating helicopters into emergency medical systems and soon established combined military and civilian networks to cover all major highways and special risk areas such as large cities, coastline and mountainous terrain. In the UK, the 1980s saw the development of, first, a paramedic crewed urban/coastal EMS
helicopter (Figure 1.4) in Cornwall, soon followed by the London based Helicopter Emergency Medical Service (HEMS) which carries both a paramedic and doctor on every flight. Despite controversies over efficacy and costs, medical helicopter systems continue to proliferate, with 15 organizations operating in the EMS role in Great Britain in 2005. However, some parts of the country still have no service at all, and in others the coverage is not seven days a week. The Automobile Association (AA) has sponsored a new charity – the National Association of Air Ambulance Services (NAAS) – with an aim to help local charities to upgrade these systems, combined with a rolling programme to provide helicopters for areas not yet covered.

### Fixed wing development

The recent history of civilian fixed wing aeromedical transport is more difficult to trace. Often these organizations are hidden from the public view by the media appetite for helicopter operations. However, the growth of international civil aeromedical transportation has been driven by rapid advances in the technology and availability of mass transportation. Larger and faster passenger carrying aircraft have brought cheap, affordable and accessible travel to millions of people throughout the world. Rapid airline growth in the post-war years and commercial exploitation have brought the most exotic corners of the Earth within reach of tourists and business travelers alike. Among these are a number who become ill or injured whilst abroad, some requiring repatriation on compassionate grounds, and others for specialist treatment. Numerous dedicated civilian medical assistance and air ambulance companies now exist (Figure 1.5). In the main, they operate in association with travel insurers, and arrange medical flights, worldwide, using fixed wing aircraft.

**Figure 1.5** Dedicated air ambulance (ShandsCair, Florida)
References