Profile and outcomes of patients transported to an accident and emergency department by helicopter: prospective case series

TW Wong, CC Lau

Objectives. To study the profile of airlifted patients and their outcomes after arrival at the hospital, and to evaluate the appropriateness of their prehospital care and the decision to use aeromedical evacuation.
Design. Prospective case series.
Setting. Accident and emergency department of a public hospital, Hong Kong.
Patients. All patients transported to the department by a helicopter of the Government Flying Service from June 1998 through November 1998.
Main outcome measures. Demographic data, sources and locations of referral, clinical features, triage category, interventions used, and outcome.
Results. A total of 186 patients were transferred by helicopter during the 6-month study period. The 101 patients who had been transferred from a rural hospital or clinic were older (mean age, 50 years versus 35 years), comprised more females (55% versus 26%), had a higher overall mortality rate (19.8% versus 3.6%), and had a higher hospital admission rate (91.1% versus 37.6%) than the 85 patients who had been airlifted from the scene of an emergency. Neurological disorders were the most common presentation among interfacility transfers (21.8%). Among the 85 scene transfers, limb injuries (32.1%) and heat illnesses (24.4%) were the most common reasons for helicopter transport. Most interfacility transfers were appropriate, but 34.1% of patients who had been transferred from the scene of the emergency were later discharged and 21.1% refused consultation.
Conclusions. Scene and interfacility transfers by helicopter have different patient profiles, and a substantial proportion of scene transfers may be inappropriate. Guidelines such as field triage and helicopter dispatch criteria need to be established.

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Key words: Air ambulances; Emergency medical services; Patient transfer; Transportation of patients; Wounds and injuries

Introduction

Hong Kong has many outlying islands and mountains that have no immediate access to medical facilities. As a result, patients often need to be transported to medical facilities either by boat or by helicopter. Helicopters are often used if an emergency transfer is required, as dictated by the situation. The helicopters are operated by the Government Flying Service (GFS), which provides medical evacuation and other services. This facet of local prehospital care has not been studied before. This study aimed to describe the profile of airlifted patients and their outcomes after arrival at the hospital.

Study setting

The Pamela Youde Nethersole Eastern Hospital (PYNEH) is designated by the Hospital Authority for receiving patients who are transferred by helicopters. The PYNEH Accident and Emergency (A&E) Department is a 24-hour facility and had a daily attendance of approximately 500 patients during the study period. The GFS operates from a site that is on the southwestern edge of the Hong Kong International Airport. There are nine helicopters (six Sikorsky S76 and three

Accident and Emergency Department, Pamela Youde Nethersole Eastern Hospital, 3 Lok Man Road, Chai Wan, Hong Kong
TW Wong, FRCS (Edin), FHKAM (Emergency Medicine)
CC Lau, MRCP, FHKAM (Emergency Medicine)

Correspondence to: Dr TW Wong

S70 Blackhawks) and two fixed-wing aircraft. The GFS is responsible for the search and rescue operations within the 400-mile radius of the Hong Kong Flight Information Region. It can dispatch a helicopter in less than 20 minutes after receiving an emergency call. The aircrew are trained in first aid.

Patient transfer can be initiated by a rural hospital or clinic, or through the police emergency '999' hotline. The GFS pilots will pick up the patient at a specified site and transfer him or her to a helipad at Siusaiwan. Inside the helicopter, oxygen and first aid equipment are available. An ambulance will be mobilised to transfer the patient to the PYNEH from the helipad. A nurse escort may be available for cases transferred from a rural medical facility. However, these nurses are not trained as flight nurses. The rural clinics will usually call to alert the hospital, if a case is being transferred. There is no direct communication between the pilot and the hospital; information is often routed indirectly via ambulance control.

Methods

All patients transported to the PYNEH A&E Department by GFS helicopter from June 1998 through November 1998 were included in this study. Data collected included patient demographics, departure location, and primary medical facility (for secondary transfers). The flight time was estimated from the medical and ambulance records for cases of secondary transfer. The ambulance travel time was recorded based on ambulance records. Preflight vital signs and interventions were recorded based on medical records. When a patient arrived at the A&E Department, the vital signs, triage category, interventions used, and outcome were documented. Clinical problems that led to the transfer were also recorded. Using the information available, the authors then assessed whether the referring diagnosis and decision to transfer were justified, and whether the initial treatment had been appropriate. The data were analysed by using the Statistical Package for Social Science (Windows version 8.0; SPSS Inc., Chicago, United States).

Results

During the 6-month study period, 186 patients were transferred by helicopter to the PYNEH A&E Department. There were more secondary transfers (n=101) from rural hospitals or clinics (all situated on the outlying islands) than there were primary transfers (n=85) through a police '999' hotline. Patients who had been transferred from a hospital or clinic were older and comprised more females than patients who had been transferred from the scene of the emergency (Table 1). The locations of calls for non-clinic cases are shown in Table 2. Slightly more than half of the cases were from the rural New Territories, while sea rescues accounted for approximately 19% (16/85) of cases.

Secondary transfers from hospitals or clinics

Prior contact was established in only 89 (88.1%) of the 101 transfers. Mean flight and ambulance time intervals were 21 and 12 minutes, respectively. The nature of the clinical problems are shown in Table 3. Neurological problems such as stroke and coma were the most common presentation (21.8%). Six patients responded only to painful stimuli and 14 were unresponsive. Pregnant women in early labour constituted approximately 19% of the transfers. There were seven cases of cardiac arrest, but only four patients were intubated before their flight. Approximately 46% of patients were given oxygen and 44% had an intravenous line inserted during the interfacility transfer.

Table 1. Characteristics and outcomes of airlifted patients

	Secondary transfer, n=101	Primary transfer, n=85	Overall, n=186
Mean age (years)	50	35	44
Males : females (%)	45:55	74:26	58:42
Prior contact (%)	88	-	47
Mean flight time (min)	21	-	19
Mean ambulance time (min)	12	15	13
Triage category (%)			
critical	40.8	26.5	34.3
emergency	27.6	9.6	19.3
urgent	26.5	16.9	22.1
semi-or non-urgent	5.1	47.1	24.3
Outcome (%)			
admitted	91.1	37.6	66.7
discharged	1.0	34.1	16.1
died	5.9	2.4	4.3
discharged against medical advice	2.0	4.7	3.2
refused consultation	0	21.2	9.7

Table 2. Locations of '999' calls for helicopter transfer in Hong Kong

Location	No. (%)
New Territories	44 (51.8)
Outlying islands	
Lantau	16 (18.8)
Peng Chau	3 (3.5)
Lamma	3 (3.5)
Hei Ling Chau	1 (1.2)
Subtotal	23 (27.0)
High seas	14 (16.5)
Hong Kong seas	2 (2.4)
Hong Kong Island	1 (1.2)
Kowloon	1 (1.2)
Total	85

Table 3. Reasons for patient transfer by helicopter

Reason/system affected	Patients	
	Secondary transfer No. (%)	Primary transfer No. (%)
Central nervous system	22 (21.8)	11 (14.1)
Labour	19 (18.8)	0
Cardiovascular	12 (11.9)	5 (6.4)
Respiratory	12 (11.9)	1 (1.3)
Gastro-intestinal	8 (7.9)	4 (5.1)
Cardiac arrest	7 (6.9)	2 (2.6)
Limb injury	5 (5.0)	25 (32.1)
Sepsis	4 (4.0)	0
Drug overdose	4 (4.0)	0
Metabolic	3 (3.0)	1 (1.3)
Head injury	3 (3.0)	1 (1.3)
Allergy	1 (1.0)	1 (1.3)
Near-drowning	1 (1.0)	0
Heat illness	0	19 (24.4)
Bee sting	0	4 (5.1)
Burn	0	4 (5.1)
Total	101	78*

* Reason for seven patients not known

On arrival at the A&E Department, 10 patients were intubated. Other interventions are listed in Table 4. Most patients were triaged as having critical, emergency, or urgent conditions (Table 1). Almost all patients (92/101; 91.1%) were admitted, and six were pronounced dead at the A&E Department. Most patients were admitted to either the medical (56%) or the obstetric (19%) unit. Fourteen patients died after admission, giving an overall mortality rate of 19.8%. Twelve patients were transferred to another hospital for rehabilitation and three discharged themselves against medical advice. The length of stay was 4 days or less for approximately 67% (42/63) of the patients who survived to discharge from the PYNEH.

The authors agreed with the referring diagnosis in 86.7% of the 101 cases. In 16.8% of cases, however, there was doubt as to whether helicopter transfer was justified. The management prior to transfer was judged to be either inappropriate or of dubious quality in 11 (10.9%) and 8 (7.9%) cases, respectively.

Table 4. Medical interventions in the Accident and Emergency Department

Intervention	Patients	
	Secondary transfer No. (%)	Primary transfer No. (%)
Airway management	1(1)	1 (1.2)
Oxygen administration	53 (52.5)	17 (20.0)
Endotracheal intubation	10 (10)	5 (5.9)
Intravenous fluid/s given	52 (51.5)	25 (29.4)
Bleeding control	2 (2.0)	1 (1.2)
Cardiopulmonary resuscitation	2 (2.0)	1 (1.2)
Total	101	85

Primary transfers from the scene of an emergency

The pattern of problems of 78 of the 85 patients who had been transferred from the scene of the emergency was very different from those who had come from a hospital or clinic (Table 3). Injuries, especially of the limbs (32.1%), were the most common reason for transfer. Heat illnesses, including two cases of heat stroke, were also common. There were two cases of prehospital cardiac arrest.

A substantial proportion (47.1%) of patients was triaged as having semi- or non-urgent conditions. Many patients (18; 21.1%) refused to be seen by a physician upon arrival; most of these patients were hikers who had lost their way in the mountains. Only 37.6% of patients were admitted, in contrast to the 91.1% admission rate of the patients who had come from a hospital or clinic. In 47 (55.3%) cases, the authors were doubtful as to whether air evacuation to a medical facility was really necessary. Five patients were intubated in the A&E Department and cardiopulmonary resuscitation was started in one case. Other interventions are shown in Table 4.

The two patients with cardiac arrest were pronounced dead in the department and one patient with heat stroke died after admission. The overall mortality rate was 3.6%. Five patients (three with significant burn injuries) were transferred to another hospital for further treatment, and three patients discharged themselves against medical advice. Of the remaining admitted patients, more than half (54.2%) stayed for 4 days or less.

Discussion

The use of helicopters to evacuate trauma patients became popular after the success of this mode of patient transfer in the retrieval of casualties in the

Korean and Vietnam wars. Much has been documented on the benefits of airlift in the management of trauma cases, although in the urban environment there may not be any real advantage.[1] In a study performed in London, the helicopter case-load survival rates were the same as for comparable patients who were attended by land ambulances that were crewed by paramedics.[2] A study from the United States has found the cost-effectiveness of helicopter transport (assuming that it provides a significant survival benefit) to be substantially higher than that of other commonly used life-saving medical interventions.[3] In rural areas, where facilities for treating severely injured patients are not available, air evacuation may prove to be life-saving.[4] In this study, trauma (limb and head injury) patients comprised only 18% (8% for interfacility and 31% for scene transfers, respectively) of airlifted patients, which is similar to the figure reported in a study from rural Norway (19%)[5] but less than that of Papua New Guinea (35%).[6]

There are three main reasons for using aeromedical transfer: time critical injury or illness; lack of resources to deal with the problem in local facilities; and the accident site being remote or inaccessible.[7] In Hong Kong, the referring source determines whether helicopter transfer is required. There is no written guideline on what kind of patients should be transferred. In a 2-year study in Norway involving 370 patients, only 11.1% of transfers were judged to have benefited from the airlift.[5] The greatest benefits were gained in complicated deliveries and children with respiratory problems or severe infections. Women in labour also constituted a substantial proportion (18.8%) of secondary transfers in this study. Many of these women, however, were in early labour only. No delivery was needed during helicopter transport or at the PYNEH A&E Department. A similar experience was reported in a study from the United States in which no inflight delivery was necessary among the helicopter transfer of 315 women in active labour and 72 women in the accelerated phase of labour.[8] Transport by boat is an alternative option in Hong Kong since the travel time in most cases will be only 1 to 2 hours.

The interfacility transfers in this study showed a predominance of neurological disorders, a large proportion of which was acute stroke. A series from the Mayo Clinic was found to include 20% neurological cases, three quarters of which were cases of stroke.[9] A similar pattern was seen in a study in which neurological cases comprised 11% of 85 cases reviewed.[10] In this study, paediatric transfers were mostly because of neurological conditions, such as febrile convulsions, which required more sophisticated investigations in the hospital. Cardiovascular cases comprised only 11.9% of the series, which is less than the figure reported from the Mayo Clinic, where myocardial infarction was present in 22% cases and other cardiac causes in 16%.[9] In the Norwegian study, 43% of patients who were transferred by helicopter had cardiovascular disease; however, the health benefit was found to be small.[5] Thrombolytic therapy is not an available option in the rural medical facilities of Hong Kong. The mean prehospital transfer time for secondary transfers was 33 minutes, so there may be some benefit if patients with acute myocardial infarction were transported by air to decrease the delay.

All nine patients in this study who had cardiac arrest died. Cardiopulmonary resuscitation usually provides no benefit.[10] In a series with 84 prehospital cardiac arrests, only one patient survived to be discharged home.[11] If a physician is available, it is probably sensible to certify the patient if initial resuscitation is unsuccessful. For patients who survive a cardiac arrest, however, transfer to a tertiary centre may be beneficial. A retrospective study has recently demonstrated favourable outcomes for patients with primary cardiac disease.[12]

The PYNEH system is rather unique in that no flight paramedics or nurses are involved in the helicopter transfer of patients. For flights from the scene of an emergency, the aircrew have to handle the patient without medical assistance. Sometimes, however, patients require interventions that are beyond simple first aid (Table 4). Even nurse escorts from the referring rural facilities are not trained in aeromedical transfer. There is clearly room for improvement. Flight physicians are often not employed, although they may contribute critical judgement in diagnosis and treatment.[13,14] It may not be cost-effective to engage a physician in the flight programme, because there may not be enough medical work available. In this study, there was an average of only one medical evacuation per day. A self-study from the United States found that only 33% of the duty time of an emergency aircrew was spent flying or providing patient care.[15]

Paramedics or flight nurses who work under well-established protocols are as effective as emergency physicians.[16] In early 2000, the Hong Kong College of Emergency Medicine, with the help of the GFS and Hospital Authority, invited overseas and local experts to organise a training programme on aeromedical transfer. Emergency physicians from local A&E

departments were trained, and 24 volunteered to provide inflight medical cover during weekends and public holidays in a pilot programme, which was started in August 2000. With the future establishment of a regional hospital in Tung Chung, however, it may be feasible to include a flight nurse or a physician from an A&E department when needed. The dispatch time for the helicopter is less than 20 minutes and there should be enough time for A&E staff to join the helicopter team. Special training would need to be given to such staff, because special skills and equipment are required to operate safely and effectively within a helicopter.[17] As an alternative, it may be feasible to train some ambulance crew in the Tung Chung area as flight paramedics. For the time being, before flight paramedics or nurses are made available, direct communication with the hospital from the scene of the emergency provides the best support for the aircrew. Further studies are required to determine which combination of staff is more cost-effective.

Whether a helicopter transfer is appropriate or not is very difficult to assess, because there are no well-established guidelines. Physiological scores have been used to assess the severity of an illness or injury and thus the appropriateness of transfer.[18] These scores can also be used to compare the patient mixes of different air ambulance programmes. If rates of admission to the PYNEH A&E Department and triage categories were used as a proxy, most secondary transfers in this study were deemed appropriate. The same cannot be said about patients who were airlifted from the scene, of which 34.1% were discharged and nearly 21.2% refused consultation (Table 1).

Triage guidelines thus need to be developed for scene transfers in Hong Kong. For secondary transfers, direct interfacility communication before the transfer would help in deciding what route to take and how the patient should be prepared. For scene flights, dispatch requests are usually routed from the Fire Service Command Centre. A set of guidelines may also be helpful to decrease unnecessary flights to the hospital. It is reported that an audit mechanism can decrease the number of transfers from the scene for trauma cases.[19] Certainly, for quality assurance purposes, an audit should be in place to evaluate both the process and outcome of care.

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