

Air Medical Transport of Cardiac Patients in Nova Scotia

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Objective: To perform a descriptive program review of the air medical transport (AMT) of cardiac patients within Nova Scotia's air medical transport program. **Methods:** A retrospective study of patients with primary, non-traumatic cardiac conditions transported by the provincial air ambulance program between August 1, 1997 and August 31, 1998, who are 16 years of age or older (non-pediatric). Various aspects were examined, including diagnosis, geography of transport, medications given by the air medical crew (AMC) and by sending institution, complications of transport and interventions performed by the AMC as well as total time spent at the sending institution by the AMC. Data was extracted from the flight patient care records (PCR) with full preservation of patient confidentiality. **Results:** The AMT program transported a total of 240 patients during the study period. Of these a total of 155 patients (64.6%) were 16 years of age or older. Of that total, 46 had a primary cardiac diagnosis (29.7%): 34 were male (73.9%) and 12 were female (26.1%). The mean age of these transported patients was 62.4±10.0 years and 59.1±17.6 years for males and females respectively. Most cardiac patients were diagnosed with a myocardial infarction (22 patients, 47.8%), with the remaining patients diagnosed with unstable angina, peri-cardiac arrest, congestive heart failure (CHF) or primary arrhythmia. Only 12 of the patients diagnosed with myocardial infarction (MI) had previously been treated with thrombolytics (54.5%). Heparin and intravenous nitroglycerine were the medications most commonly maintained by the AMC, while morphine, midazolam, nitroglycerine and dimenhydrinate were common medications given by the AMC. Twenty-three patients experienced some form of in-flight complication or change in condition, with bradyarrhythmias being the most common (23.9%). Nine patients were intubated by the referring hospital or by the AMC prior to departure and maintained as such throughout the flight. The average amount of time spent at the referring hospital packaging each patient was 64.07 minutes. **Conclusions:** This paper describes the demographics of the cardiac population utilising air medical transport in Nova Scotia. Cardiac patients comprise a large proportion of the total patient cohort in the AMT program (almost one-third) in the adult population transported. Recognition of this fact, in conjunction with review of provincial, tertiary-care, cardiac transfer policies has led to the development of specific cardiac AMT indications for Nova Scotia.

INTRODUCTION

The use of helicopters for transport of patients has grown dramatically in North America over the last two decades since the institution of the first civilian air ambulance program at St. Anthony's Hospital in Denver, Colorado in 1972.¹ Used initially as a means to deliver trauma patients quickly to definitive care, as demonstrated in the Korean and Vietnam wars, the use of rotor-wing (helicopter) programs has expanded to include medically-compro-

mised patients. This use of air transport has expanded in medical patients as time-dependent interventions have become standard of care; e.g. thrombolysis in acute myocardial infarction. Ontario's "Band-Aid One" air medical transport (AMT) program has completed its 23rd year of service, representing the oldest helicopter ambulance system in Canada. As of June 1996, Nova Scotia implemented an AMT system. This program involves the transport of patients from rural or regional hospitals, or from the scene of a trauma or illness, to the tertiary care centres in Halifax. AMT allows faster transport of patients, decreases out-of-hospital time, and offers advanced levels of critical care to the patient during transport and/or at a scene of a

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Table 1. Age of Cardiac Transport Patients

Age (years)	Male (%)	Female (%)
<30	0	1 (2.2)
31-50	5 (10.9)	4 (8.7)
51-65	16 (34.8)	3 (6.5)
>65	13 (28.3)	4 (8.7)
Total	34 (73.9)	12 (26.1)
Mean Age	62.4	59.1

trauma.² The Nova Scotia program is staffed 24 hours/day by advanced level paramedics, critical care nurses, respiratory therapists and experienced pilots. As well, dedicated obstetrical nurses are available to fly for high-risk obstetric cases.

Nova Scotia is ideally suited to rotor-wing transport since it is poorly served with fixed-wing airports and helicopters can land directly at the hospital or at the scene. The rough geography of the province often prolongs ground transport of critically-ill patients and increases overall out-of-hospital time. As well, for smaller, non-regional hospitals or health care centres, the use of the critical care transport team in the helicopter preserves the community's resources when moving a critically-ill patient since the local medical doctor or nurse does not have to go with the patient. With only two tertiary care centres in Nova Scotia, both in Halifax, this provincially-integrated AMT program is necessary to ensure access to appropriate and timely care by those living in rural and remote areas.

Cardiac patients have been thought to account for a significant number of the inter-hospital transfers within the AMT program. To date, only limited studies have been performed to examine the specific role of AMT in the transport of cardiac patients.²⁻⁶ Werman et al² evaluated those patients transported by helicopter after cardiac arrest (of varying etiologies) and found that survivors of a primary cardiac event had a favourable outcome when transferred to tertiary care by air compared to a similar ground cohort.² Jones et al³ studied the potential role of rural-scene AMT of patients with chest pain and suspected acute coronary syndromes and concluded that the AMT of rural patients with chest pain appeared promising in regard to timely interventions such as primary angioplasty or thrombolysis.³ Another retrospective review of inter-facility AMT of patients with acute coronary syndromes compared AMT patients with a matched ground transport group. No advantage to AMT was found in regard to length-of-stay or mortality, suggesting that further study was warranted to define sub-groups of patients (rural, remote, etc.) who may benefit most from AMT.⁴ A retrospective review of the role of AMT in primary rural cardiac arrest was performed by Lindbeck et al.⁶ None of the AMT cases had any pre-arrival intervention, apart from basic life support (BLS), and their conclusion was that AMT had no independent effect upon

Table 2. Referring Diagnosis of Cardiac AMT Patients

Diagnosis	No. (%)
Unstable Angina	14 (30.4%)
MI	22 (47.8%)
Acute MI	18 (39.1%)
Post MI Angina	4 (8.7%)
Congestive Heart Failure	4 (8.7%)
Peri-arrest	5 (10.9)
Primary Arrhythmia	1 (2.2%)

survival. This is not surprising considering that there was no access to immediate defibrillation in this cohort.

With these issues in mind, a descriptive review of cardiac AMT in the province of Nova Scotia was performed to measure and evaluate the utilisation of this program by primary cardiac patients. This data was subsequently used in defining proper use of the AMT program in tertiary care transport of patients within the parameters of the provincial tertiary care cardiac triage system currently in use at the QEII Health Sciences Centre by the Division of Cardiology.

METHODS

A descriptive review of the provincial AMT program was conducted to evaluate transport of cardiac patients. This retrospective study included all non-traumatic cardiac patients, over the age of 16, transported between August 1, 1997 and August 31, 1998. The AMT program uses a Sikorsky 76A twin-turbine helicopter with two pilots at all times for patient transport. The team used for this cohort of patients consisted of a critical care nurse and an advanced paramedic level three (P3). On-line medical control is provided by tertiary care emergency physicians with extensive experience in AMT. Once a call has been made and the necessity of the transport has been approved by the medical control physician, the helicopter is dispatched to the referring facility or scene. The entire communication and dispatch procedure is performed through a centrally-located communications centre in Bedford which is fully integrated with the ground ambulance system.

AMT patient care records for this time period were reviewed by hand to extract the appropriate data. Information regarding age, gender, geography of mission, diagnosis, medical therapies maintained by the AMC, medical therapies initiated by the AMC, intubation and in-flight complications were recorded and tabulated. Furthermore, information regarding the total length of time spent on scene by the AMC was measured.

RESULTS

The AMT program transported a total of 240 patients, of which 155 were 16 years or older. Forty-six of the 155 adult patients had a primary cardiac diagnosis (29.7%); 34 of these patients were male (73.9%) and 12 (26.1%) were female. Of the male patients, the majority were between 51 and 65 years of age (34.8%), with none less than 30 years of age. The fe-

male patients were evenly spread among the age groups over 30 (Table 1). The mean age for transported cardiac patients was 62.4±10.0 years and 59.1±17.6 years for men and women respectively.

The most common referring diagnosis for AMT cardiac patients was myocardial infarction (MI). Twenty-two patients (47.8%) were transported for an MI, of which 18 (39.1%) were for acute MI and four (8.7%) were for post-MI-related angina. The remaining patients were diagnosed with unstable angina (30.4%), congestive heart failure (CHF) (8.9%), peri-arrest (10.9%) or primary arrhythmia (2.2%) (Table 2). Of the patients diagnosed with a MI, only 12 (54.5%) had been treated at the sending institution with thrombolytic therapy.

All of the 46 patients who were air transported were inter-facility transfers, with no transfers in this cohort from scene or remote areas (outside of hospitals) although such utilisation of rotor-wing service is described in the literature.³ Nova Scotia, at the time of this review, was divided into four health care regions (Central, Eastern, Northern and Western). These regions, with their regional hospitals, also comprised the geographical basis of the provincial cardiac triage system for the tertiary care cardiac centre (QEII Health Sciences Centre). The Eastern Region constituted the major area of referral, with 27 (58.7%) cardiac patients referred from this region (Table 3). This corresponds to the population base of the referring regions and the greater distance from tertiary care for the larger regional hospital (Cape Breton Regional Hospital) in the Northern Region.

Forty-three of the 46 patients (93.5%) were transported to the QEII HSC. Of the three remaining patients, one (2.2%) was transported to each of the following locations: Maine, USA; Cape Breton Regional Hospital (Eastern Region); and Kentville (Western Region). The latter two were intra-regional transports using AMT (Table 3).

There were a variety of medical therapies, initiated by the referring hospital, which were maintained by the AMC. Intravenous nitroglycerine and heparin were the two most common medications maintained in transported patients, 27 (58.7%) and 32 (69.6%) respectively. There were also a variety of medications that were initiated or dosages increased by the AMT team. Morphine, midazolam, nitroglycerine, and dimenhydrinate were the most common of those medications that were initiated by the AMC. Table 4 outlines all of the medications maintained and initiated by the AMC.

Of the 46 cardiac patients who were transported, nine (19.6%) were intubated throughout the flight, all of whom were initially intubated at the referring hospital. No patients were intubated in flight by the AMC.

Twenty-three of the 46 cardiac patients (50.0%) had a complication or a change in condition while in flight, as follows: hypotension, which was defined as a systolic blood pressure <90 mmHg, was experienced by 10 patients (21.7%); 11 patients (23.9%) had periods of bradycardia (heart rate below 60 beats per minute); eight patients (17.4%) had periods of tachycardia (heart rate above 100 beats per minute); and arrhythmias occurred in five patients (10.9%) during the flight (Table 5).

Table 3. Geography of AMT of Cardiac Patients

Region	From	To
Central	2 (4.3%)	
Eastern	27 (58.7%)	1 (2.2%)
Western	6 (13.0%)	1 (2.2%)
Northern	9 (19.6%)	
QE II (Halifax)		43 (93.4%)
Other	2 (4.3%)	1 (2.2%)

Arrhythmias were classified as any abnormality in baseline, pre-transport, cardiac rhythm. Of the five patients who experienced in-flight arrhythmias, two had premature ventricular contractions, one had an irregular sinus rhythm, one had premature atrial contractions and one had ventricular tachycardia. None of the patients was treated for these arrhythmias in flight.

Finally, the length of time spent by AMC at the referring institution was determined. The average amount of time spent by the AMC on scene was 64.07 minutes (range of 20-199 minutes). This time included receiving report, assessing the patient, stabilization (if indicated), packaging the patient, transferring medications to AMT-compatible equipment, and discussion with on-line medical control.

DISCUSSION

The purpose of this study was to review the transport of adult cardiac patients in Nova Scotia by the AMT program in order to provide an overview of the program's clinical accomplishments. Cardiac patients represented almost one-third (29.7%) of all AMT patients during the study time period. This is a significant part of the adult (16 years of age and greater) AMT program. The largest percentage of the cardiac patients were males between the ages 51-65 (34.8%). Men over the age of 65 were the second most common AMT cardiac patients (28.3%), which also corresponds with the disease pattern. Women comprised a smaller proportion of those transported by AMT (26.1%).

All of the cardiac patients flown within this time-frame were inter-hospital transfers. The majority of patients transported were diagnosed with an MI (47.8%), with the largest proportion being an acute MI (39.1%). Of the patients diagnosed with an MI, just over one-half had received thrombolytic therapy prior to transport (54.5%). The percentage of patients who had been thrombolysed was expected to be greater. Thrombolytic therapy represents standard of care for acute MI and is available in all hospitals in Nova Scotia. It would be expected that the majority of patients experiencing an MI would receive thrombolytic therapy as part of their first-line treatment. The explanation for the relatively small number of patients receiving thrombolytics prior to transfer requires further study. It is possible that the cohort of MI patients transferred by AMT represented a particularly ill subgroup of patients who were being sent to tertiary care for consideration of primary angioplasty or who had contraindications to thrombolysis (referral bias).

Patients diagnosed with unstable angina represented

Table 4. Medications Maintained and Initiated by AMC

Maintained	Pre-flight (AMC Initiated)	In-flight (AMC Initiated)	Increased Dosage
heparin - 32	dimenhydrinate - 7	midazolam - 7	nitroglycerine - 5
nitroglycerine - 27	morphine - 7	morphine - 3	dopamine - 2
dopamine - 8	midazolam - 7	nitroglycerine - 2	dobutamine - 1
dobutamine - 1	lorazepam - 6	lorazepam - 1	
metoclopramide - 1	furosemide - 4	haldoperidol - 1	
lidocaine - 2	nitroglycerine - 4	diazepam - 1	
amiodarone - 1	acetylsalicylic acid - 1	fentanyl - 1	
streptokinase - 1	salbutamol - 1		
methylprednisone - 1	ipratropium bromide - 1		
	tetanus toxoid - 1		

the second largest percentage of AMT cardiac patients (30.4%). Discussion at the end of the study with Dr. Chris Foster, Division of Cardiology, QEII Health Sciences Centre, resulted in re-classifying many of these relatively stable patients, on heparin infusions awaiting cardiac catheterization, as non-AMT candidates. Individual cases with clinical syndromes of acute coronary syndromes, such as accelerated pain patterns or rise in cardiac enzymes, may make some of these patients candidates for AMT. However, the general utilisation of AMT for transport of unstable angina patients to tertiary care from regional hospitals does not seem justified at this time since it would potentially overwhelm this single helicopter program that also serves the Atlantic community for neonatal, obstetrical, pediatric, trauma and all other critically ill patients. The three other diagnostic groups identified, refractory CHF, peri-arrest cases and primary unstable refractory arrhythmias, represented a considerably smaller percentage of transported patients.

There were a number of medications that were maintained by the AMC during transport. The two most commonly used medications were heparin (69.6%) and intravenous nitroglycerine (58.7%). Both of these medications are used for patients experiencing unstable angina or myocardial infarctions. Other medications that were maintained were used for arrhythmias (i.e. amiodarone and lidocaine) or to improve hemodynamics (i.e. dopamine and dobutamine). Medications were also initiated or dosages increased in a number of patients. Medications to relieve pain, maintain airway and treat volume overload were also given.

Nine out of the 46 patients were intubated prior to transport and this was maintained throughout flight, thus demonstrating the need for advanced critical care skills within the AMC. In-flight complications or changes in condition were experienced by 34 of the patients (50.0%). These complications consisted of hypotension, bradycardia, tachycardia and

Complication	No. (%)
Bradycardia	11 (23.9%)
Tachycardia	8 (17.4%)
Hypotension	10 (21.7%)
Arrhythmia	5 (10.9%)
Total	34 (50.0%)

Table 5. In-Flight Complications

arrhythmias. Of these, bradycardia was the most common complication. No significant sequelae resulted from these minor complications. No cardiac arrest occurred in flight, which implies the inherent safety of cardiac AMT that has been confirmed in other studies.^{2,7}

The amount of time spent by the AMC on site averaged 64.07 minutes. On-scene time has been most often studied for scene transport of trauma patients from motor vehicle collisions, but is advertised by AMT programs as a basic tenet of all transports. However, out-of-hospital time is a better measure of ensuring safe transport of critically-ill medical patients. Decreasing on-scene times should never take precedence over good patient care and packaging (Guidelines for the Transfer of Critically Ill Patients).⁸ The back of an in-flight helicopter is a difficult environment to institute advanced life support interventions (such as intubation) that should have been performed prior to leaving a sending institution. Specific transport times (out-of-hospital times) were not measured in this study because air transport times are already known to be significantly less than corresponding ground times (e.g. Cape Breton Regional Health Centre - flying time 70 minutes, ground time 4.5 hours).

AMT is a valuable service. It provides rapid transport and a high level of care for critically ill patients who require timely interventions at a tertiary care institution. However, due to its cost and the fact that there is only one helicopter for the entire province of Nova Scotia (which also serves Prince Edward Island and New Brunswick, and transports pediatric, neonatal and obstetrical patients), it is important that AMT is utilised for appropriate conditions and within specific guidelines. Partially as a result of this review, such guidelines were further refined for AMT of cardiac patients through discussion with the Division of Cardiology at the QEII HSC. This group already uses a comprehensive provincial cardiac triage system to ensure that only those patients needing tertiary care interventions or investigations are referred and the remainder are treated and investigated at their appropriate regional hospitals. These same principles were used in the AMT cardiac guidelines and, further, are predicated upon close communication between the on-line medical control physicians for AMT and the on-call tertiary care cardiologist. These guidelines are listed in Appendix 1. A complete set of guidelines for AMT utilisation for trauma, pediatrics, obstetrics and neonatal cases is available from the provincial AMT

program (see address in Appendix I).

Further studies suggested by this program review are to evaluate the apparent low use of thrombolytics pre-transport in the acute MI patient population and a comprehensive cost-effectiveness analysis of ground transport versus air transport for cardiac patients.

ACKNOWLEDGEMENTS

The authors would like to thank Dr. Chris Foster of the Division of Cardiology for his review of the manuscript and his significant contribution to the AMT cardiac guidelines. The authors also gratefully acknowledge the assistance of Heather McQuinn in the preparation of this manuscript.

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Web Sites of Interest:

1. Emergency Health Services Nova Scotia: www.gov.ns.ca/health/ehs
2. Air Medical Physician Association: www.ampa.org

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APPENDIX I

Specific Considerations in Air Medical Transport of Cardiac Patients in Nova Scotia

(From *Preparation of the Patient for Air Medical Transport Manual: Guidelines for Air Medical Transport*, AMT-Nova Scotia/STARS-NS, 2000)

Provincial triage of acute cardiac conditions is predicated upon initial utilisation of the appropriate regional hospital. Thus, an uncomplicated, post-MI patient who has received appropriate treatment in a specific community hospital or health centre will be transported to the nearest regional hospital and not to the QEII Health Sciences Centre (QEII HSC) by air medical transport (AMT).

AMT can assist small hospitals and community health centres in transportation of unstable patients to the nearest regional centre if the patient's condition warrants AMT as per the original general criteria for air transport (see full document on Preparation of the Patient for Transport/Indications for AMT); i.e. if the patient is critically ill and ground transport is unavailable or excessive time is involved, or the resources of the hospital or health centre would be depleted if ground transport takes place.

If a sending physician feels that the cardiac patient is so unstable that tertiary care is indicated (e.g., ruptured mitral valve post-MI with cardiogenic shock), then these cases will be reviewed with the on-call cardiologist at the QEII HSC and AMT will be organised by the Air Medical Control Physician (MCP). If there is any concern, in borderline cases, about the patient's condition or because of logistics (lack of beds, etc.), then this case will also be reviewed by the MCP with the cardiologist on call at the QEII HSC. Only then will a transport decision be made.

Acute Cardiac Conditions Which Require Transfer to the QEII HSC by AMT:

1. cardiogenic shock
2. patients with acute MI and contraindications to thrombolysis who may require primary PTCA
3. acute ventricular septal defects or valve dysfunction post-MI
4. cardiac tamponade
5. acute mechanical valve dysfunction

Non-Acute, Urgent Cardiac Cases (may be candidates for AMT):

Other cardiac cases may be transferred from regional hospitals after initial treatment and stabilisation for further definitive tertiary care treatment and/or investigations. These cases may include the following:

1. high-risk unstable angina, usually on intravenous heparin, and for priority angiography
2. post-infarct angina or other complications, such as concurrent congestive heart failure CHF
3. medically refractory dysrhythmias
4. patients awaiting surgery (coronary artery bypass graft) with acute complications, such as unstable angina
5. worsening CHF +/-mechanical ventilation

Many of these patients can and will be transported by ground ambulance with appropriate staff. At times, pending helicopter and team availability, the AMT program may be asked to transport some of these patients. Other critical care calls, such as trauma, will take precedence.

These are guidelines only and may not apply to regional hospitals with more advanced capabilities. The Medical Control Physician will make the final decision for transfer outside of pure aviation concerns.

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