EMERGENCY SERVICES FOUNDATION

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USE OF RAPID SEQUENCE INTUBATION IN EMERGENCY MEDICAL HELICOPTER PROGRAMS IN THE USA

REPORT FROM JAMES SAMS

MICA FLIGHT PARAMEDIC

AIR AMBULANCE VICTORIA

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Introduction:

As a result of the generous financial support provided through the award of an Emergency Services Foundation Scholarship, I undertook a three-week study tour to the USA in August 1999. The purpose of this overseas study tour was to examine the experience of Emergency Medical Services helicopter programs currently using the protocol of rapid sequence intubation (RSI) which is in the early stages of implementation at Air Ambulance Victoria. The protocol involves advanced airway management of patients, particularly with trauma related head injury. This area of patient care has received a great deal of focus in recent years with research highlighting the importance of good airway management to improve patient outcomes. Six highly respected aeromedical programs were visited during the three-week study tour. This report will discuss their use of the relevant protocols under a series of headings discussing their experience and other related issues.

The helicopter programs visited in order were:

1. AirMed – University of Utah Hospital - Salt Lake City Utah
2. Life Flight - Intermountain Health Care, LDS Hospital - Salt Lake City Utah
3. Vanderbilt LifeFlight – Vanderbilt University Medical Centre – Nashville Tennessee
4. MedFlight – Ohio State University Medical Center – Columbus Ohio
5. STAT MedEvac – University of Pittsburgh Hospital – Pittsburgh Pennsylvania
6. Maryland State Police Aviation Division – Baltimore Maryland

Helicopter Medical Crew Configuration & Roles:

In the United States the vast majority of medical helicopter programs practising RSI are staffed by a team consisting of a flight nurse (FN) and a flight paramedic (FP) to deliver patient care. Less frequent is a team consisting of two flight nurses or paramedics only and in a very small percentage of programs a doctor forms part of the team working with either a flight nurse or flight paramedic. The helicopters are usually flown by one pilot although some programs with IFR capability prefer to use two pilots for added safety reasons but this is not common mainly due to cost reasons.

The programs that I looked at had been selected to enable me to observe different crewing combinations. AirMed in Salt Lake City uses a FN/FP as its standard crew configuration but also take a respiratory therapist for complex intubated ventilated patient transfers between hospitals. Life Flight in Salt Lake City and MedFlight in Columbus Ohio use a FP/FN crew. Vanderbilt LifeFlight Nashville has a FN/FN crew. STAT MedEvac in Pittsburgh uses a FP/FN combination and has an arrangement on two of their seven helicopters where the FN or FP is replaced with a second or third year resident hospital doctor. This is to increase the exposure of the doctors to acute patients particularly trauma as part of their training. In Maryland the State Police staff their helicopter with one flight paramedic.

Reasons for frequency of FN & FP crew combination:
Three main reasons: - Firstly the background experience of the crew. The initial selection process means that flight nurses are usually critical care qualified with an extensive background of managing ICU patients and ventilators and have been found to have good rapport in relating to hospital staff when involved in patient interhospital facility transfers. Flight paramedics often have extensive pre-hospital intubation skills and are experienced in the logistics of patient extrication and co-ordination with

ground emergency services at scenes again with good rapport. These two professions compliment each other forming a multidisciplinary team. (The training of paramedics in the USA is similar to but not as extensive as the training here in Victoria.)

Secondly, for cost reasons the use of doctors on helicopters is often prohibitively expensive so their usual role is administrative providing medical control and direction including clinical audit and education/ training of the FN & FP. Flight paramedics are also generally paid less than flight nurses which reduces program operating costs when they are included as part of the crew.

Thirdly, the legal situation in the USA is that responsibility for RSI rests initially with the Medical Director of the program who often in conjunction with a medical advisory committee has formulated and authorised the use of the RSI protocol by staff in compliance with State regulations. Due to State laws the actual responsibility for administering the drugs used in RSI then usually rests with a State licensed nurse that is part of the crew. The paramedic while often intricately involved in the procedure be it the administration of the drugs or the actual intubation often does not assume the legal responsibility for initiating RSI and the outcome. In some cases, this has slowed although not stopped the spread of RSI to programs that are staffed solely by paramedics.

In practice the role of the nurse and paramedic is not strictly defined. Who actually gives the medications for RSI and who does the intubation will often be based on how recently one of the crew last performed an intubation. If one of the team has had less exposure to the skill in recent times and needs to increase their "figures" they will go to the patient head end. (See "skills maintenance" section).

When arriving at a hospital for helicopter transfer, the team will divide up with one member speaking to the medical staff and receiving a detailed report including paperwork, X-rays, medications, allergies and past history of the patient. The other member will be physically assessing the patient – checking vital signs, injuries, drug infusions being administered and prepare the patient for transport, connecting devices such as infusion pumps and monitors. My observation of this system is that it considerably reduced time at the sending hospital enabling a quick turnaround.

Neonate & Paediatric Interhospital Transfers.
Crewing of the helicopter is changed for the transport of critically ill neonate and paediatric patients between facilities. In the programs I looked at they all used special neonatal teams and sometimes also paediatric teams, often a nurse combination or nurse and doctor. It was the responsibility of these teams to initiate RSI if it was needed and subsequently manage the patient in flight. Except in the case of MedFlight Ohio who employ their own specialised flight team of paediatric/neonatal nurses, other programs would pick up a team usually based at a children's hospital and due to safety reasons one program FP or FN would travel with the team.

Helicopter Medical Crew Qualifications:

Qualifications to be employed in the six different programs were fairly similar and comprehensive. Flight nurses were often required to obtain paramedic certification in addition to their registered nurse qualification and the job descriptions gave preference to nurses who held paramedic certification with field experience. Many nurses held both qualifications. Due to similarities in the FN/FP requirements between the programs a sampling of two are listed below in detail as representing the average requirements -

Flight Paramedics
AirMed: Certified paramedic with a minimum of three years on road experience (average experience of FP's in the program is 13 years) and also hold qualifications of Pre-Hospital Trauma Life Support (PHTLS), Advanced Cardiac Life Support (ACLS), and Paediatric Advanced Life Support (PALS). As AirMed is based at the main burns unit hospital for the State and also brings in burns patients from interstate they also require Advanced Burn Life Support (ABLS) certification.

STAT Medevac: Qualified paramedic with minimum of 3-5 years on road experience. As for AirMed must hold ACLS, BTLS & PALS certification.

Flight Nurses
AirMed: Registered nurse with minimum of two years ICU and one year emergency department experience (average experience is 12 years). Hold PHTLS, ACLS, ATLS, ABLS & PALS. Preference for nurses who are also qualified paramedics. Some of these certificates are able to be obtained after employment but must be qualified within one year of hiring.

STAT Medevac: Registered nurse with extensive critical care or emergency department experience (3-5 years minimum). Hold certification in ACLS, BTLS & PALS. Preference for employing nurses who are also qualified paramedics.

Medical Control – Quality Assurance & Clinical Audit of RSI:

The programs visited all had a medical director (MD) who was ultimately responsible for the patient care standards in the program. The MD's were qualified in either the specialty of emergency medicine or another critical care discipline. MD's have considerable input into the pharmacology and protocols followed including revision and changes to procedures. This often involved an administrative/coordination role in setting up meetings to discuss changes and liase with hospital doctors such as Emergency Department directors or medical advisory committee's to the program.

Another important part of the MD job description was direct involvement in the clinical teaching of FP/FN's with regular classroom theory and practical sessions to teach and qualify new staff in RSI and conduct refresher sessions.

MD's usually had the option of an occasional "ride-along" with the helicopter crew taking the opportunity to be an extra pair of hands and ears and maintain contact with the staff in their working environment to better understand issues and clinically assess protocol use.

Some medical directors had additional roles outside of the program, such as sessional work in an emergency department. Where the helicopter was affiliated to

one particular hospital, the MD was often also assistant or director of the emergency department of that hospital.

In some programs where the RSI skill was recently introduced such as in Maryland, the MD would receive a copy of the patient care record for review within 24 hours of the procedure's use. Otherwise it would be audited by an appointed clinical nurse or paramedic responsible for quality assurance, who would do the initial review and refer to the MD any cases that raised issues such as lengthy scene times, failed intubations, variations in the procedure to the written protocols etc.

This clinical staff member was also responsible for overall audit within the program and would either deal with minor protocol issues if they fell within their level of responsibility or pass on the case for medical opinion and response. This appointed person was also the "statistician " who monitored the frequency of the use of RSI and ensured that staff had reached a minimum number of procedures as required by the program and received refresher training if required. In some cases the clinical audit was a full time administrative role, in some cases the appointed person still performed some shifts as part of the helicopter crew. They also had a key role in coordinating and facilitating the in-service training programs in liaison with their medical director.

Most data required for clinical audit is "captured" by a computer software program. Helicopter crews enter details from their patient care records for account and audit purposes into their work computers and the clinical manager can retrieve information as required. For some procedures as the information is entered an alert will trigger to notify the clinical manager that a certain procedure has been carried out.

In the case of STAT Medevac where they have seven helicopters scattered around the State and a high workload, this arrangement is essential to keep the clinical audit process up to date and allow a timely response to any issues. In this program, staff have a password to log onto a Web internet site and then enter the data as soon as possible after completion of the patient transport. The site is on-line 24 hours a day and can be accessed by staff from work or home. As data is entered it will trigger drop down boxes on the computer if more information is required such as in RSI cases. Staff did express some concerns at the time required to complete the data. This was mainly due to the slow on-line data transmission speed of certain computers but faster connections are being planned that should overcome this problem.

Some programs are planning to integrate their patient care records with the hospital computer data base to enable access and print out from emergency department computers, but at the time of my visit this was not yet in operation.

Overall it was obvious from my observations during the study tour that considerable attention is given to clinical audit. There is room for improvement in our system with a more comprehensive audit required than that which is currently carried out. In particular for a thorough audit of RSI we need to know on a readily retrievable database, the number of intubations and other definitive airway care procedures that each Air Ambulance MICA Paramedic performs annually. At the present time this can only be retrieved by a laborious manual extraction of the statistics. If a MICA Flight Paramedic has not had sufficient exposure to intubations/RSI, then refresher training such as operating theatre time can be arranged to improve confidence and maintain skills currency. The Rural and Metropolitan Ambulance Services in Victoria have a working party and project underway at the Human Services Department,

which hopefully will on implementation rectify current shortcomings in our data collection.

RSI & Cricothyroidotomy- Theory & Practical Training:

One of the main aims of this study tour was to closely examine how the helicopter programs trained their staff in RSI and surgical airways, both theory and practical. At each helicopter program there were certain requirements to reach qualification in these procedures. While there was some variation between programs there was also much uniformity as well. In some programs where FN's with no previous intubation experience are employed as flight crew there was a greater emphasis on teaching this skill, which experienced proficient paramedics would not necessarily require. I have summarised the basic requirements for staff to be considered qualified in this procedure at each of the six programs as follows:

AirMed – Salt Lake City Utah

- Classroom theory lectures with Medical Director.
- Operating Theatre (OT) intubations under supervision of anaesthetist.
- Further practice on intubation manikins.
- Dog laboratory at University medical school for cricothyroidotomy (will be getting cricothyroidotomy manikins soon to replace dogs).
- Supervised practical period on helicopter with qualified FN as preceptor – initially observe staff implement skill on patients then responsible for skill under supervision.
- Time frame for qualification takes approximately 144 hours.

Life Flight – Salt Lake City Utah

- Classroom theory lectures with Medical Director.
- OT intubations – 25 supervised by anaesthetist.
- Dog laboratory for cricothyroidotomy practice.

Vanderbilt LifeFlight – Nashville Tennessee

- Classroom theory lectures.
- OT intubations – 3 adult & 2 paediatric supervised by anaesthetist.
- Clinical experience rotating through cardiac unit, trauma unit, emergency department & paediatric ICU.
- Hospital animal lab for needle/surgical cricothyroidotomy practice on sheep or dogs. (Also femoral lines, chest tubes and intraosseous.)
- Two days with ground paramedic unit as observers.
- Extra crew member on helicopter initially observing then as 2nd crew member undertaking procedures, total time frame 8 weeks supervised practical experience.

MedFlight – Columbus Ohio

- Classroom 3 hour theory lecture by Medical Director
- Practical sessions on intubation manikins.
- Dog Lab for cricothyroidotomy (also intubations, chest decompression & pericardiocentesis).

STAT Medevac – Pittsburgh Pennsylvania

- Classroom 2 hour theory lecture by Medical Director on airway management and pharmacology.
- Practical session on intubation manikins.
- Anatomy lab using sheep throats for cricothyroidotomy. Later attend University Medical Research Centre for practice on pigs.
- OT intubations – 1 paediatric & 5 adult supervised by anaesthetist.

Maryland State Police – Baltimore

- Classroom initial 6-hour theory session with Medical Director.
- OT or Emergency Room - 6 intubations supervised by anaesthetist.
- Cadaver Lab at University of Maryland Medical school – anatomy session, ETT and needle/surgical cricothyroidotomy practice.
- Classroom final 10-hour session involving theory and practical skill stations including anaesthesia computerised manikin simulator.

Skills Maintenance & Recurrency for RSI & Cricothyroidotomy:

All programs had annual requirements for staff to prove their competency in airway skills. Some revision of skills is dependent on the frequency that the skill is practised in the field. As this is an important part of introducing the RSI protocol in relation to the clinical audit and quality assurance process, I have listed the requirements below for each individual program.

AirMed – Salt Lake City Utah

- FN/FP - minimum of two intubations on patients in the field per month, if not reached then two intubations in OT or on manikin.
- Attend annual RSI and airway management lecture
- Attend dog lab for cricothyroidotomy

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Life Flight – Salt Lake City Utah

- FP/FN - Minimum 4 intubations in the field per quarter, if not reached rotation to OT for experience.
- Annual dog lab practice for cricothyroidotomy – minimum of one per year in lab regardless of field experience..

Vanderbilt LifeFlight - Nashville Tennessee

- Intubations - minimum 1 per month either at scene or in hospital OT.
- Cricothyroidotomy – 6 monthly competency pracs at hospital animal lab.

MedFlight – Columbus Ohio

- Two in-service sessions per year (every 6 months) with dog lab and cricothyroidotomy, intubations, pericardiocentesis and needle chest decompressions.

STAT Medevac – Pittsburgh Pennsylvania

- Minimum 12 intubations annually including 1 paediatric. Procedures reviewed quarterly - if low then staff sent to OT.
- Each crew member is individually checked annually for intubation success rates. If 1 below standard deviation from mean of each member (average 88% success rate when combined) required to complete 24 intubations following year in field or OT.
- Annual attendance at University of Pittsburgh Medical Centre Research Lab for cricothyroidotomy practice on pigs.

Maryland State Police – Baltimore

- First quarter – attend OT for supervised RSI with anaesthetist.
- Second quarter – attend Paediatric OT for intubations supervised by anaesthetist
- Third quarter – In service classroom revision of theory and practical skill stations with medical director.
- Fourth quarter – Clinical instructor doubles up on flights for skills checks.

Rapid Sequence Intubation Protocols:

All the programs that I visited are currently using a combination of sedation and paralysing drugs to intubate patients who meet the criteria and have an altered conscious state and Glasgow Coma Score that prevents intubation without pharmacological assistance.

The protocols as used by the six helicopter programs are attached as appendices to this report. (Appendix 1 – 6) The protocols are detailed and give the exact sequence of events for each helicopter program's RSI procedure. There are many similarities in these appendices to the protocol drawn up for use by flight paramedics in Air Ambulance Victoria. Some variations exist in the pharmacology with new "cleaner" drugs with fewer side effects becoming widely used for this procedure in the States. Some observation about the protocols in use in the USA and how they relate to our own protocol are outlined below:

Preoxygenation & Cricoid pressure

All programs emphasise the importance of preoxygenation with 100 % O2 usually for 60 seconds before any intubation attempt. Continuous cricoid pressure until intubation has been successfully confirmed is also strongly enforced as part of the protocols. This is in line with our teaching of the skill here in Victoria.

Lignocaine

Lignocaine is considered to have a place in the RSI protocol due to its suggested benefits in preventing intracranial pressure (ICP) rise, tachycardia and hypertension.during the procedure. In two of the programs it is given routinely, in the other four it is only given if an elevated ICP is suspected, for example patients with head injuries. The average dose is 1 mg/kg. This is in line with our teaching.

Atropine for Children

Programs administering atropine did so prophylactically rather than symptomatically, due to risk of bradycardia during the RSI procedure. The usual dose is 10mcg/kg I.V. However there was no consensus on age, with two programs giving atropine to all paediatric patients, while two programs gave it to different ages – below 8 and below 6 years of age. One program made no mention of its use in paediatrics and another program is still formulating a paediatric RSI protocol. Presently at Air Ambulance

Victoria the protocol requires administration of atropine only if the patient is bradycardic (heart rate < 60/min). There may be a case for the drug to be given prophylactically, but we do not yet have anecdotal experience of the frequency of bradycardia in children during RSI. We can only be guided by other studies that would suggest it advisable to have a loading dose in young children, as profound bradycardia and even asytole has occurred associated with succinycholine and laryngoscopy.

Midazolam

Midazolam was until recently the main sedation drug used in the States for RSI, having long ago replaced the sedation drugs of morphine and diazepam, which we still use in Victoria. Midazolam has the advantages of being a potent, fast acting amnesic drug, but the experience of the programs that I visited is that it has a wide effective dose range. In small doses, it may not produce enough sedation and in larger doses, there are increased cardiovascular side effects. The usual dose given is 2-5mg I.V. It was still the first drug of choice at one of the six programs, but has been relegated to second choice at five other programs in favour of a newer sedation drug Etomidate. Midazolam is still in favour as the main drug of choice for continuing long term sedation after successful intubation.

Etomidate

Etomidate is a non-opiate hypnotic sedative-anesthetic agent that has been used for some time in operating theatres but has only in the last 12 – 18 months become popular as the sedation drug of choice for pre-hospital RSI in many of the medical helicopter programs.

Its popularity is due to the following key features of its actions –

2.) Able to be injected rapidly ~ 30 seconds
3.) Rapid onset of action – less than one minute.
4.) Little if any effects on blood pressure.
5.) Decreases ICP, intra ocular pressure & cerebral metabolic oxygen requirements.
6.) Short duration of action ~ 5 minutes.

Due to the above, etomidate is regarded as the best drug choice for the hypotensive multi-trauma patient particularly with head injuries.

The main side effects with the drug have been –

1.) Involuntary myoclonic movement in approximately 30% of patients. (Lignocaine has been shown to prevent involuntary muscle movement from etomidate.)
2.) Adrenal cortical suppression up to 4 hours after injection – shown not to be detrimental to patient outcomes.

Normal dose is 0.3mg/kg IVI Adult & Paediatric

I was able to see etomidate used in RSI performed pre-hospital and have discussed at length with the flight crews and medical directors their experience with this drug. The anecdotal observations were that myoclonic movement was rarely seen and if it occurred it was of short duration. It tends to occur if the drug is given too quickly as an I.V. bolus. Nausea and vomiting are potential side effects but rarely seen in practice. When given etomidate patients usually maintain spontaneous respirations with a reasonable tidal volume.

I would highly recommend etomidate be considered to replace the use of diazepam/morphine as our primary sedation drug for RSI in Air Ambulance Victoria. In particular, it will overcome many of the concerns expressed by some members of the medical fraternity that diazepam & morphine are detrimental due to their cardiovascular effects, respiratory depression and long duration of action.

Etomidate ties in with suxamethonium in having an almost identical onset and offset of action. Within 5–7 minutes of administration, if the patient has not been intubated they will return to the status they had before drug administration, which is likely to be with spontaneous respiration and a protective gag reflex.

Vecuronium – Premed & Maintenance of Paralysis.
Vecuronium is the only non-depolarising muscle relaxant that is routinely used in all six programs visited.

The use of a non-depolarising muscle relaxant in a small initial priming dose is still somewhat controversial. Some studies have suggested that it can prevent the defasciculation and rise in ICP associated with suxamethonium administration.

It was routinely given as a pre-med. in three programs, only if time allowed in another program and not given at all in the remaining two. If the patient was in severe airway compromise, helicopter staff informed me that in practice they deleted it from the protocol as it was another step that took time when the patient was critical and needing an urgent airway established. The most likely time of use as a mini dose pre-med. is in the less urgent interhospital transfer patients where more time is available. The usual dose is 0.01mg/kg I.V. (10% of maintenance dose).

All programs use vecuronium for maintenance of paralysis to facilitate adequate oxygenation by mechanical ventilators after intubation. The usual dose is 0.1mg/kg I.V.

While the use of pre-med. minidose vecuronium is questionable in the pre-hospital acute patient, there may be a valid argument for its use in the interhospital transfer setting where more time is available. This is not an option at present in our existing RSI protocol.

The use of vecuronium in preference to pancuronium is more debatable. Vecuronium does take a little longer to draw up as it is in a powder form requiring addition of a solvent. Pancuronium has a longer duration of action of up to one hour as compared to vecuronium lasting approximately 30 minutes. This can be an advantage when managing a patient on a long flight.

The one main advantage of vecuronium over pancuronium is that it does not cause the tachycardia response commonly seen after the administration of pancuronium. This tachycardia can in some patients be both significant and prolonged and is obviously not desirable in patients who are already haemodynamically unstable. I would recommend that vecuronium be considered as a replacement for pancuronium in our existing protocol.

Suxamethonium
Despite the many documented contraindications and side effects with suxamethonium, it remains the drug of choice for the emergency time critical intubation and it is still widely used throughout the USA including all six programs I visited. Most use an initial dose of 1.5mg/kg, in line with our existing protocol.

Failed RSI – Options:

All of the helicopter programs had protocols to deal with the rare situation of a patient unable to be intubated after application of the RSI procedure. Patients in this category are at high risk unless staff are well trained and able to follow options to adequately manage this potentially life threatening situation.
Helicopter teams usually allow each team member two attempts only at intubation, if both staff are unsuccessful then they must move on to other techniques:-

Conservative management
Some programs advise crews to initially manage these patients conservatively using bag/mask ventilation if transport time to hospital is less than 10-15 minutes away. This is dependent on the ability to adequately ventilate the patient as indicated by measures such as good oxygen saturation readings.

Use of Combitube
Some programs advocate inserting a combitube as the next option if unable to intubate (for example see Appendix 6 MSP section III "Pilot Protocol for Combitube"). If still unable to adequately ventilate the patient then a cricothyroidotomy is next attempted.

Use of Laryngeal Mask Airway
At the present time of writing there was no protocol in the six programs for use of the laryngeal mask airway (LMA). AirMed is planning to introduce the LMA in the near future and STAT MedEvac is soon to conduct a study in conjunction with other aeromedical programs looking at a LMA through which you can intubate, with a plan to include it into the protocol.

Surgical Cricothyroidotomy
All programs allow the use of a cricothyroidotomy as a last resort definitive airway when the patient cannot be intubated or managed by other means. (See appendices 1-6) In the case of patients presenting with severe facial trauma likely to preclude oral intubation, staff go straight to the cricothyroidotomy option. The method used varied between programs. Most common was the basic surgical method using a scalpel to make the incision in the cricothyroid membrane and spreaders/ haemostat and tracheal hook to complete the procedure. Only one program (Vanderbilt) currently uses the Cook needle/wire guided kits that are planned for use at Air Ambulance Victoria. Another program trialled them but reverted to the scalpel method as it found the number of steps involved in the Cook kits "fiddly" and time consuming when speed and simplicity was important.

To give some idea of the frequency of cricothyroidotomy (CRICS) three statistical examples from programs visited are given for 1998: Vanderbilt - 185 RSI / 3 CRICS, Life Flight - 373 ETT / 5 CRICS, STATMedevac - 389 RSI / 5 CRICS. All cricothyroidotomies were successful. Noteworthy is the ability of the programs to ensure staff competency through access to University medical school animal or cadaver labs to initially learn the skill and revisit for refresher sessions.

Needle Cricothyroidotomy – Percutaneous Transtracheal Jet Ventilation
Due to risk of damage to the cricoid cartilage in young children, surgical cricothyroidotomy is not possible, therefore needle cricothyroidotomy is the method of choice. Two devices carried in the helicopters in the States used for this procedure should be considered for inclusion in our airway equipment kits at Air Ambulance Victoria: -

Transtracheal Catheter
This device simplified the process of needle insertion, securing and connection to different ventilation devices. I had the opportunity to practice with this equipment on a mannikin and found it to be far superior to our current procedure of insertion of a large gauge IV catheter. (See appendix seven)

Manual Jet Ventilator
Five out of the six programs visited use these devices. They considerably improve the accuracy and ease of oxygen delivery while enabling the operator to control the pressures so they do not exceed safe limits. Two examples are attached in appendix eight.

Scene Times:

One of the most impressive aspects of the operations of the six helicopter programs that I visited were the short scene times. In the many opportunities that I had to ride along with the helicopter crews I was able to observe a universal adherence to fast turn around times. All programs worked on a maximum of 10 minutes at a scene from landing to liftoff. This time frame is based on the patient normally on a stretcher in a ground EMS vehicle and packaged for transport, although this was not always the case. If the patient requires treatment such as establishment of I.V lines or RSI, it would be expected that this be done at the scene and still be airborne within the 10 minutes. Obviously where there is some distance from landing site to patient, or difficulties such as a prolonged motor vehicle entrapment requiring extrication, scene times will be justifiably longer.

To assist in keeping scene times short, the helicopters are rarely shut down and remain with rotors turning for a “hot load” unless scene times are likely to be prolonged. This differs from the scene times at Air Ambulance Victoria, which tend to be longer and generally, our helicopters are shut down at the scene for a “cold load”.

Most USA programs have an automatic audit of any scene times longer than 10 minutes with the cases checked for explanations. Certainly 15 minutes or longer would be regarded as a particularly long scene time with questions asked of the staff as to why delay occurred. Here in Victoria the issue of scene times is often a prime focus of medical scrutiny and criticism (not always justified!) We do not have an automatic audit of scene times. To some extent it is an ad hoc process and improved audit could potentially produce shortened scene times.

Five of the six programs indicated a preference to initiate definitive airway care such as RSI at the scene before loading the patient into the helicopter. However at Vanderbilt LifeFlight there was a policy of loading and treating patients in flight and I witnessed an intubation while enroute to the hospital. The interior configuration of the BK117 allows seating behind the patients’ head, which assists with this procedure. One of the reasons for the efficiency in short scene times is undoubtedly the teamwork of the two person medical crew. With similar experience and skills, the patient can be rapidly assessed, treated and prepared for transport and further treatment more efficiently administered enroute to hospital. Due to the single paramedic crewing in Victoria I feel this same level of efficiency is difficult to achieve, despite assistance from a first aid trained crew member.

In relation to interhospital transfers, the aim is to be inside the referring hospital no longer than a maximum of 30 minutes. It is common for helicopter loading and unloading at hospitals to be carried out with engines on and rotors turning.

Blood Delivery to Trauma Scene Calls:

I have included information on trauma scene blood transfusions, as it is a topical issue also relevant in the care of the trauma patient. There is some debate as to whether blood should be carried in helicopters for scene calls to haemodynamically unstable time critical patients. Also, there are questions relating to how it should be supplied, stored and fresh supplies maintained with minimal wastage.

Blood is still not widely carried on helicopters due to the difficult logistics. Of the six programs I visited only two routinely carried blood to all trauma calls. Two others had access to blood if they received pre-flight information on a patient that would meet the criteria for a blood transfusion. An example would be a patient poorly perfused facing lengthy entrapment.

Both Vanderbilt LifeFlight and STAT Medevac have carried blood for some time. The method of transport is similar with a “six pack” drink cooler or similar small insulated container being used. As there is no opportunity to cross-match blood for the emergency patient, programs use O negative whole blood as used in similar situations in emergency departments.

Vanderbilt routinely carries two blood units with the option of taking up to four if more is likely to be required. Chemical cold packs or ice packs are placed below and above the two units with a thermometer in between units to monitor temperature. Some blood units have temperature sensitive symbols attached that change according to the temperature. If the temperature reaches 10 degrees Celsius or above, the blood is returned to the blood bank for discarding. In between calls the blood is normally removed from the helicopter (particularly in warmer weather) and placed in a fridge at the hospital emergency department where the helicopter is based.

STAT Medevac has carried blood for approximately 10 years on both fixed wing and rotary flights. It routinely takes four units to a scene. Helicopters based at hospitals are able to access their stock from the hospital emergency department. Those helicopters based at an airport have overcome the problem of holding blood stock by being registered as a “Blood Bank”. The American Red Cross or Central Blood Bank deliver to the nearest hospital where the helicopter will collect its allocation. A complex administrative protocol must be followed to account for all blood including correct storage conditions.

The experience of both programs is that the blood sealed in a portable cooler normally remains below 10 degrees Celsius for a least four hours. If needed, replenishment ice is usually obtainable from any hospital visited. For an example of a protocol to use blood, see appendix nine.

Summary & Recommendations:

The scholarship provided an excellent opportunity for me to witness at first hand the current state of the art in the USA in applying rapid sequence intubation to helicopter patients, in particular head injured trauma cases. The six programs selected had a wide range of experience in this area from STATMedevac with several years and thousands of cases to a much smaller experience base such as in Maryland where a pilot RSI program has only recently been introduced.

Many aspects of patient airway management were investigated in this study and are discussed in detail in the body of the report. I was impressed with the high level of skills and qualifications expected of applicants to join the programs. Crew configurations were examined and of note were programs using two staff of similar complimentary skills. This provided a highly trained team approach capable of delivering rapid effective care at the scene and enroute to hospital. Even with definitive treatment by the helicopter crew, scene times were very short and give cause for us to re-examine our own times to seek further improvement.

Initial comprehensive training both theory and practical included access to animal or cadaver labs that enable actual hands on experience. Similar exposure here in Victoria could be beneficial. Recertification and skill maintenance were a feature of all programs, with careful records kept of a number of procedures instigated in the field and clinical skill practical sessions provided on a regular basis. Clinical audit was overseen by the medical director and a designated staff member responsible for ensuring a thorough clinical audit was maintained and refresher training accomplished with all team members. I feel there is a case for more thorough audit in this area in Air Ambulance Victoria. It was obvious from my observations that maintaining high clinical standards is an essential component to a successful RSI program.

The protocols themselves are not that dissimilar to what is proposed for Air Ambulance Victoria. Pharmacologically, the use of Atropine prophylactically in children, the drug midazolam in preference to diazepam, vecuronium in preference to pancuronium and the use of vecuronium as a pre-med. minidose are some differences examined in the text of this report. Perhaps the most significant new drug for some years – etomidate, as the primary sedation drug, is also discussed in detail. In particular etomidate offers several advantages over the drugs previously used for the sedation aspect of the RSI protocol and I would recommend it be considered for use here in Victoria as part of our RSI protocol.

The options for failed RSI are similar to our proposals here in Victoria. All programs have a protocol for a surgical or needle cricothyroidotomy available in these instances, as well as other more conservative management. The laryngeal mask airway (LMA) is not yet in use but is under consideration in some programs. I believe our proposal to use the LMA is a better option to the USA programs that use the alternative combitube. The specialised transtracheal catheter and transtracheal jet ventilator used in the USA would improve our needle cricothyroidotomy protocol and should be considered for inclusion in our airway management kit.

Finally, in this report I have discussed the issue of carrying whole blood to trauma scene calls. While it is undoubtedly of benefit in the severely hypovolaemic patient,

there are logistical problems in its supply and storage. Perhaps early consideration to obtain “O” negative blood from nearby hospitals where possible, and deliver it by road or air transport to the scene may be possible for patients meeting the criteria such as severe trauma with lengthy entrapment.