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# Contents





# Resident's Corner

## U.S. ELECTIVES: WHAT'S OUR LIABILITY?

Residents from various Emergency Medicine programs across the country have been going to centres in the United States to do either elective or mandatory rotations as part of their training. There is some controversy as to whether this is necessary, but most residents feel it is a valuable experience.

I have just returned from a Trauma Elective in Denver, Colorado. More than ever before, I became aware of the medico-legal risks of our specialty. I began to wonder if my Canadian sources of malpractice insurance would be adequate coverage in the event of a suit.

I spoke with one of the administrators of the Foothills Hospital, and, although he "believed" we would be covered for out-of-country electives, he felt he would have to investigate the matter further. Each hospital varies slightly in its coverage of suits brought against residents, but, as we are employees, it is likely that as long as we are practicing in the "proper manner", doing jobs considered part of our job description, we are safe. . . . *In Canada.*

I then spoke with the Emergency Residency Director at the hospital in Denver where I had done my elective. Apparently, their residents do not carry any malpractice insurance, and, in their hospital, malpractice suits are directed against the staff physician who signed the chart. Once again, this varies tremendously across the country, according to individual hospital board policies.

A representative at Reed Stenhouse Limited (insurance brokers) told me that no Canadian insurance company would cover a physician working in the United States. One suggestion he gave was to contact a large insurance company in the States to obtain information regarding temporary coverage.

No one I have yet been in contact with has heard of a Canadian resident being sued while in the United States. This by no means guarantees that it cannot or will not happen! The Residents' section of C.A.E.P. will pursue this further, but in the meantime, my suggestion to those residents considering electives in the United States is to inquire into the provisions made by the employing hospital and/or the elective hospital for malpractive coverage.

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# Complications of Cardiopulmonary Resuscitation

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**Abstract**

*Post mortem findings recorded on the charts of 82 victims of non-traumatic cardiac arrest managed with cardiopulmonary resuscitation (CPR) were retrospectively reviewed. The complication rate was 54% in adults and 33% in children (less than or equal to 16 years of age).*

*Complications varied from incidental to life-threatening. Patients with complications were significantly older ($P < .01$) and had CPR performed significantly longer ($P < .05$) than patients with no complications. Physicians treating patients in the post-resuscitative phase should be aware of the frequency and types of complications which might arise, and the factors associated with them.*

KEY WORDS: cardiopulmonary resuscitation, complications, CPR, resuscitation, post-resuscitative care

## Introduction

Although closed chest cardiopulmonary resuscitation (CPR) was described both eloquently and accurately as early as 1906 by George Crile[1], it was not until 1960, when Kouwenhove[2] reported its effectiveness in human subjects, that CPR became accepted as a valuable technique in the resuscitation of patients suffering from cardiac arrest.

As with most medical procedures, CPR is not devoid of complications. Descriptions of these complications appeared shortly after the introduction of CPR[3,4]. An early review of the literature [5] revealed a wide range of complications from incidental to life-threatening and involving potentially most organ systems.

The extension of CPR to the pre-hospital sector with elaborate networks for providing citizen CPR training has resulted in improved survival from cardiac arrest[6]. Despite improved training techniques, the widespread use of CPR will likely result in an increase in the prevalence of complications.

Because these complications can interfere with care in the post-resuscitative phase, awareness of their frequency and range of severity is indeed important. To determine the extent of complications, post mortem findings on the charts of victims of non-traumatic cardiac arrest in a general hospital population were retrospectively reviewed. The incidence and types of complications are reported, as well as factors contributing to their occurrence.

## Materials and methods

The records of all deaths occurring between January 1981 and December 1983 at Victoria Hospital, an 1100 bed teaching hospital, were reviewed. Patients who had received closed chest cardiopulmonary resuscitation and undergone a full post mortem examination were selected. There was no distinction made between patients arresting out of hospital or as in-patients. Patients with a history of trauma in the pre-arrest period were excluded.

The duration of CPR (specifically, the duration of cardiac compressions) was estimated using clinical progress notes, ambulance attendants' records, and cardiac arrest nursing notes. In the case of a patient having several arrests, the total duration of CPR was noted. Anatomic complications of CPR were tabulated according to gross and microscopic autopsy findings as noted by the attending pathologist. When the etiology of a given pathologic finding was in doubt (tracheal vomitus, organ congestion, pulmonary oedema), the finding was excluded as a complication of CPR.

## Results

A total of 82 patients met criteria for entry into the study group. These patients ranged in age from 4 days to 90 years. An examination of the age distribution

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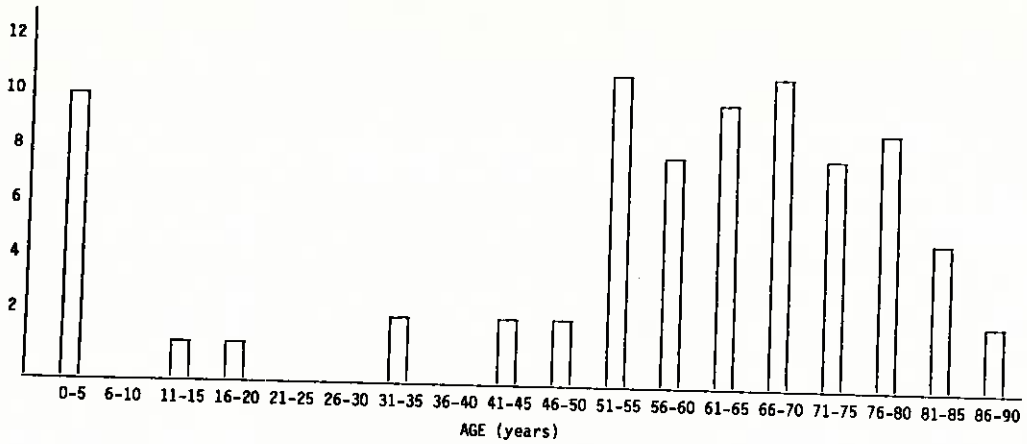


Fig. 1 – *Paediatric and adult study populations*

(Figure 1), revealed two distinct study populations, paediatric and adult. For purposes of analysis, they were considered separately. The paediatric population was defined as less than or equal to 16 years of age (N = 12). The adult population was defined as greater than 30 years of age (N = 70). There were no patients aged 17-32 years.

*Complications* – In the adult population 38 patients (54%) had one or more complications. Twelve patients (17%) had multiple (2 or more) complications.

The most frequent complication (Table I) was that of marrow emboli (24%), followed by rib fractures (23%). In the paediatric population 4 patients (33%) had one or more complictions. Two patients (17%) had multiple complications. These complications (Table II) tended to be more significant in terms of severity than those of the adult population.

*Age and Duration of CPR* – In the adult population, the impact of age and duration of CPR on the complication rate was examined. The results were analysed using the two-sample t-test to compare the means (Table III).

The mean age of the adult population was 65.2 ± 12.2 years (mean ± SD). In the group with complications, the mean age was 68.9 ± 9.5 years, which was significantly higher than 60.8 ± 13.7 years of the group with no complications ($P < .01$).

The mean duration of CPR in the overall group was 32.9 ± 19.8 minutes (mean ± SD). In the complication group, the average was 37.5 ± 22.7 minutes. This was significantly greater than 27.5 ± 14.2 minutes in the group without complications ($P < .05$).

An attempt was made to predict the presence or absence of complications based on the variables of age and duration of CPR using a logistic regression analysis. This analysis indicated that other significant variables, not measured, were necessary to carry out such a calculation.

In the paediatric age group, similar analysis showed that neither age nor duration of CPR had any significant bearing on the presence or absence of complications.

## Discussion

*Rib and Sternal Fractures* – Rib fractures are one of the most common complications resulting from closed chest CPR. The incidence of rib fractures in adults in this review was 23%; this correlated with the results in previous studies which identified a range from 19%[7] to 33%[4]. Sternal fractures were found in only 4% of cases reviewed, less than reported in the literature (9%[7] to 22%[8]).

Rib and sternal fractures are a result of "blunt chest trauma" occurring with chest compressions during CPR. To some extent, bony trauma may result from incorrect hand position during resuscitation; however, the brittle osteoporotic bones of the elderly are also felt to be a significant factor. Children, especially the very young, have very compliant chest walls and, rarely suffer rib or sternal fractures as a result of CPR. Of the 12 paediatric cases in this series there were no patients found with rib or sternal fractures.

The diagnosis of bony chest trauma following CPR is made primarily on the basis of physical examination and plain radiographs. Rib fractures may be identified by palpable crepitus over the bony thorax. Radiographic evaluation following CPR may be misleading,

TABLE I: Incidence of specific CPR-related complications in the adult population (N = 70)

| Complication | Number of patients* |
|---|---|
| Marrow emboli | 17 |
| Fractured ribs | 16 |
| Fractured sternum | 3 |
| Hemopericardium | 2 |
| Pulmonary haemorrhage | 2 |
| Ventricular haemorrhage | 2 |
| Mediastinal haemorrhage | 2 |
| Gastric erosion | 2 |
| – with pneumoperitoneum | 1 |
| Epicardial bruising | 1 |
| Pericardial fluid | 1 |
| Renal perihilar haemorrhage | 1 |

*a patient may appear in more than one category if that patient had multiple complications

TABLE II: Incidence of specific CPR-related complications in the paediatric population (N = 12)

| Complication | Number of patients* |
|---|---|
| Mycocardial haemorrhage | 2 |
| GI hyperemia or haemorrhage | 2 |
| Pulmonary haemorrhage | 1 |
| Bilateral pneumothorax, pneumomediastinum | 1 |

*a patient may appear in more than one category if that patient had multiple complications

as rib and sternal fractures can easily be missed on a single AP chest film. Often the victim of cardiac arrest is critically ill and a proper lateral chest x-ray needed to demonstrate a sternal fracture and oblique "rib views" cannot be obtained.

Although Lockett, et al, have described the use of myocardial imaging using 99m Tc pyrophosphate to detect bone trauma following CPR[9], this technique is not as yet being widely used to detect fractures following resuscitation.

The danger of bony trauma to the thorax, other than impaired ventilation secondary to pain, lies in the potential for injury to underlying organs in the chest or abdomen. Rib fractures, for example, raise concern about the possibility of pneumothorax, hemothorax, and lacerations to the lung, liver or spleen. Similarly with sternal fractures, the physicians must consider cardiac contusion, myocardial rupture, and cardiac tamponade.

*Marrow Emboli* – Embolization of bone marrow fragments during CPR is surprisingly common. Most studies have indicated that the incidence of marrow emboli is less than 20%[4,7,10]. However, a study by Jude et al estimated that 50% of resuscitation attempts were complicated by marrow emboli[11]. This review showed that 24% of adult resuscitations were associated with marrow emboli.

With closed chest massage, the ribs, sternum, and vertebral bodies may be sufficiently traumatized to cause disruption of red marrow, and particles are able to escape into venous channels. Most marrow emboli lodge in the medium and small sized pulmonary arteries; however, distant metastases have been reported.

While marrow emboli are more commonly found in the older age group, it is of note that it is not necessary to have rib fractures to produce bone marrow emboli.

The significance of marrow emboli is currently unknown. There were no cases in this study in which the amount of embolic material to the lungs was thought to be sufficient to be responsible for an unsuccessful resuscitation.

*Visceral Trauma* – Intra-abdominal injury is a less common, but well documented complication of CPR. Several cases of gastric mucosal laceration in closed chest CPR have been described[12,13,14]. In this study two patients were noted to have intra-abdominal injury as a result of CPR.

Tears of the gastric mucosa occur primarily along the left lesser curvature of the stomach. The mechanism for this injury is felt to be a result of high intragastric pressure with the stomach being distended with large volumes of air. This may occur with improper positioning of the jaw during bag and mask ventilation, with inadvertent intubation of the esophagus, or during mouth-to-mouth resuscitation.

In addition to upper GI bleeding, cases of gastric rupture and subsequent pneumoperitoneum have been described[15,16,17]. In this autopsy series, one patient was noted to have had pneumoperitoneum following closed chest CPR. In this instance, a known alcoholic suffered a cardiac arrest, and was successfully resuscitated. Following a difficult intubation, the patient was noted to have a markedly distended abdomen. At autopsy the patient was found to have ruptured through a pre-existing gastric erosion with a resultant large pneumoperitoneum.

Physicians caring for successfully resuscitated patients should be cognizant of these complications and must be suspicious of abdominal distension or upper GI bleeding following CPR.

Liver lacerations and subcapsular hematomas of the liver are also associated with cardiopulmonary resuscitation. While the diagnosis is usually made incidentally at autopsy, patients who have been successfully resuscitated and who have complained of right upper quadrant abdominal pain have been operated on and found to have had significant liver lacerations and hemoperitoneum[18].

Children may be at greater risk of developing liver trauma following CPR because of their high-lying diaphragm and the small size of their chest cavity. There is, of course, the additional problem of exerting excessive pressure to the wrong parts of the chest or abdomen while resuscitating a child[19].

Interestingly, there have been no reported cases of renal trauma resulting from closed chest CPR. In this study, one patient was found to have a large perirenal hematoma, as a result of resuscitation. On review of the chart, no other explanation could be found to account for this finding.

*Cardiac and Mediastinal Trauma* – The incidence of cardiac and mediastinal trauma following cardiopulmonary resuscitation is low. The most common mediastinal injury is mediastinal bleeding. In Powner's series[17], the incidence of mediastinal bleeding was estimated at 4%. In this series, two cases of mediastinal bleeding were found, both caused by misplaced subcla-

TABLE III: Complication rate related to age and duration of CPR

| | Overall | Complications (N = 38) | No complications (N = 32) |
|---|---|---|---|
| Age (Years ± SD) | 65.2 ± 12.2 | 68.9 ± 9.5 | 60.8 ± 13.7 * |
| CPR duration (Minutes ± SD) | 32.9 ± 19.8 | 37.5 ± 22.7 | 27.5 ± 14.2 + |

* $p < .01$
\+ $p < .05$

vian vein catheters which had perforated through the vein and into the mediastinum.

Pericardial bleeding occurs occasionally with an incidence of about 1%. A catastrophic complication resulting from pericardial bleeding is, of course, pericardial tamponade.

Although rare, complications such as myocardial rupture, aortic rupture[20], papillary muscle rupture[21], and disruption of prosthetic heart valves have been described. None of these complications appeared in this study.

*Paediatric Complications* – Unlike adults, rib fractures and marrow emboli seem to occur rarely as a result of resuscitation in children. In this study of 12 patients in the paediatric age group (16 years of age or less), there were no cases of rib fracture or bone marrow emboli identified. This is likely the result of a very compliant chest wall in children.

The results showed a complication rate of 33% in children as compared to 54% in the adult population. While the complication rate in children was less than that in adults, those complications which were identified tended to be more potentially life-threatening (Table II).

Physicians caring for children in the post resuscitation phase should be wary of the fact that myocardial or pulmonary haemorrhage may have occurred as a result of the chest compressions. Similarly, pneumothorax or pneumomediastinum may be present as a result of either ventilation or chest compressions.

## Summary and conclusions

In summary, medical records of 82 patients, adults and children, were retrospectively reviewed to determine the anatomic complications of cardiopulmonary resuscitation. Fifty-four percent of the adults and thirty-three percent of the children demonstrated anatomic complications. The severity of these complications ranged from incidental to life-threatening.

A significant relationship was demonstrated between the duration of CPR and patient age on one hand, and the presence of complications on the other. Further work is necessary to explore this relationship, and to seek out other determinants of complications. This might allow more accurate prediction of complications following cardiopulmonary resuscitation.

Although the nature of this study, including only those patients having had CPR and a full post mortem examination, has obvious limitations in predicting the nature and the frequency of complications in patients surviving a cardiac arrest, the retrospective nature of the study guaranteed that no patient was selected for autopsy because of the study being in progress, and that the pathologist was not examining the patient for specific CPR related injuries. The possiblity that an injury during CPR was suspected, and an autopsy requested on that basis, cannot be ruled out.

Injuries related to procedures performed during the arrest procedure, but not specifically related to cardiac compressions or ventilation, such as was the case with the mediastinal bleeding secondary to the central line, were noted, as were pre-existing conditions which predisposed to further injury during the arrest procedure. Other pre-existing, but undocumented conditions, such as generalized osteoporosis, might well have influenced the results of this study.

As this study was conducted as a post mortem review, no definitive statement can be made regarding complications in the successfully resuscitated patient. However, physicians caring for such patients in the post-resuscitative stage should have a high index of suspicion in seeking out the presence of these complications and be prepared to treat them.

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# Long distance critical care transport

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## Introduction

Critically ill patients are frequently transported from one institution to another when the referring hospital's staffing, space, equipment, or medical expertise are not optimal for providing necessary patient care. Long distance critical care transport, whether by land or air, presents a unique medical situation requiring both technical and medical expertise. The main objective of critical care transport is to deal as safely as possible with the "out of hospital" phase, during which the patient is most vulnerable to deterioration.

The single most important step in ensuring a successful patient transfer, is the appropriate assessment and stabilization of the patient prior to transport. In addition to directing attention to the condition of the patient at the time of transport, it is essential to consider additional problems that may arise during transport, and to ensure that these potential problems have either been eliminated, or means and personnel are available to intervene as necessary. While it is possible to perform certain technical procedures in transit, the environment in either a ground ambulance or aircraft is far from that of the in-hospital setting in terms of space, noise, lighting, mobility and availability of additional personnel and supplies.

The purpose of this article is to outline the general principles of pre-transport assessment and stabilization, to highlight potential problems unique to long distance transport, and to provide guidelines for instituting a safe patient transfer.

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## Assessment and stabilization

In many instances, it is not necessary to have made a specific diagnosis, or to have undertaken definitive treatment (for example with the polytraumatized patient), but whenever possible, the critically ill patient undergoing long distance transport should be adequately oxygenated and hemodynamically stable. The "ABCs" of resuscitation provide a framework for discussing pre-transport stabilization.

### "A"irway

A patent upper airway is mandatory, and is the first priority of pre-transport stabilization. Endotracheal intubation should be performed on all patients . . .

1 who are unable to maintain or protect their airway
2 who require positive pressure ventilation because of inadequate ventilation or for hyperventilation in the setting of raised intracranial pressure or . . .
3 who require pulmonary toilet not obtainable without intubation.

Trauma patients are considered to have a cervical spine injury until disproven radiographically, and following cervical spine immobilization, the blind technique of naso-tracheal intubation is performed if the patient is breathing spontaneously. In cases where breath sounds are minimal or absent, or disruption of facial anatomy makes nasal intubation impossible or contra-indicated, oral intubation with controlled inline traction on the cervical spine may be performed. In certain instances definitive airway control will necessitate cricothyroidotomy or tracheotomy.[1,2]

It is important that the endotracheal tube is adequately secured, and an oral tube protected with a padded bite block to eliminate problems on route. If the patient is to be transported by fixed wing aircraft, sterile water may be used to inflate the cuff of the endotracheal tube to prevent changes in cuff volume occurring with changes in altitude. If air is used to inflate the cuff, the cuff pressure must be readjusted during flight as the cuff will expand with increasing altitude (decreasing atmospheric pressure) and may cause tracheal pressure necrosis; conversely decreased cuff volumes with descent may result in a leaking cuff. As a change in patient status enroute is almost always that of deterioration, it is always safer to err on the side of caution and obtain and maintain definitive airway control prior to leaving the sending centre.[1,3,4]

### "B"reathing

Prior to transport, clinical, radiological, and biochemical (arterial blood gases) assessment of pulmonary function are desirable if available at the sending hospital. Whenever possible, oxygenation and ventilation should be assessed with arterial blood gases. Although helicopter flights take place at relatively low altitudes (approximately 3000 feet) where altitude problems are minimized, it is important to know that most fixed wing aircraft flying at higher altitudes, will have cabin pressures adjusted to approximately 6000-8000 feet; some

TABLE I: Altitude, atmospheric pressure and blood gases*

| Altitude | | Atmospheric PO2 | Alveolar PO2 | Optimal Aterial PO2 |
|---|---|---|---|---|
| Ft | M | | | |
| sea level | | 159 | 107 | 98 |
| 2000 | 600 | 148 | 96 | 86 |
| 4000 | 1200 | 137 | 84 | 73 |
| 6000 | 1800 | 125 | 71 | 64 |
| 8000 | 2400 | 116 | 59 | 55 |

*The CO2 tension remains relatively constant between sea level and 8000 ft provided the expired to alveolar ventilation CO2 ratio does not change.[3]

specialized aircraft will allow cabins to be pressurized to levels below sea level. If the patient is to travel by air, it is important to note that oxygen tension will decrease as altitude increases and thus the patient's arterial oxygen saturation may decrese significantly. The effects of altitude on atmospheric and alveolar PO2, and on arterial PO2 are outlined in Table I. In Table II the equivalent oxygen concentrations necessary to maintain a partial pressure of arterial oxygen (Pa02) of 100mmHg at different altitudes are presented.[3,4,5]

For short trips, of less than one hour in duration, manual ventilation (if indicated) with a bag valve device may be appropriate provided an oxygen reservoir is available to provide oxygen concentrations of up to 100%. On longer transfers, or when special ventilatory modes are required to maintain adequate oxygenation (PEEP, CPAP), a mechanical ventilator may be necessary. The advantages of a mechanical device over manually operated systems include the ability to select specific ventilatory modes, the freeing of an additional pair of hands to aid in other procedures, and the provision of accurate information as to how the patient was ventilated on route (inspired oxygen concentration, tidal volume, ventilation rate and pressures) to assist the receiving hospital in evaluating the patient's status. The disadvantages include the size and weight of some units, large oxygen and air consumption, and the need for personnel experienced in the use of such equipment.

TABLE II: The FI02 equivalents necessary to maintain a PaO2 of 100mmHg

| Meters | 0 | 400 | 1200 | 1800 | 2400 | 3000 |
|---|---|---|---|---|---|---|
| Feet | 0 | 2000 | 4000 | 6000 | 8000 | 10000 |
| | 21 | 23 | 25 | 27 | 29 | 32 |
| | 30 | 33 | 35 | 38 | 42 | 45 |
| | 40 | 44 | 47 | 51 | 55 | 60 |
| | 50 | 54 | 59 | 64 | 69 | 75 |
| FI02 (%) | 60 | 65 | 70 | 76 | 83 | 90 |
| | 70 | 76 | 82 | 90 | 97 | 100 |
| | 80 | 87 | 94 | 100 | * | * |
| | 90 | 98 | 100 | * | * | * |
| | 100 | 100 | * | * | * | * |

*Positive Pressure Ventilation Required [3]

[Example: If an FI02 of 40 percent is necessary to maintain a Pa02 of 100mmHg at sea level, an FI02 of 50 percent (51% on chart) will be necessary to maintain a similar Pa02 at 6000 ft.]

Portable oxygen/air powered ventilators are presently available, and may be used for both ground and air transport. Ventilatory settings should be determined by blood gas analysis, if possible, prior to transport. Whenever a mechanical device is utilized, a reliable manually operated system should be close at hand in the event of sudden equipment or power failure.[6,7]

Whenever ventilating a patient or providing supplimental oxygen, an adequate oxygen supply must be ensured for the duration of the transfer. This means guaranteeing that additional oxygen cylinders are available; examples of the size and capacity of oxygen cylinders are outlined in Table III.[3]

In the setting of air transport, the evaluation and treatment of thoracic injuries is particularly important due to the serious effects of altitude on trapped gases (the volume of a gas is expanded by 30% at 8000 ft), and the difficulty of treating such disorders adequately during flight. It is imperative that large bore (32 French) chest tubes be inserted prior to transport whenever suspicion of a pneumothorax or hemothorax exists. Chest tubes are also recommended in the presence of multiple rib fractures, flail chest, or in the setting of high positive end expiratory pressures (PEEP), (greater than 15cm of water), as such patients are at a considerable risk of developing a pneumothorax. When doubt exists it is much safer to insert a chest tube prophlyactically.[2,3,4]

Placement of chest tubes in the third to fifth intercostal space in the anterior axillary line will provide optimum security and prevent kinking of tubes. As the patient is likely to require at least two bed transfers, it is essential that the chest tube be sutured in place and well protected from accidental removal. Thorocostomy tubes are preferentially connected to an underwater seal, and preferably to a suction and drainage system. Glass drainage bottles are dangerous and awkward during transport and should be replaced with one of the single patient plastic units. Heimlich valves may

TABLE III: Oxygen cylinder capacity and estimated endurance of supply

| Cylinder Size | Capacity (litres)* | Usual Capacity+ | Cylinder WeightFull (lbs) | Endurance and Supply | | |
|---|---|---|---|---|---|---|
| | | | | Flow Rates (litres/min) | | |
| | | | | 4L/min | 8L/min | 10L/min |
| D | 356 | 300 | 11 | 1hr15min | 35min | 30min |
| E | 622 | 600 | 16 | 2hr30min | 1hr10min | 1hr |
| G | 1200 | 1000 | 32 | 4hr10min | 2hr5min | 1hr40min |
| Q | 6320 | 2000 | 70 | 8hr20min | 4hr10min | 3hr20min |
| H&K | 6900 | 6500 | 150 | 27hr | 13hr30min | 11hr |

*Capacity at 20 degrees C., 14.7 PSI (760mmHg)

+ Usual capacity is an empirical calculation making allowances for losses secondary to cracking of the cylinder, variance in flow rates and temperature changes.[3]

occasionally be of benefit, but are easily clogged when there is fluid drainage from the pleural space. It is imperative that clamps for chest tubes be readily available in case of disconnections on route or during patient transfers.

It is also necessary that oropharangeal and endotracheal suction devices be readily available through all stages of the patient transfer; a number of portable suction devices are presently available.[8]

### "C"irculation

With a patent airway and adequate ventilation and oxygenation ensured, the patient's hemodynamic stability is addressed. It is imperative that a patient have at least two intravenous lines during any long distance transport. During transport, it is not uncommon for one line to be lost and it can be very difficult to restart a lost line in a moving ambulance or aircraft, particularly in patients who are peripherally vasoconstricted. By initially guaranteeing the presence of one more intravenous line than is required for fluid and medication administration, problems in transit are less likely to arise.[3]

In the hypovolemic or traumatized patient intravenous lines should be of the largest possible bore, and should be connected to large bore blood tubing in anticipation of the need of rapid fluid replacement or the administration of blood products. Pressure cuffs over intravenous bags may aid flow of fluids when head room is limited, and may be employed to infuse fluid rapidly if the need should arise. Glass bottles should be avoided due to the risk of breakage. It is imperative that adequate quantitites of crystalloid and blood components be taken to cover the transport period.[9]

Application of the pneumatic anti-shock garment in transit, with limitation of space and personnel is not practical; therefore, prior to transport, the garment should be applied to all trauma patients and other patients at risk of developing hypotension. The pump assembly should be attached, so the device can be inflated rapidly should the need arise. When travelling by air the volume within the pneumatic anti-shock garment will rise with increasing altitude. It is important to remember that the converse is also true, and the device will lose volume with descent, at which time the patient's blood pressure may fall. It is therefore advisable to leave the pump assembly attached, and carefully monitor the patient's blood pressure during descent; the garment can then be re-inflated as necessary.[3,4]

Background noise in a transport vehicle makes blood pressure assessment difficult with a stethoscope. Blood pressure can be obtained by palpation or by means of a Doppler device; some specialized transport units allow for continuous hemodynamic monitoring.

A volumetric infusion pump should be utilized for all patients requiring infusion medications. Gravity dependent systems (including the simple elevated IV setup) rely on the fact that gravity will generate a fixed pressure determined by the height of the bag above the catheter site. A system used by many institutions is the IV controller which utilizes a photo sensitive detector to count the number of drops delivered, thus maintaining a pre-set IV drip rate; these systems, however, rely on the above mentioned principles of gravity (and therefore depend on the height of the IV bag) to maintain flow. Because of space limitations, and rapid changes in altitude with air transport, the effects of gravity on flow rates is unreliable. In order to be effective in all transport situations, a volumetric infusion pump is optimal because of its ability to generate pressure. It is recommended that pediatric patients have all IVs maintained on an infusion pump to avoid the risk of over infusion. It is essential to ensure adequate supplies of intravenous infusions and medications to last the duration of the transport.[10]

### "D"isability

NEUROLOGICAL ASSESSMENT
AND STABILIZATION

The two most important aspects of central nervous system management for long distant transport, are those of raised intracranial pressure and protection of the spinal cord. The management of raised intracranial pressure will include intubation and hyperventilation (to 25-30mm Hg PCO2), and, in the non-hypotensive patient, volume restriction and the use of mannitol. Dexamethasone, though not of proven value, may also be administered on the advice of a neurosurgical consultant. Because of the crystalline and unstable nature of mannitol, blood filters are necessary for its administration, and should be included with the transport materials if mannitol infusion is anticipated. A standardized approach to neurological evaluation is essential for relaying accurate information in a way that allows monitoring of changes in neurological status. The Glasgow Coma Scale has become widely accepted as a method for evaluating and recording neurological status, and transport personnel should be familiar with its use.[11,12]

Assessment and stabilization of the entire spine is essential for traumatized patients, and techniques to eliminate possible damage to the spinal cord include the use of cervical collars in combination with other stabilization devices (tape, sandbags, Gardner-Wells tongs) for the cervical spine, transferring the patient by log rolling and securing the patient on a backboard prior to transport. The use of specialized scoop stretchers and mobilizers have made patient transfer both safe and technically simple. Accurate documentation of initial and subsequent findings provide valuable information to the receiving centre.[2,3,13,14]

### Other assessment and procedures prior to transport

The discussion above has focused on the principles and procedures of resuscitation. It is important however,

that other basic procedures be performed prior to transport of the critically ill patient.

A large gastric tube should be inserted, either nasally or orally, unless contraindicated. This may prove a diagnostic tool; more importantly it aids in the prevention of vomiting and aspiration, particularly important in the patient whose injuries dictate he be maintained in the supine position. Land or air travel may induce nausea in a patient not experiencing this in the stationary environment of the hospital. A gastric tube should not however be relied upon to prevent aspiration; concerns about airway protection mandate endotracheal intubation. In patients with gastric distention or ileus, gastric intubation is essential with high altitude travel to reduce gas expansion with changes in altitude to uncomfortable or dangerous levels. This is of primary importance in pediatric air transport, when acute gastric distention may infringe significantly on diaphragmatic excursion, and decrease the adequacy of ventilation.[2,3,4]

In the absence of a urethral injury, an indwelling urinary catheter is important for both monitoring urine output and preventing bladder distention.

The management of lacerations and fractures, will entail dressings and simple reductions and should be dealt with prior to leaving the sending facility, with attention directed to distal neurovascular status before and after manipulation. It is important to ensure that all splinting and traction devices be accommodated in the proposed transport vehicle, and that traction devices be securely tied to avoid changes in tension during movement; weights should not be used during transit. Lower limb fractures and fractures of the pelvis may be splinted with the pneumatic anti-shock garment.[2,3,13,15]

It is important that time not be spent with investigations or procedures that will delay transport and have little or no impact on the patient's management prior to or during transport. Special investigations, such as additional cervical spine X-rays following fracture demonstration in the trauma patient may ultimately be appropriate, but in many instances will not be necessary if the decision for transport has been made and adequate stabilization (ie/C-spine immobilization) can be ensured.

## "Special" patients

It is beyond the scope of this article to describe the specific management of unique patient situations. The neonate may present specific problems (hypothermia or respiratory distress syndrome) and special transport equipment may be necessary (incubator, neonatal airway kits). The high risk perinatal transfer will necessitate obstetrical consultation and specialized monitoring devices (fetal heart monitor). The above discussion has focussed on the basic principles of pre-transport stabilization and each patient may require appropriate specialized procedures or equipment for safe transfer.[16,17]

## Equipment

The specific equipment necessary for transport of the critically ill patient will depend on the individual medical and surgical problems. Features of equipment used for transport should include compactness, both in size and weight, the provision of a long-lasting reliable power source, and most importantly the quality of portable functionability. A list of the types of equipment which should be considered before transport are outlined in Table IV. Advanced preparation is the essential key to successful transport, and it is advisable to have transport packages prepared and labelled in advance, and made easily accessible at the transferring centre. A pre-established system will eliminate oversights caused by rapid preparation of equipment in the hectic time when a critical transport is needed.[7,8,13,14,15,18,19]

TABLE IV: Equipment potentially necessary for long distance critical care transport*

| |
|---|
| **Communication** |
| Radio-communication system (vehicle to Base Station or Dispatch) |
| In-unit communication system (aircraft) |
| **Airway/ventilation** |
| Airways (nasopharyngeal/oropharyngeal) |
| Endotracheal Tubes/stylets |
| Laryngoscope |
| Suction Equipment |
| Oxygen source and masks |
| Air source |
| Bag-valve mask system with reservoir bag |
| Ventilator (portable) |
| Chest tubes and underwater seal units/Heimlich valves |
| **Cardiovascular** |
| IV catheters/tubing/infusion solutions (plastic) |
| Volumetric infusion pump |
| Infusion pressure pumps |
| Cardiac Monitor/defibrillator |
| Pneumatic antishock garment |
| Blood pressure cuff/Doppler System |
| **Digestive/excretory** |
| NG tubes |
| Foley catheters with drainage system |
| **Orthopaedic** |
| Scoop stretcher/back board |
| Splints/traction devices |
| Cervical spine immobilizing devices (collars, sandbags, cervical orthosis) |
| Dressings |
| **Medication drug box** |
| Others: Incubator, fetal monitor, burn dressings, additional batteries |

*Each Clinical Situation will dictate special equipment and medications necessary. All equipment mentioned should be for adult or pediatric use.

## Initiating the transport procedure

One of the most important aspects of transport of the critically ill patient is that communication exist between the referring and receiving physician prior to patient transport. This is critical for several reasons. It is essential that the receiving physician have the capabilities to care for the patient being transported; this will include consideration of appropriate equipment (eg. CT scanner), space (eg. intensive care bed) and staff (eg. specialized surgical teams). The receiving physician frequently will request that specific investigations or procedures necessary for patient stabilization be performed prior to transport. In some instances of transport from one critical care unit to another, it may be appropriate for prolonged periods of stabilization at the referring centre prior to transport. In contrast, in other instances (the polytraumatized patient at a primary centre), it may be more important to transport the hemodynamically stable patient as quickly as possible from the referring to the receiving centre. It is important during this physician-to-physician contact that a plan of stabilization and transport be agreed upon. Prior to transport, it is also imperative that the physician responsible for the patient during transfer be identified. In the absence of a medical or paramedical system where the receiving physician delegates certain acts to specific personnel, the referring physician usually maintains responsibility for the patient until they arrive at the receiving centre.[20]

## Staffing

In many regions of the country specialized transport teams are available through the receiving institution whose sole purpose is the transportation of the critically ill. Because they have the proper equipment, and expertise to make the out of hospital time as safe as possible, such teams should be utilized whenever available. When cicumstances dictate that staff must be provided by the sending facility, certain criteria should be met by those who accompany the patient to provide optimum care. Staff should be familiar with the patient and his/her condition, should have experience and training to provide appropriate emergency care, and should have competence in handling any life support equipment accompanying the patient. A sufficient number of staff are required, considering the limited space available in most vehicles; it is important to avoid duplication of skills among the staff. Orders for the care of the patient during transfer should be clearly documented in writing and reviewed with the staff accompanying the patient prior to leaving the sending hospital. Staff should always ensure that they are familiar with the safety features and emergency equipment of the vehicles used for transport.[20]


Fig. 1 – *A Bell 212 helicopter used for critical care transport in southern Ontario.*

## Type of transport vehicle

A number of factors will determine the most appropriate mode of transport for the critically ill patient. Fixed wing aircrafts are frequently preferred for the long distance transport, as the critical "out of hospital period" is reduced, but often will be impossible (weather conditions, unable to land because of irregular terrain) or relatively contraindicated (Table V). Helicopter transport, because of lower altitude flying will reduce com-

TABLE V: Complications of high altitude transport

| I. Expansion of Gases: | Intervention |
|---|---|
| 1. Within Body Cavities or tissues | |
| Pneumothorax | Chest tube |
| Pneumocephalus | *Fly at low altitude |
| Perforating eye injuries | *Fly at low altitude |
| Gas Gangrene | *Fly at low altitude |
| GI tract/Pneumoperitoneum | *Nasogastic suction, Fly at low altitude |
| 2. Within Equipment | |
| Orthopedic Air Splints | Monitor pressure in splint and status of limb |
| Pneumatic Antishock Garment | Monitor blood pressure and status of limbs |
| Air in IV fluid reservoirs | Close monitoring to prevent air embolism |
| Endotracheal cuff | Inflate cuff with water or monitor cuff pressure during flight |
| 3. Others | |
| Casts on edematous limbs | Splint cast and elevate limb as necessary |
| II. Others | |
| (1) Hypoxemia | Oxygen/Transfuse |
| (2) Anemia | Oxygen/Transfuse |
| (3) Sickle Cell Anemia | Oxygen/Transfuse |
| (4) Decompression Sickness | *Fly at low altitude |

*The decision to transport these patients by air will depend on their clinical status and other modes of transport available. Special air vehicles are available which allow cabins to be pressurized to and below sea level values, thereby minimizing these "high altitude" problems.[3,4]

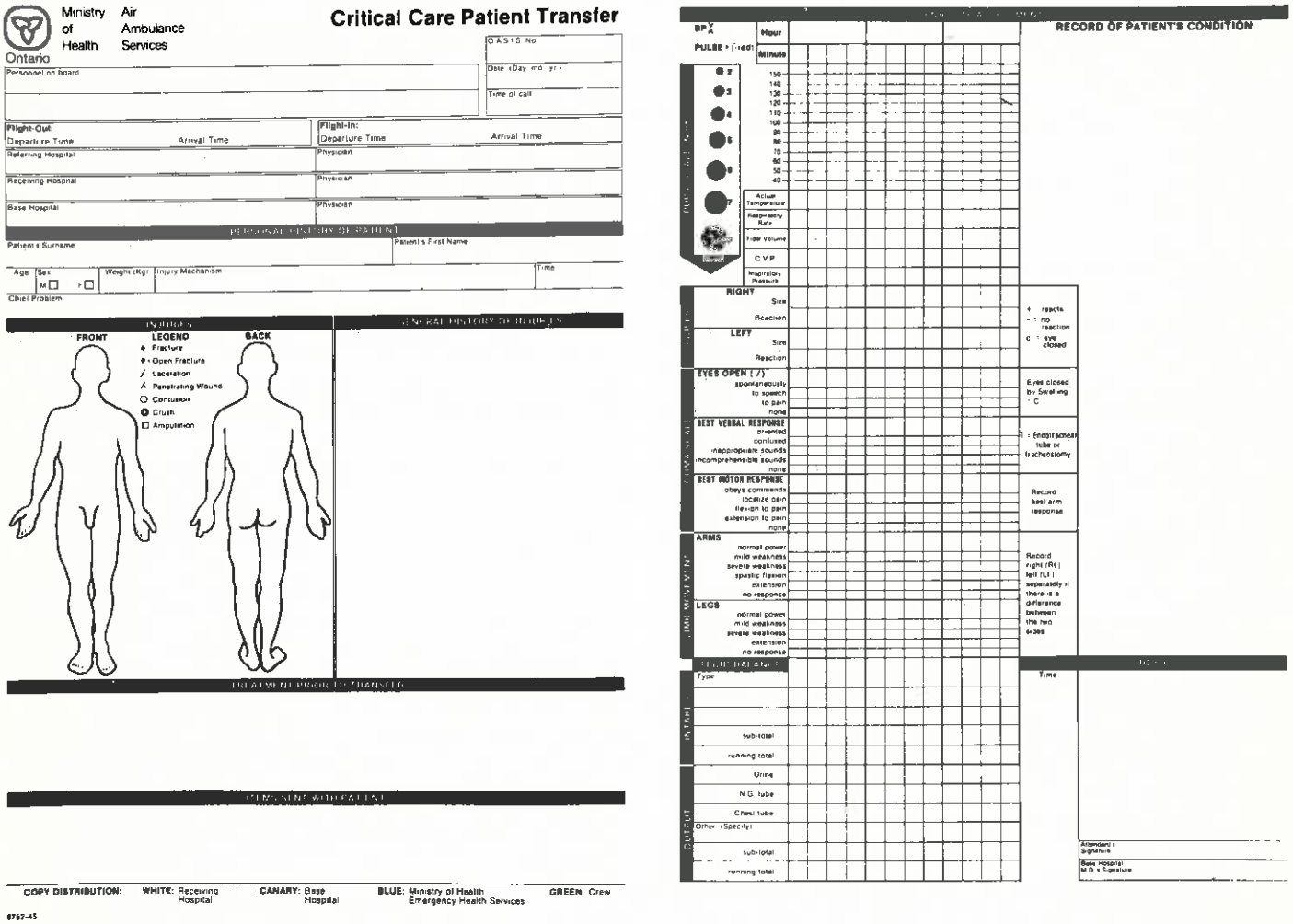


Fig. 2 – *Critical Care Patient Transfer Form*

plications related to high altitude pressure changes, but is limited in distance secondary to reduced fuel capacity. Land transfer will often be the method of choice for short distance transfers, and will at other times be necessary for long distance transfers; the type of land vehicle utilized (basic ambulance versus specialized critical care transport unit) will be dictated by local availability. A discussion between the referring and receiving physician should determine the safest and most rapid means of patient transport. It is important for both referring and receiving physicians to know the types of transport systems available and to know how to access these vehicles through appropriate dispatching services.[3,4,8,16,21]

## Charting

The need for accurate records can not be overemphasized. Well kept records are invaluable as a source of information and are essential to maintain continuity of care. Good records include information regarding time, force and mechanism of injury (if applicable), condition and treatment prior to hospitalization and condition and treatment within the hospital environment. Records including both physician and nursing notes should accompany the patient along with X-rays, lab reports and specimens. Forms for use in transit are valuable as writing extensive notes is not possible and yet essential documentation should be recorded; an example of an aeromedical transport form is included in Figure 2.

## Summary

This article highlights the stabilization, equipment and personnel necessary for the emergency transfer of critically ill patients. With adequate stabilization prior to transport, good planning in terms of equipment and medication needs, and attention to potential problems before they arise, critically ill patients can be trans-

ported with confidence to a facility best able to meet their continuing needs.

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# Acetaminophen poisoning: how should we treat it?

MILTON TENENBEIN MD FRCP(C)*

Acetaminophen overdose is a common emergency department presentation. Although N-acetylcysteine has emerged as the agent of choice to prevent hepatotoxicity, its method of administration remains as a topic of debate. Prescott from Edinburgh favours intravenous administration while Rumack from Denver recommends the oral route. Before discussing this controversy, acetaminophen poisoning will be reviewed.

Relatively speaking, acetaminophen is not especially toxic. Mortality from acute ingestion, untreated with specific antidote, is low. Salicylate overdose is more dangerous with a case fatality rate (deaths per 100 poisonings) ten times greater. Acetaminophen's pharmacology and toxicology has been thoroughly reviewed by Jackson et al. Briefly summarized, an acute ingestion of at least 7.5 gm in an adult or 150 mg/kg in a child has the potential for causing toxicity. The liver is the target organ and symptoms and signs of hepatotoxicity do not occur until a few days after the ingestion. However, it is not well appreciated that during the first 12 hours post ingestion of toxicologically significant amounts, gastrointestinal disturbances such as nausea, vomiting and abdominal discomfort are the rule. Most patients who develop hepatotoxicity survive and do not develop long-term hepatic structural or functional abnormalities.

The mechanism of hepatotoxicity is well known. Normally the liver metabolizes acetaminophen by either glucuronidation or sulfation with small amounts entering the cytochrome P-450 mixed function oxidase system. The product of the latter pathway is hepatotoxic but it is inactivated by combination with hepatic glutathione. In overdose situations, the glucuronidation and sulfation pathways become saturated resulting in increased activity of the cytochrome system. Glutathione depletion follows shortly thereafter leaving the liver defenceless against the action of free hepatoxic metabolites. Specific therapeutic interventions directed towards prevention of liver damage provide alternate sulfhydryl groups to bind this toxic metabolite. N-acetylcysteine is such an agent. Maximum benefit is derived from treatment within the first 10 hours of overdose. Treatment between 10 and 24 hours is felt to be worthwhile.

Acetaminophen induced hepatotoxicity in children less than 10 years of age is very rare. Although a child's liver is inherently more resistant to the toxic effects from overdose of this drug, this is not the chief reason for this observation. Rather, small children usually ingest pediatric acetaminophen preparations. In Canada, the total amount of acetaminophen per package of infant drops, pediatric syrup or chewable tablets is limited by law so as not to cause significant toxicity after acute overdose of the entire amount. Therefore nothing other than reassurrance is required for the over 12 kg toddler who has ingested the equivalent of one package or less of a pediatric acetaminophen preparation. The figure of 150 mg/kg (which is relatively conservative) can be used as a guideline for therapeutic interventions.

Serious adult toxicity due to acetaminophen overdose in Canada should decrease because of a recent federal regulation. It states that the total amount of acetaminophen per package that can be displayed in pharmacies cannot excede 24, 325 mg tablets. Larger amounts are potentially available to the consumer through a physician's prescription of acetaminophen-codeine compounds. All physicians would be practising sound preventive medicine by not exceeding 20 tablets per prescription.

Any adult who may have ingested at least 7.5 gm or any child who may have ingested at least 150 mg/kg of acetaminophen within the last 4 hours urgently requires an appropriate "gastric emptying" procedure (induced emesis or gastric lavage). Subsequent administration of activated charcoal is effective in preventing further absorption of acetaminophen as well as any other co-ingestants. However, it should not be given if oral antidotal therapy is planned because it can bind the antidote thereby preventing its absorption and subsequent effectiveness. Blood for acetaminophen level should be drawn at 4 or more hours post ingestion.

N-acetylcysteine therapy, either intravenous or oral, should be begun if the patient presents within 24 hours of ingestion and fulfills any of the following criteria:

1 Has a plasma acetaminophen level falling within the area of the acetaminophen nomogram that indicates potential hepatic toxicity.
2 Could have ingested at least 7.5 gm (adult) or 150 mg/kg (child) of acetaminophen and blood levels are completely unavailable.
3 Could have ingested at least 7.5 gm (adult) or 150 mg/kg (child) of acetaminophen and is seen greater than 10 hours post ingestion.
4 Could have ingested at least 7.5 gm (adult) or 150 mg/kg (child) of acetaminophen and the result of the blood level will not be available before 10 hours post ingestion.

*From the Manitoba Poison Centre

All patients in the above groups 1 and 2 must receive an entire course of N-acetylcysteine. In other situations an entire course may not be necessary:

1 N-acetylcysteine may be discontinued in the above groups 3 and 4 if the initial acetaminophen level falls within the non-toxic section of the nomogram.
2 For patients in whom decisions regarding discontinuation cannot be made because the time of ingestion is uncertain a second acetaminophen level should be drawn 4 hours after the first. If it is 50% or less than the first level (indicating a half-life of less than 4 hours) N-acetylcysteine therapy can be discontinued.

**Intravenous vs Oral N-Acetylcysteine**

In the United States neither the oral nor the intravenous preparation has received regulatory approval and only the former is widely available. Therefore the American clinician's choice is simple. However both dosage forms have been approved for use in Canada and are widely available. There is debate as to which protocol is superior. My recommendation is that intravenous N-acetylcysteine is the therapy of choice for acute acetaminophen ingestion.

Intravenous administration of N-acetylcysteine has several advantages. It takes less time to complete (20 vs 72 hours) and the use of activated charcoal is not precluded. Its absorption is unaffected by the commonly occurring spontaneous emesis of significant acetaminophen ingestion. And, N-acetylcysteine being quite foul tasting, commonly induces emesis after its oral administration. This would not occur after intravenous administration.

The most important advantage of intravenous over oral therapy is that it is more efficacious. Only each original series of Prescott and of Rumack (cited below) can be compared with each other because of similar evaluative criteria in each study. When begun within 10 hours of overdose, intravenous therapy provided protection from severe hepatotoxicity in 98% of the cases as opposed to 83% for oral therapy ($p < 0.005$). When started between 10 and 24 hours both methods showed some efficacy which rapidly decreased with time following ingestion.

A commonly cited advantage of oral therapy is that it would produce higher hepatic levels of the antidote. But portal vein N-acetylcysteine levels have never been measured, rendering this assertion speculative. One may equally speculate that because of the commonly occurring emesis, and because of occasional prior treatment with charcoal, that lower concentrations of this antidote may be attained in the liver after oral therapy. In fact this may be the reason for the observed decreased efficacy of this therapy.

There is one major disadvantage of intravenous N-acetylcysteine therapy. Hypersensitivity-like reactions have occurred during its administration. These reactions occur at a rate of 0.2-3.0% and are most likely dose dependent and not a true allergy. In cases of iatrogenic overdose of N-acetylcysteine these manifestations occur more regularly and in a more severe form. Patients who have experienced such reactions have been skin tested to differing doses of N-acetylcysteine. They reacted to only the higher dose suggesting a dose-response relationship. This evidence suggests that N-acetylcysteine promotes histamine or other mediator release in a dose dependent fashion. The mechanism for these reactions is important. Dose dependency implies potential controllability. Rather than giving the initial bolus dose in 15 minutes it can be infused over 1 hour to lessen the likelihood of reactions.

Most of the observed reactions have been mild and easily controllable with an anti-histamine. Additional N-acetylcysteine has been given following anti-histamine therapy without any further problems. However, some serious reactions have been described ranging from one case of an anaphylactoid reaction to a few cases of bronchospasm. Because of this, and despite the disadvantages or oral therapy, some emergency physicians may wish to use oral N-acetylcysteine for acute acetaminophen overdose.

**Additional Reading:**


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## ERRATA

*In the Toxicology Forum in the April 1985 edition of the CAEP REVIEW, "Tricyclic antidepressant poisoning: Three major controversies", an error was made in the order of the paragraphs, such that the treatment is included in the area subtitled "Kinetics". Apologies for this error are extended to both Dr. Tenenbein and our readers.*

Explanation: On page 46, the paragraph starting – *"The half-life may also be prolonged . . ."* and ending – *". . . signs that can occur in the clinical situation."* – (top right column) should be followed by the sub-headings (and their respective texts) – *"CLINICAL PRESENTATION": "PATHOPHYSIOLOGY": and "MANAGEMENT."*

The paragraph shown immediately following the above paragraph in the April issue – *"Serious dysrhythmias require treatment."* – should follow after the paragraph ending – *". . . resulting in the need for different therapies."* – under the sub-heading – *"MANAGEMENT"*.

# Meetings to note

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The CAEP Review adheres to the requirements for manuscripts submitted to biomedical journals as contained in the declaration of Vancouver of January 25th, 1978.*

Manuscripts should be typed, double spaced including the title page, abstract, text, acknowledgements, references, tables and legends and illustrations. Each component of the manuscript should begin on a new page. Authors should keep copies of everything submitted.

**Title Page** The title page should include the title of the article which ought to be concise and informative. The title should be amenable to indexing. The title page should also contain the full name, academic degrees, and affiliations of each author. The title page should include the name of any organization sponsoring an assembly or meeting in which the article may have been originally presented. If the research has been supported by grants, such financial support should be acknowledged on the title page. Finally, the title page should also contain the address for reprint requests.

**Abstracts** All original contributions and review articles should be preceded by an abstract, typed, double-spaced on a second page following the title page. The abstract should be no more than 150 words, stating the purpose of the study, basic procedures involved, principal findings including statistical significance, and principal conclusion drawn. Abbreviations or symbols should be avoided wherever possible. Below the abstract up to 10 key words or short phrases should be provided which will assist indexers in cross-indexing articles.

**Text** The text of original articles of a basic science or clinical nature should conform to ceptable standards for scientific articles. It should be divided into introduction, methods and materials, results, and discussion section.

**Introduction** The introduction section should clearly state the purpose of the article and should give only references pertinent to the rationale for undertaking the article. The review of the literature should not be included in the introductory section.

**Methods and Materials** The methods and materials sections should clearly and thoroughly outline the methodology and materials employed in the undertaking of the study. In particular, the selection of clinical or experimental subjects should be well defined, apparatus used should be specified, and references relating to the selection of materials and methods should be given, such that other investigators can reproduce the methods and evaluate the results. Any new or substantially modified methods should be described fully, giving reasons for their use and evaluating their limitations.

**Results** The results of experiment should be presented in a logical sequence in the text with tables, illustrations, graphs, etc. to clarify important results or observations.

**Discussion** The discussion of the findings should relate the observations to other relevant studies. It should emphasize new and important aspects of the study and conclusions. The discussion section should not comprise an exhaustive literature review.

**Acknowledgement** Persons who have made a substantial contribution to the study, yet who are not listed as authors may be acknowledged.

**References** References should be listed in the form as adopted by Index Medicus and the National Library of Medicine in United States. All authors should be listed in studies with three or fewer names. Otherwise, the first three names only should be listed. Journal name should be abbreviated again according to the style in the Index Medicus. The title of the article should be included.

**Tables** Each table should be typed separately on a piece of paper double-spaced. Tables should have a short heading. Explanations should appear in the footnote not in the heading. If data is from other sources, this should be indicated and permission should be obtained and acknowledged. Tables should not be submitted as photographs.

**Illustrations** Illustrations should be submitted as sharp, glossy, black and white photographs 5 x 7 or 8 x 10 (12.7 x 17.3 cm. or 20.3 x 25.4 cm.) Figures should be professionally drawn, lettered and photographed – free-hand or typewritten letters are unacceptable. Lettering should be consistent throughout and sufficient size that when photo reduced will still be legible. Illustration should be accompanied by a brief legend on a separate piece of paper indicating the purpose of the content of the illustrations. Abbreviations should be avoided or explained. Photographs of patients who are recognizable should be accompanied by a consent form.

## Preparation of other material

The Review will consider material other than original experimental work. In particular, the Review will from time-to-time publish review articles from experts in the field who have conducted a thorough literature search. Papers submitted of this nature should comprise of extensive literature reviews on a narrow clinical topic, well-referenced, and of significant relevance to the clinical practice of Emergency Medicine.

Emergency case reports will also be accepted for publication. Such papers should comprise a brief factual presentation of an emergency case. Reports accepted for publication will be of cases of unusual problems or innovative therapies. Following the case presentation should be a brief discussion of the diagnosis and treatment and subsequently, a brief review of related literature.

The Review will also consider for publication, guests editorials from time to time. These should represent an authoritative opinion or comment on current problems faced by Canadian Emergency Physicians. They may relate to the educational, clinical research, administrative, political aspects of Emergency Medicine.

Letters to the Editor will be published regularly in the Review. Such letters should be addressed to the Editor and should comprise brief comments on topics recently discussed in the Review or elsewhere. In addition, brief communications of cases or other items of interest will be considered for publication in this section from time to time. In each case, the letter must be clearly signed by the author with a return address, and permission to publish indicated.

## Approval to publish

All manuscripts submitted for publication will be reviewed by the Editor or other members of the Editorial Board. If any substantial changes are to be made in the manuscript, a copy will be forwarded to the author prior to publication for approval. Authors are responsible for all statements made in the text including changes suggested by the Editor. No changes will be accepted after final approval by the author has been made.

## Deadlines

The CAEP Review is a quarterly publication with press dates the first day of each quarter. Copy deadlines are the 8th of the preceding month. Material to be considered for publication and review by the Editorial Board should be submitted at least sixty days prior to publication to date.

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*These requirements known as the Declaration of Vancouver were agreed upon at that city on January 25th, 1978. Members of the International Steering Committee included J.F. Murray, M.D. (Chairman); E.G. Huth, M.D.; S. Lock, M.A.M.B.; W.R. Barclay, M.D.; S. Crawford, Ph.D.; R.W. Mayo; H.R. Meiss; I. Munroe, M.D.; F.H. Porcher, M.A.; A.S. Relman, M.D.; D.A.E. Shephard, M.B.; T. Southgate, M.D. Enquiries regarding the Declaration should be sent to Dr. E.J. Huth, Annals of Internal Medicine, 4200 Pine Street, Philadelphia, PA 10904 U.S.A.