Transport Bulletin

Sept./Oct.'00

American Association for Respiratory Care

Notes from the Editor

by Steven E. Sittig, RRT

As I write this edition of my "Notes from the Editor" in mid-August, I cannot help but wonder where the summer has gone. I hope everyone has had an enjoyable summer and that you had time to get away from work for a while and enjoy yourselves. If you're like me, vacations never last long enough and returning to work is never easy after having been on one!

Not long ago, I went on a rotor wing flight to western Wisconsin. Flights to the Wisconsin area are almost always very scenic. The terrain changes from the relatively flat farmland of southeast Minnesota to that of wooded hills and bluffs amongst farms and fields. The call came in at 5 a.m., and we were airborne shortly thereafter. Our flight time to the referral hospital was about 35 minutes. As we flew eastward, we caught the first glimpse of the sun coming up over the horizon. I love to fly early in the morning, as it is such a great part of the day. The downside to this flight was that I was surely not going to end up going home on time.

As the sun slowly rose in the sky, the colors of the trees and the fields changed from dull dark grays to deep vibrant greens. In the valleys, thick fog covered the floor. From a distance this fog bank made us feel as if we were approaching a lake that surrounded the wooded hills and fields.

Since we had yet to pick up our patient, I had the luxury of enjoying the scenery. As I noticed a small group of deer near a tree line, I thought to myself how lucky I was to have a job that affords me the opportunity to see the start of such a beautiful summer day. Some days we need to sit back and just appreciate the things around us. Even though the workday may get to be long and stressful, there is almost always something you can appreciate and take home at the end of the day.

One last item I wished to pass on to the readership. I am sure you all heard about the two unrelated air medical helicopters that went down on July 25. Life Flight from Georgia went down with all three crew members perishing. The same day in Australia, an air med helicopter went down with five onboard, including a pediatric patient and the patient's mother. It seems this sort of news has been happening all too frequently. We in the transport industry know that every time we board an aircraft for a flight there is risk. It is a risk we are willing to take in order to help the patients we serve. I just wish to remind the readership that there is an excellent website where you can get information, and most importantly, sign a virtual condolence book that is sent to the program that has incurred the loss. We in the air medical community are a tightly knit group of people, and when we hear of an aircraft going down with loss of life, we feel that loss – even though we most likely never knew the crewmembers.

If you have not already guessed it, the web page is called Flight web and the address is www.flightweb.com. Rollie Parrish has developed an excellent site, and there are many other features to be found there, including ongoing posts concerning transport issues. I highly recommend you check out this web site.

Until next time, may all your transports end safely for both you and your patients. ■

The Transport Community: *ASTNA*

Editor's Note: *The Transport Community is a new feature of the Bulletin that will take a closer look at some of the other organizations in our industry. This issue we feature the Air & Surface Transport Nurses Association.*

The Air & Surface Transport Nurses Association (ASTNA), which is also known as the National Flight Nurses Association, is a nonprofit member organization founded in 1980 with the mission of representing, promoting, and providing guidance to professional nurses who practice the unique and distinct specialty of transport nursing. ASTNA currently has about 1800 members who primarily work in adult, helicopter, ground, and fixed wing EMS programs. Most members are registered nurses. The organization sponsors special interest groups for ground, maternal, military, pediatric, perinatal, and fixed-

"ASTNA" continued on page 2

"ASTNA" continued from page 1

wing sub-specialties, and has ten regional chapters across the nation. According to the ASTNA web site, the group's objectives are to:

- Provide clear and decisive leadership for the unique and distinct professional specialty of transport nursing.
- Facilitate opportunities for communication and collaboration among transport nurses.
- Provide representation and liaison in forums that relate to the practice of transport nursing.
- Support and promote scientific research that enhances transport nursing knowledge and air medical patient care practice.
- Promote continuing education specific to the advancement of transport nursing.
- Serve as an information resource about transport nursing and air medical care delivery systems.
- Maintain organizational competency and strength.

Position statements published by the ASTNA include:

- Care of the Pediatric Patient During Interfacility Transfer
- Educational Recommendation for Nurses Providing Pediatric Emergency Care
- Flight Nurse Certification
- Flight Nurse Safety in the Air Medical Environment
- Improving Flight Nurse Safety in the Air Medical Helicopter Environment
- Intravenous Conscious Sedation in Air Medical Transport
- Role of the Registered Nurse in Basic Life Support Air Transport
- Role of the Registered Nurse in the Prehospital Environment
- Staffing of Critical Care Air Medical Transport Services
- Statement of Drug Testing for Flight Nurses

For more information about the ASTNA, contact the organization at: Air & Surface Transport Nurses Association, 915 Lee Street, Des Plaines, IL 60016-6569, (847) 460-1170, FAX 847/460-4001, www.astna.org. ■

Transport Bulletin

is published by the
American Association for Respiratory Care
11030 Ables Lane
Dallas, TX 75229–4593
(972) 243–2272
FAX (972) 484–2720
e–mail: info@aarc.org

Kelli Hagen
AARC communications coordinator

Debbie Bunch
Bulletin managing editor

Edwards Printing
Bulletin typesetting

Chair
Jerry Focht, RRT
Northwest MedStar
P.O. Box 255
Spokane, WA 99220–2555
(800) 572–3210, ext. 2
FAX (509) 455–4734
e–mail: focht@arias.net

Bulletin Editor
Steven E. Sittig, RRT
Mayo Clinic Transport Team
(507) 255–5696
e–mail: sittig.steven@mayo.edu

Internet Coordinator
David Lucero, BS, RRT
(719) 365–5615
e–mail: David_Lucero@memhospcs.org

CAMTS Representative
Thomas J. Cahill, RRT, NREMT–P
Shriners Hospital for Children
Cincinnati Burns Institute
(513) 872–6000
e–mail: tcahill@shrinenet.org

Medical Advisor
William Bernhard, MD
(410) 272–7259

Head Trauma in the Transport Environment and in the Clinical Setting: *Part Two*

by Steven Sittig, RRT

Editor's Note: *Part One of this article appeared in the July-August issue of the* Bulletin.

In the first installment of this article, we looked at the history and early research that has led to our current understanding of head trauma. In this installment we will look at the reasoning behind current suggested medical care of the patient with head trauma.

In trying to understand this condition, one must review some basic concepts of head injury. There are actually two types of head injury, aptly called primary injury and secondary injury. Primary head injuries occur at the time of the trauma to the head and are irreversible. Examples of primary injury are brain lacerations, avulsions of cerebral matter, and diffuse axonal injury. Neurologic tissue cannot be repaired, and no treatment is available for primary injury. The most severe primary injuries generally result in fatalities on scene.

Secondary injuries are pathophysiologic processes that are initiated by the accident and continue to injure the brain. These processes of secondary injury can be interrupted, therefore preventing further brain injury from occurring. Cerebral swelling is an example of secondary injury and is the current focus of most head injury management. As the brain swells in response to injury, the injury spreads by mechanical compression on the brain tissue. As vessels are compressed in the brain, ischemia is produced, and intracranial pressure is increased, opposing the brain's supplied perfusion pressure by the heart.

Cerebral edema is not the only form of secondary injury to the brain. At the time of injury there are changes in cerebral blood flow that predispose the brain to ischemic injury. Also, the brain cannot compensate for declines in oxygen delivery after it has been injured; therefore, it becomes very susceptible to hypoxia. Finally, it is becoming apparent that inflammatory cascades are triggered in the brain at the time of injury and continue to damage tissue long after the injury. The only possible goal for the treatment of head injury is to limit or prevent secondary injury. The rapid identification and evacuation of mass lesions remains a cornerstone of medical management of head injury.

Fortunately, there are many modes to help prevent this secondary injury, such as oxygenation, adequate blood pressure maintenance, elevation of the head, hyperventilation, mannitol, ICP monitoring, perfusion pressure elevation, ventriculostomy, and barbiturates. Inadequate oxygenation and perfusion in the field is as damaging to the injured brain as the failure to identify and evacuate a clot.

Transport crews need to broaden their brain resuscitation paradigm from the "fly faster to the operating room" or "swoop and scoop" mentality to one that appreciates the importance of early oxygenation, perfusion, and ICP control in the injured brain. The good thing is that all these modes of limiting secondary injury are available to the transport team. Oxygenation, blood pressure maintenance, head of bed elevation, mannitol, and hyperventilation seem deceptively simple, but these modes are crucial. If they are not utilized properly, they can have a profound impact on the patient's outcome. In the end, if the brain is not adequately perfused and oxygenated in the first minutes after the injury, a good outcome may not be possible for the patient.

Hypoxia

Hypoxia is well known to be deleterious to the head-injured patient. Good evidence

"Head Trama" continued on page 3

"Head Trama" continued from page 2

exists that head-injured patients who present with a PaO_2 <60 have worse outcomes than those who do not. Yet many head-injured patients continue to present in a hypoxemic state, implying that many prehospital caregivers do not appreciate the low tolerance of the injured brain to even brief episodes of hypoxia. In the National Trauma Coma Databank, a PaO_2 <60 mmHg was found to be one of the top five predictors of poor outcomes in severely head-injured patients. This finding should be well noted because it shows that keeping patients adequately oxygenated is as crucial to good outcomes as reducing ICP.

What constitutes an adequate PaO_2 is not known, but some early data from measurements of the brain's tissue oxygen tension have established a normal brain tissue oxygen pressure of 20 to 40 mmHg. A brain tissue oxygen level of 10 to 15 mmHg is considered hypoxic. Based on work done by Kiening, brain tissue pO_2 in the hypoxic range corresponds to an arterial PaO_2 <100 mmHg. This finding shows that a PaO_2 <100 may not provide adequate oxygenation for brain resuscitation and the PaO_2 should never be below 60.

It is imperative that transport teams realize the importance of adequately oxygenating severely head-injured patients. Although medical transport personnel feel this is an obvious part of practice, the data show that it is not occurring at least 30% of the time. Therefore, at least 30% of the time inadequate oxygenation levels are contributing to increased secondary injury to the brain.

Hypotension

Hypotension has long been acknowledged as a major cause of morbidity and mortality in head-injured patients. The National Trauma Coma databank found a systolic blood pressure of less than 80 and an ICP of greater than 20 to be the most important factors in determining outcome for head injury patients. As with oxygenation, the minimum adequate is not known, although a systolic blood pressure of 90 has been shown to be the level below which outcomes are poorer.

In a study by Chestnut, it was found that even one single episode of a systolic BP less than 90 significantly worsened outcomes statistically. Recalling that even one episode of hypotension can have serious consequences, transport teams should not be complacent about blood pressure management. Once again, the obvious and routine turns out to be crucial for good recovery from head injury.

The perfusion pressure of any organ is the difference between the arterial inflow and the venous outflow pressures. The mean arterial pressure (MAP) represents the cerebral arterial inflow pressure, and the pressure in the delicate cerebral veins represents the venous outflow pressure. Since it is not possible to actually measure this venous pressure, data obtained by Luce, et. al., have demonstrated that intracranial pressure very closely resembles cerebral venous pressure. Because of this relationship, ICP can represent cerebral venous pressure. To calculate the cerebral perfusion (CPP), one need only subtract the ICP value from the MAP.

In an uninjured brain, cerebral blood flow remains constant over wide variations in CPP because the cerebral vascular resistance (CVR) changes in response to changes in CPP. This adjustment of CVR is known as the principle of cerebral autoregulation. However, autoregulation is generally impaired after head trauma, so that CVR becomes constant, and as a result, CBF is entirely dependent on CPP.

Recent evidence has correlated poor outcomes after head injury with a CPP of 60 mmHg or less. One must realize that either an increasing ICP or a decreasing MAP may attain a CPP of 50 to 60. Therefore, management of adequate blood pressure is needed to ensure an adequate CPP.

Hyperventilation

Hyperventilation has been a tool available to transport teams for some time. Recent publications have now questioned whether this modality may at times do more harm than good. It has been shown that many patients who die of traumatic brain injury (TBI) have histologic evidence of cerebral ischemia. As previously described, some of this mortality is a result of inadequate blood pressure management and oxygenation. But there is more to this discussion, as it has been noted that in the first 24 hours after a head injury, cerebral blood flow declines, at times to near ischemic levels.

Why this decline occurs is not totally understood, but by no means is it certain that the brain does not operate near ischemic thresholds soon after injury. Hyperventilation reduces cerebral blood volume by reducing the caliber of cerebral blood vessels. This reduction in cerebral vascular caliber, however, also reduces cerebral blood flow, which occurs at a time when the brain may be operating at near ischemic levels. The fear is that hyperventilation, although reducing ICP, may also be contributing to cerebral injury by increasing the ischemia the brain is experiencing. The benefit of ICP reduction with hyperventilation has to be balanced with the threat of cerebral ischemia.

Some troubling data have been obtained from jugular venous catheters (JVCs), which are used to measure the oxygen saturation of blood leaving the brain. As the brain becomes ischemic, the percentage of oxygen it consumes increases. So the oxygen saturation of blood leaving the brain decreases. JVCs are used to monitor brain ischemia or low cerebral blood flow through this type of desaturations. In traumatic brain injury, desaturations of less than 50% are associated with poor outcomes.

In 1991, Cruz, et. al., found that hypocapnia induced by hyperventilation was associated with significant jugular venous desaturation. Patients with a mean PCO_2 of less than 22 had a mean SjO_2 of 45, whereas those with a mean pCO_2 of 32 had a mean SjO_2 of 59.

In another study by Sheinberg, researchers found significant desaturations in 10 of 33 patients with a pCO_2 less than 28. This collection of data implies that hyperventilation is often associated with significant ischemia.

While hyperventilation is apparently effective in reducing ICP in some patients, it is more effective at reducing cerebral blood flow and may actually lead to more ischemia and poorer outcomes. For this reason, current American Association of Neurological Surgeons (AANS) guidelines on hyperventilation specify it should be used only when absolutely indicated.

The practice of hyperventilating all patients with suspected head injuries during transport can no longer be supported. The guidelines say that only patients who show objective signs of herniation, such as unilateral or bilateral pupillary dilation, asymmetric pupillary reactivity, motor posturing, or deterioration in neurologic examination, should be hyperventilated. In paralyzed patients these last criterion are not available. Only in the presence of these signs should hyperventilation be used. All other patients with depressed mental status but no signs of herniation should be kept at a pCO_2 of 35 to 40.

Mannitol and glucocorticoids

Mannitol is another drug that can be used by transport teams to help reduce ICP by establishing an osmotic gradient between plasma and cells and acting as a plasma expander that reduces blood viscosity and increases cerebral oxygen delivery and cerebral blood flow. The rapid effect of mannitol is most likely due to increased oxygen delivery, as it takes 15 to 30 minutes for an osmotic gradient to be established.

Mannitol, like other hypertonic fluids, can cause the blood/brain barrier to open. With repeated or prolonged administration, this opening of the blood/brain barrier can cause an accumulation of mannitol in the brain. With this increased level of mannitol in the brain, an unwanted reverse fluid shift into the brain can be created. Therefore, mannitol should only be given as a bolus.

Mannitol is excreted entirely in the urine. At serum osmolarity greater than 320 mOsm, the risk of acute renal failure from acute tubular necrosis becomes significant, especially in patients with preexisting renal failure or in those who are receiving nephrotoxic drugs. Like hyperventilation, mannitol is not a cost-free therapy and should not be used unless clinically indicated by signs of herniation or progressive neurologic deficit.

In addition, mannitol should only be given to patients who have been adequately fluid-resuscitated, and euvolemia must be maintained throughout the management of all head-injured patients. It is also suggested that mannitol not be given to patients with a serum osmolarity of greater than 320 mOsm, as it

"Head Trama" continued on page 4

"Head Trama" continued from page 3

may injure neurons. Mannitol also has the side effect of depleting the body's stores of sodium and potassium, as well as water, and must be used cautiously, especially in head-injured children, as it may transiently increase intravascular volume, CBF, and ICP.

Corticosteroids have also been used in head injury patients, as they are assumed to prevent vasogenic brain edema through stabilizing effects on vascular membranes. The literature is varied on their use and depends on each practice. The AANS guidelines do not specifically recommend their use.

Conclusion

While the transport of head-injured patients needs to be rapid to ensure proper neurologic care, it must be stressed that there is a lot the transport team can do to help improve the patient's outcome. Simple things like adequate oxygen levels, blood pressure management, and the use of select pharmacology when indicated can make significant impact on long-term outcomes. Since there are many theories as to the best way to manage head trauma, local practice may vary. I hope this overview will help you in your involvement with head trauma in the transport setting or in the ICU. If you would like to read more on this subject, I suggest the AANS Guidelines for the Management of Severe Head Injury; Chapter 93 (pages 1095-1111) of Kazmarack and Pierson's *Comprehensive Respiratory Care*; and the April-June 1999 issue of the *Air Medical Journal*, which was the basis and main reference for this article. ■

CAMTS Update

by Thomas J. Cahill, RCP, RRT, NREMT–P

The Commission on Accreditation of Medical Transport Systems (CAMTS) Board of Directors met in Cincinnati, OH, on July 15 and 16. Members reported that the fiscal year ended in the black, with the loan to AAMS paid off. Financial and marketing incentives for programs that are reaccrediting were also discussed. Linda Rifenburgh, and Albert Michaels, from the FAA, were welcomed to a luncheon. Rifenburgh described her daughter's air transport experience two years ago. (Her experiences are also featured in the CAMTS June, 2000 newsletter in an article entitled "Megan's Story.") Rifenburgh intends to pursue public and governmental support for legislative efforts and adherence to air medical transport standards.

The Board deliberated on 12 programs requiring accreditation actions. Of the 12, the following actions were decided (RW= Rotorwing FW=Fixed Wing G=Critical Care Ground):

2 new programs were fully accredited:

- Duke Life Flight – Durham, NC(RW)
- LifeGuard Alaska – Anchorage, AL (RW/FW)

6 programs were reaccredited:

- AirEvac Services, Inc. – Phoenix, AZ (RW/FW/G)
- Air One – Tyler, TX (RW)
- Life Flight–Allegheny General Hospital – Pittsburgh, PA (RW/FW/G)
- MedFlight Air – Albuquerque, NM (FW)
- Northwest MedStar – Spokane, WA (RW/FW/G)
- Survival Flight – Ann Arbor, MI (RW/FW/G)

In addition:

- 3 programs were awarded provisional action
- 1 program was withheld

The Board also reviewed three programs with changes or updates, two appeals, and five progress reports that resulted in no change in accreditation status. There are now 78 accredited services on the published list. (See following article.)

The Board will meet again October 13-14 in Salt Lake City, UT. ■

Updated List of CAMTS Accredited Services

The Commission on Accreditation of Medical Transport Systems (CAMTS) proudly presents its list of accredited services as of July, 2000.

Alabama

Critical Care Transport – Birmingham	FW/G
MEDjet International – Birmingham	# FW

Alaska

Lifeguard Alaska – Anchorage	RW/FW

Arizona

Classic Lifeguard – Page	RW
LifeNet – Tucson & Phoenix	RW/FW
AirEvac Services, Inc. – Phoenix	RW/FW
Guardian Air – Flagstaff	RW/FW
Native American Air – Mesa	RW/FW
Medical Express – ShowLow	FW
Critical Air Medicine –	RW/FW

Arkansas

Angel Flight – Little Rock	RW

California

Air Med Team – Modesto	RW
Critical Air Medicine – San Diego	# RW/FW
Life Flight – Sacramento	RW/G
Medi–Flight – Modesto	RW
Mercy Air Service – Fontana	RW
REACH Mediplane – Santa Rosa	RW/FW
Mercy Air Ambulance – Redding	RW/FW

Colorado

AirLife–HealthOne – Aurora	RW/FW/G
AirLife of Greeley – Greeley	RW
Flight For Life – Denver	RW/FW
St Mary's Air Life – Grand Junction	RW/FW

District of Columbia

MedStar	RW

Florida

AIR TREK – Punta Gorda	FW
Care Flight – Clearwater	FW
MEDjet – Miami	FW

Illinois

REACT – Rockford	RW/G

"CAMTS Update" continued on page 5

"CAMTS Update" continued from page 4

Loyola LIFESTAR –
Maywood RW

Indiana
Welborn Life Flight –
Evansville RW

Kansas
LifeNet –
Olathe # RW

LifeWatch –
Wichita RW/FW/G

Kentucky
CAREFLIGHT –
Lexington RW/FW

Louisiana
Life Air Rescue –
Shreveport RW

Michigan
AeroMed –
Grand Rapids + RW

Flight Care –
Saginaw RW/G

MidWest MedFlight –
Ypsilanti RW

North Flight, Inc. –
Traverse City RW/FW

Survival Flight –
Ann Arbor RW/FW/G

W Michigan Air Care –
Kalamazoo RW/G

Minnesota
Mayo Medical Transport –
Rochester + RW/FW

Nevada
Mercy Air –
Las Vegas RW

Missouri
ARCH Air Medical Services –
St Louis RW/FW

LifeNet –
St. Joseph RW

MedFlight –
Joplin RW

New Mexico
Gallup Med Flight –
Gallup FW

MedFlight Air –
Albuquerque FW

Lifeguard –
Albuquerque RW/FW

Presbyterian Air –
Albuquerque FW

San Juan Air Care –
Farmington RW/FW

Native American Air –
Gallup FW

New York
Albany Med Flight –
Albany RW

North Carolina
EASTCARE –
Greenville + RW/G

Duke Life Flight –
Durham RW

North Dakota
LifeFlight MeritCare –
Fargo RW/FW

Ohio
CareFlight –
Dayton RW

Life Flight –
Toledo RW

Metro Life Flight –
Cleveland + RW/FW/G

Shriners Transport Team –
Cincinnati FW

University Air Care –
Cincinnati + RW

STAT MedEvac –
Cleveland RW

Oklahoma
AirEvac For Tulsa –
Tulsa RW/G

Tulsa Life Flight –
Tulsa RW/G

Pennsylvania
Allegheny Life Flight –
Pittsburgh RW/FW

STAT MedEvac –
Pittsburgh RW/FW

LifeStar –
Erie RW

South Carolina
CareForce –
Columbia RW

Life Reach –
Columbia RW

MEDUCARE –
Charleston RW/FW/G

South Dakota
INTENSIVE AIR –
Sioux Falls RW/FW

Texas
AeroCare –
Lubbock RW

Air One –
Tyler RW

CareFlite –
Dallas & Fort Worth RW/FW

HaloFlight –
Corpus Christi RW/FW

ALS Texas Air Life –
San Antonio RW

Critical Air Medicine RW/FW

Med Flt Air –
El Paso FW

Utah
Air Med –
Salt Lake City RW/FW

Life Flight–IHC –
Salt Lake City RW/FW/G

Virginia
Inova Medical AirCare –
Falls Church RW

Washington
AirLift Northwest –
Seattle RW/FW

NorthWest MedStar –
Spokane RW/FW

Neonatal Transport Team –
Tacoma G

Critical Air Medicine –
Pascoe FW

West Virginia
Health Net RW/FW

Wisconsin
Flight For Life –
Milwaukee RW

International
STARS –
Calgary, Alberta, Canada RW

RW=Rotorwing, FW=Fixed Wing, G =Ground,
# = Corporate Office (base in other states),
+ = With Commendation ■

American Association for Respiratory Care
11030 Ables Lane
Dallas, TX 75229-4593