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AALNC
AMERICAN ASSOCIATION OF
LEGAL NURSE CONSULTANTS

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PURPOSE

The purpose of The Journal is to promote legal nurse consulting within the medicallegal community; to provide novice and experienced legal nurse consultants (LNCs) with a quality professional publication; and to teach and inform LNCs about clinical practice, current legal issues, and professional development.

MANUSCRIPT SUBMISSION

The Journal accepts original articles, case studies, letters, and research. Query letters are welcomed but not required. Material must be original and never published before. A manuscript should be submitted with the understanding that it is not being sent to any other journal simultaneously. Manuscripts should be addressed to JLNC@aalnc.org. Please see the next page for Information for Authors before submitting.

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We send all submissions blinded to peer reviewers and return their blinded suggestions to the author. The final version may have minor editing for form and authors will have final approval before publication. Acceptance is based on the quality of the material and its importance to the audience.

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ARTICLE SUBMISSION

The Journal of Legal Nurse Consulting (JLNC), a refereed publication, is the official journal of the American Association of Legal Nurse Consultants (AALNC). We invite interested nurses and allied professionals to submit article queries or manuscripts that educate and inform our readership about current practice methods, professional development, and the promotion of legal nurse consulting within the medical-legal community. Manuscript submissions are peer-reviewed by professional LNCs with diverse professional backgrounds.

We particularly encourage first-time authors to submit manuscripts. The editor will provide writing and conceptual assistance as needed. Please follow this checklist for articles submitted for consideration.

INSTRUCTIONS FOR TEXT

- Manuscript length: 1500 – 4000 words
- Use Word© format only (.doc or .docx)
- Submit only original manuscript not under consideration by other publications
- Put title and page number in a header on each page (using the Header feature in Word)
- Place author name, contact information, and article title on a separate title page, so author name can be blinded for peer review
- Text: Use APA style (Publication Manual of the American Psychological Association, 6th edition) (https://owl.english.purdue.edu/owl/resource/560/01/)
- Legal citations: Use The Bluebook: A Uniform System of Citation (15th ed.), Cambridge, MA: The Harvard Law Review Association
- Live links are encouraged. Please include the full URL for each. Be careful that any automatic formatting does not break links and that they are all fully functional.
- Note current retrieval date for all online references.
- Include a 100-word abstract and keywords on the first page
- Submit your article as an email attachment, with document title articlename.doc, e.g., wheelchairs.doc

INSTRUCTIONS FOR ART, FIGURES, TABLES, LINKS

- All photos, figures, and artwork should be in JPG or PDF format (JPG preferred for photos). Line art should have a minimum resolution of 1000 dpi, halftone art (photos) a minimum of 300 dpi, and combination art (line/tone) a minimum of 500 dpi.
- Each table, figure, photo, or art should be submitted as a separate file attachment, labeled to match its reference in text, with credits if needed (e.g., Table 1, Common nursing diagnoses in SCI; Figure 3, Time to endpoints by intervention, American Cancer Society, 2003)

INSTRUCTIONS FOR PERMISSIONS

The author must accompany the submission with written release from:

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- Any recognizable person in a photograph, for unrestricted use of the image
- Any copyright holder, for copyrighted materials including illustrations, photographs, tables, etc.
- All authors must disclose any relationship with facilities, institutions, organizations, or companies mentioned

GENERAL INFORMATION

Acceptance will be based on the importance of the material for the audience and the quality of the material, and cannot be guaranteed. All accepted manuscripts are subject to editing, which may involve only minor changes of grammar, punctuation, paragraphing, etc. However, some editing may involve condensing or restructuring the narrative. Authors will be notified of extensive editing. Authors will approve the final revision for submission.

The author, not the Journal, is responsible for the views and conclusions of a published manuscript. The author will assign copyright to JLNC upon acceptance of the article. Permission for reprints or reproduction must be obtained from AALNC and will not be unreasonably withheld.

Julie Dickinson
MBA, BSN, RN, LNCC

President, AALNC

A Message from the President

The AALNC Board of Directors; in conjunction with AALNC's committees, taskforces, and staff; had a busy summer season working on numerous projects and initiatives for the association. As discussed in my last letter to you, these efforts tie into AALNC's strategic plan, which is designed to position AALNC as the industry leader, improve our visibility to the legal community, and develop a sound business model. Since my last letter, AALNC has:

1. Positioned AALNC as industry leader

- Launched the first seven modules of the new online course!
- Increased the number of annual *JLNC* issues to three!
- Conducted focus groups to identify educational needs of seasoned LNCs
- Initiated new member offering for health and disability insurance through AmWins
- Introduced new members-only "Ask an LNC" question and answer column on website
- Revised AALNC's *Code of Ethics and Conduct with Interpretive Discussion*
- Expanded the LNCC© Review Course to cover two new practice areas from the LNCC© exam
- Initiated a new discussion forum for AALNC Chapter leaders
- Continued its quarterly leadership calls with AALNC Chapter Boards of Directors
- Attended conferences of the Association for Nursing Professional Development and the American Nurses Credentialing Center
- Exhibited at the American Association of Nurse Life Care Planners conference
- Attended the Nurses' Service Organization Annual Partnership Conference
- Continued with our many other quality educational programming and initiatives, including webinars and case studies, and continued our educational research project

2. Improved visibility to the legal community

- Exhibited at the American Health Lawyers Association conference
- Placed ads for the LNC Locator© in AAJ's Products Liability Law Report
- Collaborated with The American Association of Nurse Attorneys for discounted rate to attend their annual conference
- AALNC member Tracey Maw RN, MSN presented "Ancillary Evidence May Be the Key to a Successful Defense" at DRI's Nursing Home / Assisted Living Facility Litigation Seminar
- Continued ongoing positions on:
  - ABA's Health Law Section's Nursing and Allied Healthcare Professionals Taskforce
  - DRI's Nursing Home / Assisted Living Facility Litigation Seminar Steering Committee
  - DRI's Medical Liability and Health Care Law Seminar Steering Committee

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Editor's Note

Wendie Howland
MN, RN-BC, CRRN, CNLCP, LNCC

Editor, JLNC

Welcome to the *JLNC's* final issue for 2014. It's been an interesting year full of exciting happenings and changes, some of which you'll see in the notes from Association President Julie Dickinson on the previous page.

You're looking at the big change in the Journal we promised you in July. We got the go-ahead to design a new *JLNC* template to make our Journal much more visually appealing, adding color, design elements, photographs, and illustrations to enrich your reading. We've asked our authors for photos so you can meet them in person. We've lifted an idea from a venerable medical society's journal (whose members apparently travel widely and own great cameras), and included some members' seasonal photographs to inspire you.

You're looking at the big change in the Journal we promised you in July. We think our Journal is much more visually appealing now, adding color, design elements, photographs, and illustrations to enrich your reading.

Perhaps a competition is in order: Email me your photographs (jpeg), from vacations or closer to home, and we'll choose the best ones for the next four issues (Spring, Summer, Fall, and Winter, if those help get your creative juices flowing, too). Be sure to include an address for your prize!

We know that change is, well, different. We know that sometimes it's hard to leave comfortable old ways behind. Even though we're all doing things we never dreamed of when we started our nursing careers, I expect all of us have felt we were on the wrong side of the street when the bus went by… at least once. But, to mix transportation metaphors, ships were not meant to stay in port, and if you're not making waves, you're not moving forward. This is an exciting time. Let's go!

All the best,

Wendie A. Howland

Wendie A. Howland
whowland@howlandhealthconsulting.com

FEEDBACK FROM AN ATTORNEY CLIENT

One reader's attorney client shared the following:

"I read through the AALNC journal articles on nursing home issues. They were incredibly helpful, particularly the explanations of evaluating and handling swallowing issues and the information on identifying geriatric syndromes. They helped me put the XXXXXXX and XXXXX cases in better perspective in my mind."

RECENT DECISION ON FALLS

The West Virginia Supreme Court in a recent nursing home neglect case may have very well changed the legal landscape for future cases across the country. On June 18, 2014 the Court in Manor Care v. Douglas __ S.E.2d __(W.VA, 2014) held that corporations that operate a nursing home can be held liable under the principle of general negligence rather that the usual legal action for medical malpractice. The significance of this change is that in most states general negligence cases do not have an award cap as exists in many states regarding medical malpractice.

An 87 year old woman was admitted to the Heartland Nursing Home(operated by Manor Care, Inc.) diagnosed with Alzheimer's dementia and Parkinson's disease. She was ambulatory with a walker, well-hydrated and -nourished, and recognized and communicated clearly with family members and staff. However, only 19 days later she was dehydrated, malnourished, bedridden, and barely responsive. She had also sustained head trauma from several falls, and she died after being hospitalized. The attending physician testified at trial that the cause of death was severe dehydration.

The Court's decision describes lower court testimony that the nursing home had multiple employee reports of chronic understaffing and multiple inspections done by the state Department of Health and Human Services. In fact, the Court notes that the only time the staffing appeared to be near the required standard was on the day of a state inspection. Also in testimony at the lower court the Director of Human Resources testified that the chronic understaffing resulted in a 100% nursing staff turnover rate.

The lower court held that the corporation that managed and staffed the facility failed to provide a budget that allowed adequate staffing as required by the state. The Supreme Court decision reversed some parts of the lower court's decision, but in its decision wrote, "Despite being made aware of the chronic understaffing at Heartland Nursing Home by various sources including their own employees and the State of West Virginia, MC Companies refused to ensure the presence of a sufficient number of staff to meet basic life-sustaining needs of its vulnerable, and sometimes helpless residents".

The Court held Manor Care Inc. and its associated companies liable for $32 million in punitive damages under the theory of general negligence. The Court decision gives plaintiffs in future cases another potential cause of action along with or separate from any claim of medical malpractice. This could permit a jury to award larger punitive damages than is allowed under a state's medical malpractice limits.

James Hanus, RN, BSN, OCN, MHA
Editorial Board Member, JLNC

YOUR JLNC WANTS YOUR INPUT

Our upcoming issue on electronic health records will include a piece on dictation/transcription and autoentry software. Do you have a favorite odd, amusing, or downright scary example of obvious error that still made it into records you received for review? Send them along to the editor. We'll make you anonymous if you choose, but all people who send submissions will be entered into a drawing for a prize at the Indianapolis AALNC conference in April! Deadline for submission to be entered in the drawing: March 30, 2015.

Wendie A. Howland MN RN-BC CRRN CCM CNLCP LNCC
Editor, JLNC

Sunset, Cape Cod Canal

Off Cape Town, South Africa
Eben Franks

Monterey afternoon

Provincetown wharf

Bloodstain Patterns: The Stories They Tell

Lori Combs BS, RN, LNC, Critical Analysis Consulting, LLC

The analysis of bloodstain patterns is not a simple science. Physics, chemistry, and trigonometry determine the characteristics of blood and the velocity and trajectory by which it travels. There are many elements to the bloodstain pattern to be examined to arrive at an accurate hypothesis. It is erroneous to believe that only the height from which the blood drop originated will determine the resultant pattern on a surface.

The human body is an amazing creation. The body can reveal health and disease in very minute signs and symptoms. In life, it can heal and repair itself with the blood that flows through the organs and vasculature. Human blood can reveal a great deal of information in life, but what stories can it tell in death?

HISTORICAL BACKGROUND

The forensic community has used bloodstain analysis for decades, beginning in the 1890s with Eduard Piotrowski from the University of Krakow. In 1895, using a rabbit model, Piotrowski published a study on bloodstains' formation, direction, and spread resulting from blunt force trauma to the head (Brodbeck, 2012). Many studies on bloodstains and bloodstain patterns followed, including the discovery that it was possible to determine the trajectory of the bloodstain pattern (Brodbeck, 2012).

In 1955, Dr. Paul Leland Kirk of Berkley in California testified at the Dr. Samuel Sheppard case regarding the bloodstain patterns. This testimony appeared to be the first evidence of this type involving the extensive analysis in the reconstruction of a homicide (Spitz & Fisher, 2006). In later years, the International Association of Bloodstain Pattern Analysts (IABPA) was formed to encourage, promote, and standardize the science (IABPA, 2011).

"Information that may be gained with bloodstain pattern analysis include, for example, the position of the individual when the blood was deposited (sitting,

standing, etc.), the relative position of individuals at the time of bloodshed, the possible type of weapon used as well as possible mechanisms that could have produced the blood staining on a surface" (Minnesota Department of Public Safety, 2014, para 1.).

WHAT FACTORS DETERMINE PATTERN?

The concept of bloodstain pattern analysis requires a basic understanding of the properties of liquid blood and why it behaves the way that it does. Three basic physical properties of liquid blood are viscosity, specific gravity, and surface tension (Spitz & Fisher, 2006). The bloodstain analyst must have this basic knowledge of the physical properties of liquid blood to be able to reconstruct the pattern of events.

Bloodstain patterns occur when blood leaves the body and lands on a surface. Blood that leaves the body will not separate as it travels through the air until there is an interruption by some physical force. When a drop of blood leaves the body, it does so in a spherical pattern until it strikes a surface or is otherwise physically interrupted in its travel. When a blood drop strikes a surface, the shape of the drop will either be round or elliptical. According to Spitz and Fisher (2006), spatter extent depends more on the surface that the blood strikes than the distance it has traveled.

In the analysis of bloodstain patterns, it is important to know that the height from which the blood travels is not the determining factor for the resulting pattern. The surface of the object to which the blood lands will determine the bloodstain pattern more than the distance from which it falls. Blood that drops from a great height will not produce a spatter if the surface it lands on is hard and non-porous. For example, if a drop of blood strikes a piece of glass, there will be little or no distortion of its edges (**Figure 1**). If a blood drop lands on a porous surface, such as a paper towel or newspaper, there will be considerable distortion of its edges.

Bloodstain patterns can also appear in a drip formation. This results from the force of gravity, and no other, acting on the blood, e.g., blood that drips from a fingertip or a knife blade that lands on a wall and runs down.

TYPES OF PATTERNS

Figure 1. Bloodstain on a hard serface

Bloodstain patterns that appear in a spatter formation is blood that is moving by force, such as in castoff (thrown from a moving object such as a knife or weapon) or impact patterns. Bloodstains produced with force behind them can indicate directionality. For example, a long oval shaped pattern with a trailing pattern can show directionality due to the pattern of the body of the stain and the "tail." In **Figure 2**, the blood has moved from right to left. This means the blood was traveling from right to left before it hit the surface.

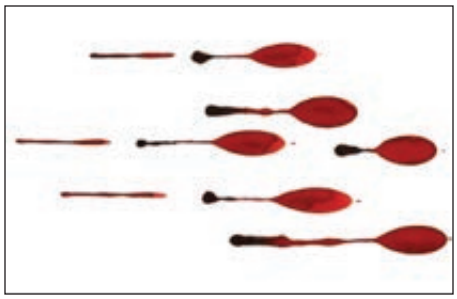

Figure 2. Bloodstain showing movement from right to left

Blood also can be thrown off from its original parent drop to produce another smaller pattern that is called a wave castoff (Spitz & Fisher, 2006). Directionality alone does not indicate height of the origin on the blood spatter; the calculations necessary to determine that exceed the scope of this article.

Impact angle is another component in pattern analysis and considers the angle of the surface to which the blood lands. The degree of distortion of the blood drops' spherical pattern depends upon the impact angle. The lesser the angle, the more elongated the bloodstain pattern will be. Therefore, blood that comes into contact with a surface at a ninety-degree (vertical) angle will produce a pattern much different from blood that comes into contact with a surface at a ten-degree (shallow) angle. Determining the impact angle of a bloodstain pattern requires the trigonometric calculation arcsin (**Figure 3**) (Spitz & Fisher, 2006).

Another consideration is the blood's traveling speed. Bloodstain patterns change with rate, with distinctive patterns from low- to medium- to high-velocity spatter. Low-velocity could be the result of stepping on a pool of blood with a shoe, like a child splashing in a puddle of water. Medium-velocity blood spatter can be observed with physical assault, such as being punched in the nose, and high velocity will occur from impacts such as from a gunshot.

Another component to consider is whether the blood is arterial. There are three types of arterial bloodstain categories: types I, II, and III. These patterns show arterial pulsation. Type I arterial patterns are usually large with very elongated "spines" (Spitz & Fisher, 2006), indicating that energy that produced the pattern overcame gravity. Type II arterial patterns are smaller and have very few, if any spines (Spitz & Fisher, 2006), e.g., a gunshot wound to the aorta in

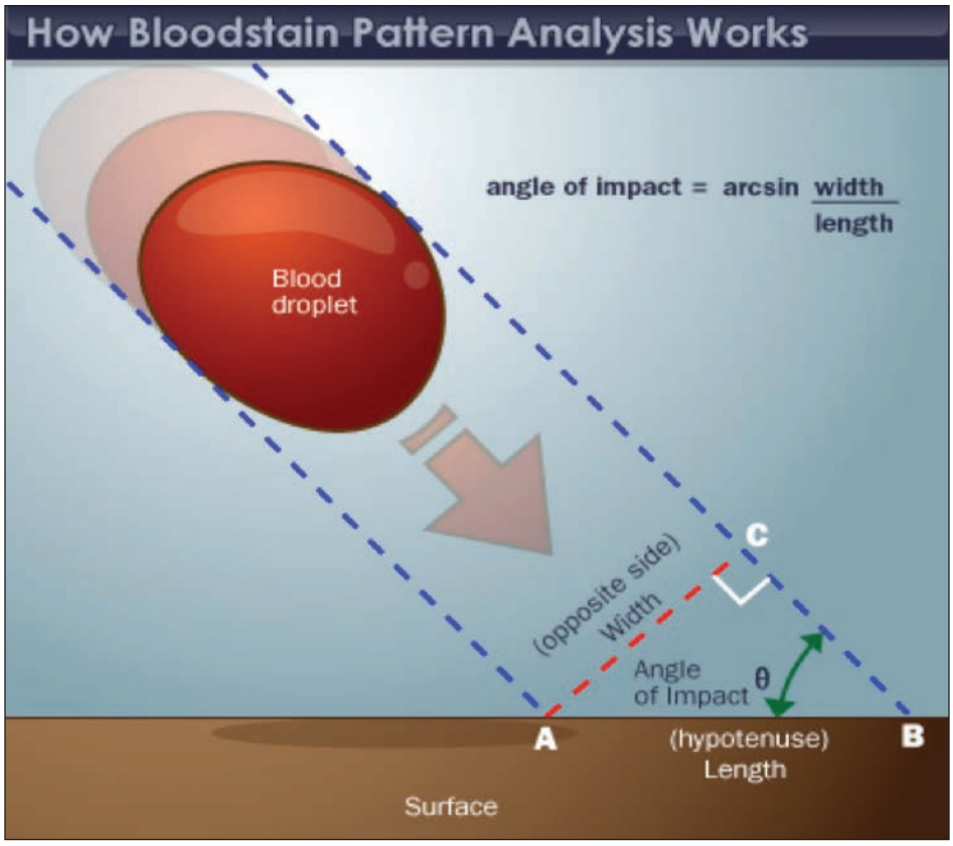

Figure 3. Arcsin

which blood pumping out of the wound hits a nearby wall. The amount of blood in this type of arterial pattern usually is quite large and it will runs down the surface where it lands. Type III arterial blood patterns are typically quite small due to an obstruction, usually by some overlying tissue (Spitz & Fisher, 2006).

Expirated bloodstain patterns occur when the blood from the respiratory tree is blown with air from the mouth or nose onto a surface, such as a nearby victim's hand. Blood patterns are found in the areas of the nose and mouth and appear in a pattern similar to the medium or high-velocity impact spatter. Looking at the nasal passages or the mouth of the victim can aid in the identification of expirated blood patterns.

Transferred blood patterns occur when another object has come in contact with the blood and has formed a pattern of its own, such as bloody footprints, handprints, and fingerprints, or smears across surfaces from bloody body parts, clothing, or hair.

CONCLUSION

Knowing the basics of bloodstain pattern analysis can assist the Legal Nurse Consultant involved in criminal cases to understand crime scene evidence and the expert's analysis and report. This knowledge would also be quite valuable to assist attorney clients understand crime scene evidence and question experts during deposition and trial.

The science of bloodstain pattern analysis is complex and involves knowledge of other sciences, especially physics and trigonometry. Although the analysis of bloodstain patterns is a very valuable tool to assist law enforcement in the recreation of crime scenes, it cannot solve a crime by itself. It is a valuable component of the complete investigative process. The purpose of this article is to provide a basic knowledge of the science of bloodstain pattern analysis. There is much more information on the science of bloodstain pattern analysis at the website for the International Association of Bloodstain Pattern Analysts at http://iabpa.org.

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Lori Combs has been a Registered Nurse for over 20 years. Her specific area of focus was emergency medicine, but also included PACU, telemetry, and primary care clinics. During her emergency room experience, she attended training in adult sexual assault examinations (SANE) in Dallas, Texas and performed SANE exams for adult victims of sexual assault. Lori has also completed two Forensic Nursing courses and is in the process of becoming board-certified in Forensic Nursing. She has furthered her forensic training with attending a Nurse Death Investigations course in Houston, Texas and has obtained her Bachelor's Degree in Criminal Justice with a focus on Crime Scene Investigations (CSI). She currently owns her own Legal Nurse Consulting firm since 2011. She can be contacted at LoriCombs@CriticalAnalysisRN.com.

Hired by the Defense: The LNC's Role in Shaken Baby Syndrome Cases

Erin Gollogly, BSN, RN

Keywords: non-accidental injury, child abuse defense

Legal nurse consultants play an important role in supporting the criminal defense attorney with child abuse cases, particularly those that allege shaking as the mechanism of injury. Child abuse is a pervasive problem in our country and is an emotionally charged subject for all involved. The LNC must take an objective, unbiased approach to reviewing and opining on these cases. It is important for the LNC to understand all aspects of child abuse as well as the current controversies surrounding the mechanisms of injury, particularly head trauma and shaking injuries.

Child abuse is a real and pervasive problem in our country. The medical community is required to identify abused children and take action to protect them. Correctly distinguishing between accidental and non-accidental injuries in children has critical consequences. Just as abuse is devastating to families, so also are false allegations. Legal nurse consultants assisting defense attorneys in these cases have the important and often difficult job of determining if the alleged non-accidental injuries could have been caused by other, accidental mechanisms. Careful review of the alleged victim's medical records, police reports, the autopsy if applicable, pathology reports, and photos are as important as being familiar with conditions and mechanisms that may be mistaken for abusive injuries. The LNC will need to search current literature for material to support a well-informed opinion.

HISTORY AND DEFINITIONS

In 1946, an American pediatrician and radiologist named John Caffey first described a relationship between subdural hemorrhages and long-bone fractures in children. Twenty-six years later, in 1972, he described radiologic and clinical characteristics that he asso-

ciated with shaking injuries (Christian, Block, & Committee on Child Abuse and Neglect, 2009). The term shaken baby syndrome (SBS) was published by Ludwig and Warman in 1984 (Ludwig & Warman, 1984).

In 1987, Duhaime et al. looked at 48 cases of infants and young children who were seen at the Children's Hospital in Philadelphia diagnosed with "shaken baby syndrome." Of those, there were 13 fatalities, all with signs of blunt trauma to the head. Interestingly, the evidence for blunt trauma in more than half of the thirteen cases was found only at autopsy. Their biomechanical models supported their theory that impact was required to produce the most severe abusive head injuries. The conclusion, then, was that injuries diagnosed as "shaking" injuries required impact to the head (Duhaime, et al., 1987). Controversy began to emerge in the medical and scientific communities surrounding the importance of impact in head injuries of abused children. Biomechanics has become an important part of the study of SBS and mechanism of injury. Certainly this field of science has improved and clinical research has expanded, but experts have used biomechanics to both support and refute the roles of shaking and impact on abusive head injury. Clinicians and researchers mostly agree that exact mechanisms for abusive head trauma still remain poorly understood (Christian, Block, & Committee on Child Abuse and Neglect, 2009).

In 2009 the American Academy of Pediatrics revised their policy statement to include new terminology and a shift in understanding of the mechanisms of pediatric head injury, introducing and defining the term abusive head trauma (AHT) to include all mechanisms of injury inflicted upon the head and its contents, including shaking and impact, into the literature (Christian, Block, & Committee on Child Abuse and Neglect, 2009).

DIAGNOSIS

The three concurrent findings most associated with the diagnosis of AHT are subdural hemorrhage, retinal hemorrhages, and encephalopathy. The theory is that violently shaking an infant creates shearing forces that directly damage capillaries in the eye, causes tearing of the bridging veins in the brain leading to subdural hemorrhage, and results in encephalopathy (Clark, Adams, & Luthert, 2002). The common assumption has long been that presence of this symptom triad is pathognomic for abuse; however, there is no question that impact can cause these injuries.

In the absence of external signs of head trauma, the conventional wisdom is that violently shaking the child caused the injuries. However, whether shaking alone can cause this triad is now controversial. Some medical and scientific professionals now believe that minor falls or other accidental or unintentional means can account for the triad and other injuries previously attributed exclusively to shaking. This controversy has caused heated debate in the criminal justice system, with some cases being dropped for lack of evidence.

THE "SHAKEN BABY SYNDROME" TRIAD OF INJURIES

Retinal Hemorrhage Retinal hemorrhage (RH) is abnormal bleeding in the retina. These hemorrhages can occur, under, or within the retina. In children, some causes of RH are traumatic head injury, retinopathy of prematurity, sepsis, coagulopathy, hypoxia, seizures, and cardiopulmonary resuscitation (Levin, 2009; Agrawall, Peters, Adams, & Peirce, 2012).

A detailed, accurate description of RH by an ophthalmologist should be included in every suspected case of AHT. The description should describe the number, type, and extent of the hemorrhages. RH can be described as dot, blot, or flame-shaped. In abuse, RH are typically described as flame-shaped, diffuse over multiple retinal layers, and bilat-

HIRED BY THE DEFENCE:
The LNC's Role in the Shaken Baby

- Dural traction or brain sag (e.g., treated hydrocephalic patients or those with brain atrophy)
- Subdural hygroma or chronic subdural effusion occurring after acute SDH or meningitis
- Enlargement of the subarachnoid spaces
- Bleeding tendency (e.g., thrombocytopenia, hemophilia, patients receiving anticoagulants)
- Osteogenesis imperfecta
- Glutaric aciduria, type 1
- Rupture of arachnoid cyst resulting in intracystic hemorrhage and SDH

Table 1. Predisposing factors for subdural hematoma formation. (Proctor, 2014)

eral. However, flame-shaped RH have been seen in infants who were perinatally distressed, particularly if by a hypoxic event (Choi, Jung, & Kim, 2011). RH has been seen in healthy, full-term infants as well (Watts, et al., 2013).

Subdural Hemorrhage Subdural hemorrhage (SDH) is bleeding between the dura and arachnoid maters of the brain, and is most commonly caused by major head trauma. Despite the small appearance on radiographic imaging, SDH usually accompanies diffuse brain injury. In children, SDH occurs most frequently in those less than two years old. In newborns, SDH has been associated with instrument-assisted birth, seen in up to 8% of term babies (Proctor, 2014). SDH can also take place during labor when vertex molding causes blood vessels to tear (Hawkins, 2013). The prognosis in children with acute SDH is grim due to accompanying extensive brain injury.

SDH can also result from minor head injury, due to rupture of veins in the subdural space. Bleeding is slow in these cases and tends to be larger than bleeds from major head trauma, and clinical signs may not be immediately apparent. Predisposing factors for hematoma formation are listed in Table 1 (Proctor, 2014).

Although relatively rare in children, chronic subdural hematomas (CSH) may be present in babies as a result of birth-related SDH. A thick outer membrane forms on the surface of the dura following the initial meningeal insult. A thin inner membrane then also develops which encapsulates the clot. This process occurs over approximately two weeks (Proctor, 2014). These CSHs are prone to rebleeding from seemingly minor insult. In such a case, if the caregiver reports a mechanism of minor trauma, it would appear to be inconsistent with the acute findings (Gabaeff, 2013).

The conventional wisdom is that violently shaking the child caused the injuries. However, whether shaking alone can cause this triad is now controversial.

Encephalopathy Encephalopathy is a general term for damage, disease, or malfunction of the brain. The main symptom of encephalopathy is altered mental status (AMS), and many cases of alleged child abuse present with a child with a change in mental state. There are many causes of encephalopathy including infection, such as meningitis; metabolic dysfunctions, such as glutaric acidemia type 1; increased intracranial pressure, e.g., from hydrocephalus; and poor nutrition. Lack of oxygen or blood flow to the brain also causes encephalopathy and can be caused by birth trauma, apnea, seizures, choking, or other mechanism. The LNC must look for the presence or possibility of any of these conditions during record review.

REVIEW OF THE RECORDS

The LNC should review the medical records of the victim, EMS treatment records, police reports, autopsy reports, and pathology reports. Photos, if available, are often helpful. Depending on the child's history, birth and pediatric visit records may also be valuable.

Police reports give a picture of alleged events related to how the child may have been injured. The important part of the police reports are their accounts of the scene and/or interviews with the alleged abuser and other family members or caregivers. These reports may also reveal that the child had a recent previous injury or illness that may be related to the alleged injuries.

Photographs, ideally high-resolution, of the child are helpful in that they may or may not show evidence of external injury. Photos of the scene may also be available and may be able help the LNC assess the child's surroundings at the time of injury.

Medical records provide information about the injuries and clinical findings. The LNC must think critically about whether the findings are consistent with the narrative of events and about the possibility of other causes. Questions to keep in mind include:

1. If the child had an intracranial bleed, did the medical staff rule out coagulopathies or other predisposing or risk factors?
2. Did the child ever have any previous radiological studies (for comparison to rule in/out CSH)?
3. If retinal hemorrhages were present, did an ophthalmologist evaluate the child? Are the retinal hemorrhages described in detail, with the number, type, and appearance?
4. Did the child have a hypoxic event?
5. Is there a thorough birth history and medical history?
6. Are there any reported genetic disorders that may explain the findings? Was any genetic testing done?

As the LNC reviews the medical records and police, autopsy, and pathology reports, the answers to these questions and others provide the basis for forming an informed opinion about possible alternative causes for the findings.

SUMMARY

Defense attorneys must establish reasonable doubt in the minds of the jurors about their clients' guilt. Conversely, proof of guilt beyond a reasonable doubt is the burden of the prosecution. The legal nurse consultant's responsibility for the defense is to evaluate the case thoroughly to determine if there could be other possible causes or explanations for the alleged injuries, perhaps a difficult task at best. Performing thorough and thoughtful literature and record reviews are imperative for the LNC to make informed opinions for the defense attorney's consideration.

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Presidential Pearls

"Lawyers love to read good pieces of prose so you need to develop strong writing skills to be noticed by lawyers. Taking a writing course at a local college is beneficial. It was one of the first things I did when I started working in-house years ago. Nurses typically come to the practice from clinical work used to using 2-3 word phrases or checking boxes in the medical records."

Sherri Kehoe, *Past President, AALNC*

Criminal Legal Nurse Work: Uncovering What Lies Beneath

Jennifer Graney, RN, BSN, LNCC

Keywords: non-accidental injury, child abuse defense

When I made the decision to work in legal nursing I thought I would be assisting mainly with medical malpractice cases and the occasional personal injury case, outlining catastrophic injuries. To my surprise, one of my first large cases was with a criminal defense firm. They asked me to analyze the medical records to help them understand the clinical information. The attorney asked that I interpret findings in the medical record for them to use in briefs and arguments. In working with these attorneys over two years, I came to understand that my role as a legal nurse could aid a defense team in ways I never anticipated.

This article is a case study outlining major clinical factors, discussion of relevant research performed, discussion of key points highlighting strengths and weakness for the client's defense, and recommendations provided for further discovery with relation to occult medical aspects in this case. It is clear as the LNC working on this case I was able to aid this legal team to the best possible outcome for this client.

A man faced Federal charges in an international child pornography ring involving over 600 arrests in the US. The FBI conducted a four-year cyberspace investigation targeting and tracking individuals who bought child pornography over the internet. The most horrific sites were traced to a man in Russia, eventually brought into US custody for prosecution. Officials involved called this the most successful child pornography bust in history.

When the attorney approached me to take this case I was reluctant to get involved, concerned first that my reputa-

tion as a mother and member of society would be compromised being involved in such a taboo subject. Second, I didn't want to be labeled by the professional LNC community as the nurse who helps or supports those involved in heinous criminal acts. I told the attorney no.

He persisted, telling me that he knew if I met the client and his family I would change my mind. He truly believed this man had a medical reason for committing these crimes; that was the only reason he was willing to be involved. Knowing that the attorney had highly ethical standards, I dubiously accepted the case and went to the office to meet the client. In short order, I realized my attorney client was right. The medical community man failed this man: He had undiagnosed, embarrassing, and untreated sexual and behavioral problems. As the case evolved I realized my investigative medical analysis was integral in uncovering what lay beneath the surface of the charges.

The medical community man failed this man... I realized my investigative medical analysis was integral in uncovering what lay beneath the surface of the charges.

LNC CRIMINAL CASE STUDY

Michael Green was a 55-year-old gentleman who had massive physiological and psychological symptoms as a result of a brain injury sustained in a motor vehicle accident (MVA) in January 1976. He had his first symptoms associated with brain injury just two months after the accident. He described these first experiences of abnormal brain function as like "déjà vu."

Mr. Green's déjà vu experiences increased to ten or fifteen times a day over the next several months. He had his first generalized tonic-clonic seizure (GTC) twelve months after the MVA. In 1979 he had three GTCs in one day, leading to a neurology evaluation. He was prescribed phenobarbital for his seizure disorder.

According to Mr. Green's personal log, he described changing seizure patterns over the next couple of months, with feeling tingling in his hands, "out of body" sensations, and feelings of being dropped in an elevator. He continued having GTCs and found himself at the bottom of a flight of stairs in a postictal state more than once. He began keeping a seizure log in 1981. Seizures continued frequently over the next several years. He sought more aggressive medical management from another neurologist. A brain CT in 1986 showed temporal lobe scarring.

In 1991, Mr. Green's neurologist retired. He had another, more severe, GTC. He consulted Dr. Owen Smith, following him to University of Pennsylvania. Dr. Smith suggested neurosurgery, since Mr. Green's seizure activity had been refractory to pharmacologic treatment since 1978. After extensive diagnostic testing, surgery was scheduled for May 1992.

Mr. Green's first neurosurgery began with awake open-brain mapping, with probes inserted into the brain to allow the surgeon to avoid areas of the brain controlling language, music and speech during temporal lobe resection of the scar tissue found in his 1988 CT. Along with the removal of the scar tissue, a central neurocytoma was discovered. A central neurocytoma is a benign lesion that consists of mainly of nerve or ganglionic cells, also known as a ganglioneuroma or a gangliocytoma. There are no known risk factors for neurocytoma development.

Immediately after the surgery, Mr. Green noted decreased seizures. However, in June 1993, he suffered another GTC at work. Later in 1995, he experienced a complex partial seizure while he was driving, which secondarily evolved into a GTC. After that, he lost his license.

He continued to have simple partial seizures manifested by ringing in the ears and tingling sensations, and complex partial seizures manifested by foul tastes, smells, and tugging sensations in his face. In 1995, after a night of alcohol consumption Mr. Green had another GTC. Despite medications and routine management, his journal indicated his seizure activity was occurring much more frequently than he was sharing with his healthcare providers. He felt that "as long as he didn't tell anyone," including his neurologist, he was "cured."

In the fall of 1999, Mr. Green had another GTC. He contacted his neurologist, Dr. Smith, and discussed options for better seizure control; they began trialing different medications. Mr. Green began experiencing psychiatric side effects from these and by mid-1999 was on an extended release version of the medication he had been on for years, carbamazepine (Tegretol XR). His headaches, already constant, increased.

In November 1999, he had a second two-stage brain surgery, a craniotomy for brain mapping followed by partial resection of the remaining right temporal lobe (mesiolateral portion), with an

amygdala-hippocampectomy and the removal of some white matter, this time under general anesthesia.

According to Mr. Green's log, he reported problems after this surgery: personality changes, an increase in appetite, and an increase in sex drive. He described an insatiable sexual appetite and had claimed that he asked his wife for sex daily. He stated in his log that when she did not comply with his daily sexual advances he felt it necessary to masturbate. His issues with emotional lability continued. He also had difficulty with the inability to initiate things he was supposed to be doing.

Over the next few years, Mr. Green had increased headaches and simple partial seizures, complete partial seizures, periods of rage, and impulsive behavior. In late 2002 and early 2003, his headaches increased in severity and his pain was constant. During this time he began to have difficulty sleeping.

By mid-2003, Mr. Green noticed a "clicking" noise when he walked and began experiencing pain in his head associated with changes in the weather; also, his vision was worsening. Later that year he noted an obviously depressed area in his skull. His neurologist urged him to speak with the neurosurgeon who performed the 1999 surgery, Dr. Kline.

In the early 2004, Dr. Kline found the 1999 bone flap was necrotic and recommended emergent cranioplasty for the following month. In April 2004, Mr. Green had a cranioplasty with a titanium mesh prosthetic flap. Several days later, Mr. Green reported hearing a "crunching sound (like) breaking a handful of pencils." He became worried about the cranioplasty coming off. Over the next few months his seizure activity increased and the headaches became intractable. He also noted the click in his skull again and reported a severe buzzing sound that only stopped when he pressed his finger to his skull. He saw Dr. Kline to discuss this in July. This time Mr. Green opted not to have Dr. Kline do the revision and began a search for the best surgeon he could find to repair the failed cranioplasty.

By early 2005, Mr. Green met with a neurosurgeon from Harvard who refused to operate on Mr. Green, telling him that the risk of infection was too great. In early spring 2005, Mr. Green consulted Dr. Mason in New York, who agreed to perform a revision cranioplasty with prosthesis.

This was scheduled, but postponed due to manufacturing problems with his prosthetic skull. Mr. Green began calling the manufacturers himself to expedite the delivery of his prosthetic skull. His cranioplasty was done in June 2005. About a month and a half later, Mr. Green noted bloody, purulent greenish drainage from the surgical wound. He saw his physician immediately. Cultures revealed "a mixture of flora including Gram-positive cocci, Staph species, E. coli, and Enterobacter," according to Dr. Mason. Dr. Mason recommended follow-up care by an infectious disease specialist, Dr. Frank, who prescribed oral antibiotics, (levofloxacin (Levaquin) and amoxicillin clavulanate (Augmentin), and antibiotic ointment for the external surgical scalp wound.

Mr. Green returned for follow-up care in September 2005 and was not seen again in Dr. Mason's office until April 2007.

Mr. Green's described his emotional lability in his log as "raging" for reasons as simple as "being out of rye bread." He described being so angry in traffic that he threw a metal coffee mug at another driver's car. From 2005 to 2006, he had increased seizure activity and logged stopping his car as many as thirty times for the onset of complex partial seizures. He became increasingly anxious, had episodes of getting lost on his way home from work, and experienced surreal feelings about physically being in more than one place at the same time. His chronic headache decreased, but he had increased simple partial and complex partial seizures, new visual hallucinations, a constant soapy metallic taste in his mouth, lethargy, and an odd reaction after eating in which he felt very cold and syncopal. He went from crying to raging anger without much external cause.

Mr. Green suffered another GTC in February 2006. He returned to Dr. Smith, who again noted his emotional lability and began titration of medications for seizure control and anxiety. Over the course of several months Dr. Smith tried several different medication combinations for Mr. Green, including carbamazepine (Tegretol), escitalopram (Lexapro), Zonisamide (Zonegran), oxcarbazepine (Trileptal), lorazepam (Ativan), Topiramate (Topamax),

My literature searches outlined existing diagnoses, expanded on diagnoses listed in the medical record, and summarized diagnostic characteristics of neurological disorders that were not addressed in this patient's care.

vigabatrin (Sabrin), and levetiracetam (Keppra). Dr. Smith began to discuss permanent disability, though Mr. Green had difficulty accepting this.

In September 2006, he had another GTC while a passenger in a colleague's car. In 2008, his seizures continued and his auras frequently changed, with fullness in his throat that brought him to his knees, and "twitching and tugs with thumps" in his ears. Mr. Green also described sensations of odd smells like peanut butter and jelly, the smell of winter, or a cafeteria smell.

Diagnostic Testing (see Figure 1)

Mr. Green had approximately thirty-four EEGs over this time. Of those, one was inconsistent with epilepsy; four were read as normal. All the rest were read as abnormal, showing focal slowing over the right temporal or right fronto-temporal regions of the brain, with one showing centrotemporal slowing.

The first neuropsychological examination in 1992 showed "striking focal deficit in some aspects of his visual perception and memory." It also revealed "clear improvement overall in mental alertness and intellectual faculty."

The second, in 1999, additionally looked at whether the opposite side of the brain could support basic cognitive function in the event of complications during surgery. This revealed labile mood, short temper or irritability, impaired frontal functions (frontal dysfunction), and difficulties with impulse control. Mr. Green was diagnosed with organic personality syndrome, mild frontal dysfunction, emotional dyscontrol (labile mood), and temporal lobe syndrome.

This is only a small portion of Mr. Green's medical history, symptoms, and the pathophysiology involved with his initial traumatic brain injury.

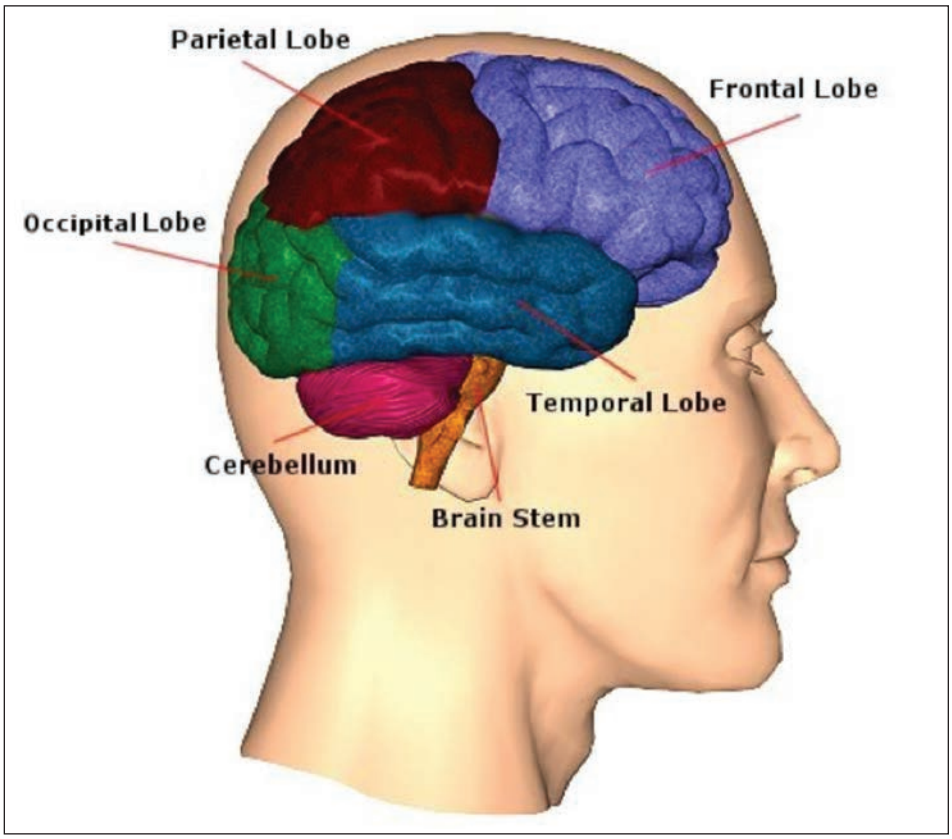

Figure 1. Lobes of the brain. From: Total Brain Injury (TBI) Resource Guide. Illustration of Brain. Accessed 9/10/2014: http://www.neuroskills.com

APPLICABLE CASE RESEARCH

After carefully reviewing and summarizing the medical records I felt we needed further analysis to help the attorney understand their legal application. This information further aided the attorney in understanding the diagnoses and findings contained within the summary. My literature searches outlined existing diagnoses, expanded on diagnoses listed in the medical record, and summarized diagnostic characteristics of neurological disorders that were not addressed in this patient's care. I developed the following literature summaries:

- Detailed brain mapping including Broadmann's areas of the brain
- Temporal lobe syndromes
- Changes in sexual behavior after temporal lobe disturbance
- Kluver-Bucy syndrome
- Frontal lobe dysfunction
- Organic personality syndrome
- Emotional dyscontrol

Then I outlined key issues for the defense and potential areas for further research:

Key Issues of Challenge for Defense

- Mr. Green's decision not to disclose information to his physicians about the extent of his seizure activity, personality changes, problems with sexual behavior, and appetite changes
- Mr. Green's admittedly poor adherence to medical plan of follow-up care for his increased seizure activity
- Mr. Green's failure on occasion to seek care in a timely manner
- Mr. Green's consistently high cognitive function pre- and post-surgery, despite the presence of seizure activity
- Mr. Green's consistent ability over the years to maintain daily function in his personal and professional life

despite the difficulties caused by his temporal lobe epilepsy

Areas Recommended for Further Discovery

- Complete copies of medical records from any doctor Mr. Green consulted for
  - July 1999 through April 2004
  - March 2007 through present.
- Current copies of any medical records from Dr. Smith and/or Dr. Mason
- Copies of any psychological records available, counseling or other
- A complete list of current medications for thorough investigation of drug interactions and potential side effects

THE WORK OF THE LNC

I was able to condense thousands of pages of medical records into a thirty-page medical summary. The attorney had this document bound and presented to the judge for education regarding the client's background medical history leading to his arrest.

Medical records were of little help in this patient's hypersexual problems and ultimately his deviant sexual behavior. I was able to deduce the sexual side effects of his injury using a holistic nursing approach: I interviewed the patient and his wife separately and reviewed his personal journal regarding his medical journey, his frustration, and his fears in telling his medical provider the truth.

These interviews and materials combined with the medical records led me to do further research, which in turn led me to discover a specific syndrome of hypersexuality and impulsivity called Kluver-Bucy syndrome. Kluver-Bucy syndrome has been reported in studies involving temporal lobectomy and head trauma. Its symptoms and gradual onset appeared to match Mr. Green's medical history. After I gave the attorneys the results of my research, they discussed the findings with the client, who shared it with his personal treating physician and other neurologists. Ultimately, after evaluations by his treating physician and other neurologists on both sides of the case, this diagnosis was officially established.

For whatever reason, Mr. Green's resulting hypersexuality was unspoken, undiagnosed, and worsened for decades, eventually leading to criminally deviant behavior. Without careful evaluation of the medical records it is likely that he would have remained undiagnosed.

My medical investigation and applied research changed Mr. Green's outcome. The attorney argued successfully to have his client's overall sentence for the possession of pornographic material reduced. He was able to negotiate having Mr. Green's incarceration in a lower security prison, advocated for his comprehensive rehabilitation while in prison, and coordinated outpatient followup after his release.

The work I did as an LNC helped the attorney to deal with his client's sexual complications and side effects of brain damage from a motor vehicle accident almost thirty years before. For whatever reason, Mr. Green's resulting hypersexuality was unspoken, undiagnosed, and worsened for decades, eventually leading to criminally deviant behavior. Without careful evaluation of the medical records it is likely that he would have remained undiagnosed. A person who clearly suffered for years would have spent the rest of his days behind bars without appropriate care, diagnosis and treatment. ❧

Ms. Graney is a veteran of the critical care environment with over 14 years serving in various capacities such as a Neuro-trauma Intensive Care Nurse at the Hospital of the University of Pennsylvania. Ms. Graney earned her BS in Nursing from the University of North Carolina at Wilmington, graduating Magna Cum Laude. Nurse Graney is a member of Sigma Theta Tau International, Honor Society of Nursing and holds certifications for Advanced Cardiac Life Support and Legal Nurse Consulting. In her 11 years at JCG, Jennifer has participated in case review for both plaintiff and defense firms and has consulted on mass tort pharmaceutical litigation, criminal defense, medical malpractice and PI case work. She has assisted in matters at both the federal and local levels of court and her clients have received settlements as high as $1.5M and $2M, with numerous settlements in the high six figures. She can be contacted at jgraney@jcgmedlegal.com.

Considerations in Evaluating a Measured Ethanol Concentration: A Review

Thomas P. Neuser BSMT, MT(ASCP)

Keywords: alcohol, blood alcohol, BAC, ethanol, laboratory studies

Although alcoholic drinks are almost always legal for adults to possess and consume, society demands that those using alcohol do so responsibly. Laws, industry regulations, and work requirements limit times, places, and amounts of alcohol allowed. Persons suspected of violating these restrictions are liable to penalties and are frequently tested for ethanol concentration. The results may carry significant consequences, highlighting the need for an understanding of how ethanol appears in biological specimens and how specimen type affects result interpretation. A review is provided to assist the legal nurse consultant when evaluating a measured ethanol concentration.

The views expressed in this article are those of the author. They may not reflect the views of the State of Wisconsin, the Wisconsin State Laboratory of Hygiene (WSLH), or any of the other staff of the Forensic Toxicology Section at WSLH.

INTRODUCTION

Determining ethanol (alcohol) concentration (BAC) is among the most common medico-legal laboratory analyses, done for:

- Prohibition against consumption of alcohol
- Medical necessity
- Investigation of impaired driving
- Fitness for duty
- Myriad other reasons

People are tested for ethanol levels every day by variety of analytical techniques. The science underlying all these tests is well understood. Since a person may be subject to criminal penalties and civil liability at defined levels, the assay process is generally done under rigorous quality control. Therefore, the analytical results are highly reliable (College of American Pathologists Surveys, 2013 and previous). The challenge lies in the evaluation of these results, and particularly in understanding how the type of specimen(s) tested and the timing of specimen collection affect results interpretation.

Common specimens include whole blood, blood serum or plasma, urine, and breath, and their interrelationship can be complex; alcohol concentration *in vivo* changes constantly. Ethanol research is formidable – there are published studies on every aspect of how humans and ethanol interact – and it is easy to over-interpret small differences in test results. A full explanation is beyond the scope of this article, but a basic understanding of ethanol pharmacokinetics is helpful when confronted with alcohol concentrations reported in different units by different providers This article will help you identify some key parameters and alert you to the possible causes of seemingly inconsistent test results.

Ethanol is a small molecule, is completely miscible in water, and easily crosses most body membranes. After it enters the GI system, it diffuses into the capillary bed, is picked up in the abdominal blood flow, and carried throughout the body. Ethanol permeates all body water, both circulating and interstitial, and its concentration in any part of the body is proportional to local tissue blood flow and water content.

Ethanol leaves the body by metabolism and excretion. Relative rates of these competing processes determine whether an individual's ethanol concentration is rising, falling or on a plateaued (Jones, 2003; Dubowski, 1985). BAC can be plotted over time, resulting in a *blood alcohol curve* (**Figure 1**).

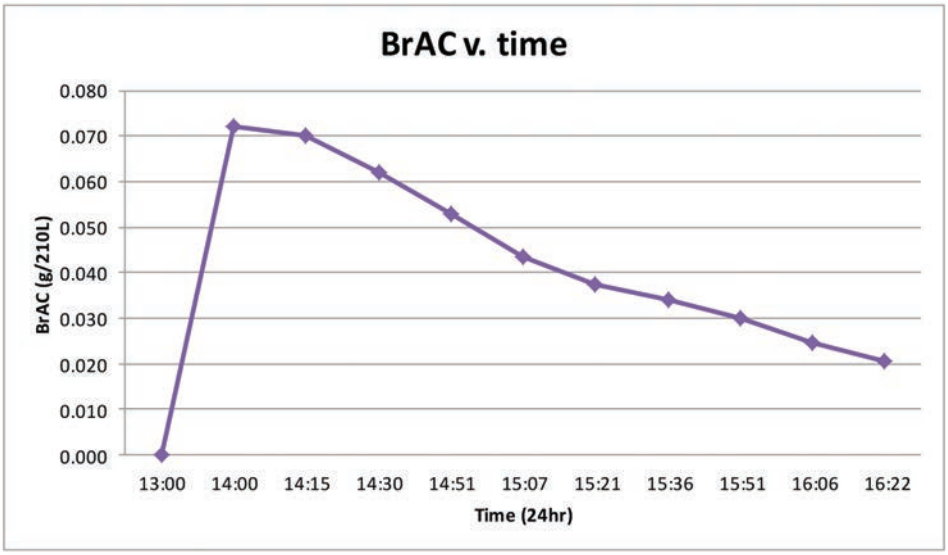

Figure 1. Change in breath alcohol content with time. (WSLH internal data.) Note 24-hour clock; time frame is from 1300 (1:00 pm) to 1622 (4:22 pm)

ABSORPTION

The *absorption phase* of a blood alcohol curve shows when the blood ethanol content is rising. Many factors determine how quickly ethanol enters the blood; the most important is the rate of stomach emptying, as for other drugs.

Ethanol's delivery route, as with any drug, strongly affects its bioavailability. These factors affect how rapidly it reaches the intestine for absorption:

- Whether a person is fed or fasting
- Amount and composition of food in the stomach
- Type, rate of drinking, and alcohol concentration of the beverage
- Effects of injury from a vehicle crash or other event
- Whether or not a person is smoking

(Watkins & Adler, 1992; Holt, 1981; Grimes & Goddard, 1978; Jones & Neri, 1991; Jones, Jonsson & Neri, 1990; Rose, 1979).

Published studies have helped to define the influence of all these factors. Unfortunately, study protocols isolating a single parameter also frequently require that the ethanol be consumed in ways that poorly mimic real-life drinking patterns. Studies specifically designed to assess ethanol absorption in social situations defined the shape of an alcohol curve better, especially the important parameters: *time required to reach peak alcohol concentration* and *degree of concentration increase following the last drink*. Strong anecdotal and empirical evidence indicates that blood ethanol concentration increases little if at all once 30 minutes have elapsed following the last drink (Stowell & Stowell, 1998; Winek, Wahba & Dowdell, 1996; Gullberg &

Predmore, 1982). At this point absorption may not be complete but the time of rapid increase in BAC has passed.

DISTRIBUTION AND ELIMINATION

Ethanol *distribution* and *elimination* rates are far less variable. Distribution occurs as alcohol circulates with the blood. Ethanol does not bind to plasma proteins and, as a small molecule, it quickly leaves the circulation and equilibrates in the body water. This swift equilibration is important because *total body water volume far exceeds circulating volume*, so body water acts as a reservoir for the dose. So once the rapid-absorption period passes, changes in ethanol concentration occur at modest rates. In real-life situations, the time required to bring a test subject to the sample collection site is enough to allow essentially uniform ethanol distribution in the body. (Jones, Norberg & Hahn, 1997; Jones, Lindberg & Olsson, 2004).

Unlike absorption and distribution, ethanol *elimination* steadily, and predictably, changes BAC during usual specimen collection time. Ethanol is removed from the body by both excretion and metabolism. While the literature describing the details is voluminous, the essentials are straightforward. Ethanol as a drug is unique regarding the dosages involved.

A single twelve-ounce serving of beer may contain ten to more than twenty grams of ethanol. This large drug load rapidly saturates the multiple enzyme systems that account for most ethanol elimination, so elimination occurs at an essentially constant rate. This rate is subject to considerable inter- and intra-individual variation so it is impossible to know any individual's precise elimination rate. When considering the rate of elimination, then, it is best to rely on a population average that encompasses most healthy individuals: An ethanol disappearance rate range of 0.010 – 0.025 grams per deciliter per hour (g/dL/hr) (Jones, 1992; Winek & Murphy, 1984).

While there are several possible valid specimens for the determination of ethanol content, they are not identical, the interpretation of the test results differ.

Again, caution is required when applying this information, due to individual variation and the uncertainty about absorption. Furthermore, one should not attempt to calculate an individual's ethanol disappearance rate based on multiple specimens. There will be insufficient data points to overcome the inherent uncertainties, so the calculated elimination rate will be no more predictive than a population average.

ANALYSIS: WHY WHOLE BLOOD?

Modern analytical techniques have made ethanol measurement routine, shifting the focus from the reliability to interpretation. The first variable is the specimen type. Not every "blood alcohol concentration" is a **blood** alcohol concentration. Unless the specimen was collected for forensic purposes, the result was likely not derived from whole blood but from serum or plasma. Breath or urine specimens likewise may be misreported as blood results, and for postmortem testing, vitreous specimens are common. While these are all valid specimens for the determination of ethanol content, they are not identical, the interpretation of the test results differ.

From early microdiffusion methods to modern chromatographic techniques, whole blood, either capillary or venous, has been the reference specimen in alcohol research. An anticoagulant may be added to prevent the blood from clotting, but all the cellular components and plasma proteins remain in the specimen as the testing begins. When collected for forensic purposes, as in an investigation for impaired driving, the blood is typically collected with potassium oxalate/sodium fluoride as anticoagulant/preservative. If collected for medical necessity, as in an emergency department following an injury, the specimen may be collected with heparin or EDTA as anticoagulant. Regardless of the anticoagulant, if the specimen has not been separated into components (as it would be by clotting or centrifuging), blood ethanol concentration can be interpreted directly, without any modification due to specimen manipulation. Nevertheless, the consultant should determine the type of specimen tube that was used for the whole blood collection, since in an emergency situation an analysis might have been performed on a non-ideal specimen.

WHEN IT'S NOT WHOLE BLOOD

When a whole blood specimen has been separated into its components, the result from the manipulated specimen cannot be a blood ethanol concentration. If the blood was collected with an anticoagulant, the cellular components may be separated (as in a centrifuge) and the plasma tested. If collected without

anticoagulant, the clotted material is separated and the serum used for testing. For purposes of ethanol analysis, plasma and serum are identical and have higher ethanol concentrations than the whole blood from which they were prepared. This is because ethanol is hydrophilic: the cellular components of the blood contain less water than the liquid (plasma) in which they circulate. So removing these cells or clotted material results in a specimen with a higher ethanol concentration than the original whole blood.

The amount of increase compared to whole blood varies with the individual, but is about 12 - 15 percent (Rainey, 1993; Shajani, Godolphin & Image, 1989; Winek & Carfagna, 1987). It is important to keep this in mind when the test result is provided by a medical facility rather than a forensic laboratory. Specimens collected for forensic purposes are normally whole blood specimens, while medical facilities almost exclusively report serum or plasma ethanol concentrations. A laboratory report should state the specimen type; but if it does not, knowledge of the testing laboratory will suggest which specimen was analyzed, and this can be checked.

BREATH ANALYSIS

Ethanol appears in human breath due to gas exchange in the alveoli. Circulating ethanol is in intimate contact with the alveolar air, and ethanol, like carbon dioxide and other waste gases, readily crosses the thin tissue barrier. Ethanol then appears in the end-expired breath in a concentration proportional to the ethanol content of the blood (Harger, 1938; Jones, 1990).

Compared to blood, breath has significant advantages as a specimen type. It may be obtained quickly without the need for medical personnel, and requires minimal cooperation from the test subject. The analytical instrumentation may be portable, is designed for ease of operation, and is equipped with circuitry to monitor specimen quality. Results are available immediately, allowing for timely action by law enforcement, regulatory officers, or medical professionals. Much of the research into alcohol impairment has been performed using breath alcohol determinations,

In the United States, forensic whole blood ethanol concentration is typically reported as g/100 mL while breath concentrations are reported as g/210 L). It is a mistake to assume that a breath result of 0.08 g/210 L means the individual had a blood concentration of 0.08 g/100 mL.

and breath testing is now widely used in investigations of impaired driving, fitness for duty, juvenile alcohol use, and probation compliance (Harding, 2003).

The history of breath alcohol testing is inextricably linked with blood alcohol testing, so much so that the prohibited alcohol concentration in motorists carries the same numerical value (typically 0.08, with lower prohibited values in certain circumstances). The reporting units are different. In the United States, forensic whole blood ethanol concentration is typically reported as g/100 mL while breath concentrations are reported as g/210 L) . It is a mistake to assume that a breath result of 0.08 g/210 L means the individual had a blood concentration of 0.08 g/100 mL.

Many factors contribute to this uncertainty, including:

- Unavoidable biological variability in the partition ratio of ethanol between blood and breath
- Differences in specimen quality (when duplicate specimens are tested) even from compliant test subjects
- Testing protocols that may require selecting the lower of two separate test results
- Although the result may be given to the third decimal place, only the first two places count; there is no rounding and the last digit is dropped

These factors combine to make it more likely that a breath test of 0.08 g/210 L reflects a blood ethanol concentration higher than 0.08 g/100 mL. (Jaffe, Siman-Tov, Gopher & Peleg, 2013; Roiu, et.al., 2013; Gainsford, Fernando, Lea & Stowell, 2006; Harding, Laessig & Field, 1989).

However, individual variation in body temperature, breath temperature, or hematocrit may skew the blood:breath ethanol ratio. There are situations, often involving field screening tests, where the breath specimen may be taken when the ethanol concentration between the arterial and venous circulation may be significantly different. (Jones, 2004 and 2010)

Results may differ between screening devices and evidential breath testing devices. While they may use the same methodology, their sampling protocols are different for waiting periods and determining specimen quality (Gullberg, 1991). Assessing the reasons for differences between breath- and blood-ethanol test results (or even multiple results from both screening and evidentiary breath testing instruments) is important. Results should never be plotted for comparison on the same alcohol-time curve.

URINALYSIS

Ethanol enters in urine from the blood by crossing a thin tissue barrier in the renal glomeruli. This initial glomerular filtrate changes as it passes through other structures in the glomerulus, with active waste excretion and water and solute reabsorption. The final product, urine, travels down the ureter to be retained in the bladder until voided.

Each of these steps adds a layer of complexity to the interpretation of a urine ethanol concentration and presents challenges not associated with other specimens.

The body physiologically maintains blood and breath composition in a very narrow range. However, urine composition varies widely. To maintain homeostasis, the kidney responds to changes in hydration by conserving or releasing water and electrolytes. Therefore, urine-blood ethanol concentration ratio will vary depending on the individual's hydration state. Ethanol itself inhibits antidiuretic hormone release, causing more water loss and diluting the urine.

Urine is formed continuously. Its ethanol concentration is related to the ethanol concentration of the blood while the urine was being formed, and the blood ethanol concentration is constantly changing. If urine dwells in the bladder for a significant tim, the ethanol concentration in a voided specimen may not correlate well with the individual's blood ethanol concentration at the time of voiding, and may be not at all predictive of the degree of impairment caused by the ethanol (Winek, Murphy & Winek, 1984; Morgan, 1965).

This uncertainty can be avoided (in living subjects) by discarding the voided specimen and then allowing enough time to produce a second urine specimen for analysis. The urine-blood ethanol concentration ratio in the second specimen, typically about 1.3:1, will more reliably predict the blood ethanol concentration during the period when the urine was formed (Jones, 2006; Jones, 2002; Jones, 1991). Even so, individual differences in

physiology and hydration make the estimation of blood ethanol concentration from a urine ethanol analysis an uncertain business, and as with other methods, results from two different specimen types should never be plotted on the same alcohol-time curve.

WHY WAS THIS INDIVIDUAL TESTED?

All of these factors, singly or in combination, affect ethanol concentration interpretation. Deciding which factor carries the most weight can be daunting. When evaluating an ethanol test result, therefore, it's important to know the reason for the specimen collection. Knowing the answer to this question allows the consultant to avoid distraction by unrelated issues.

Monitoring. The simplest situation involves monitoring a person prohibited from using alcohol. Specimen type, number, or even alcohol concentration, isn't important when the sole purpose of testing is showing whether alcohol is present.

Medical alcohol testing is for evaluating patient status and guiding treatment. An admission serum or plasma specimen may be paired with a urine specimen, repeated as needed to assess detoxification progress. As these are usually done in the same facility, specimens are typically of the same type and analyzed the same way. This greatly simplifies results interpretation.

Prohibited ethanol concentrations. These are the most complicated cases with multiple opportunities for uncertainty. Result(s) are used for estimating ethanol concentration at an earlier time. Here again it is useful to recall the purpose of the analysis: it's not the actual BAC value but whether it was at or above the prohibited concentration.

By now, the reader can appreciate the difficulties involved. The estimate may rely on multiple specimens collected at different times and analyzed by different instrumentation. Statutes defining a prohibited alcohol concentration frequently specify the specimen type; thus, a specimen of serum or urine may serve as the basis for estimating a blood ethanol concentration.

All these uncertainties are additive. The more remote the time of interest is from specimen collection, the lower the confidence in the result. However, the uncertainty associated with ethanol absorption, elimination rates, or specimen type should not be a distraction from the core question. It doesn't matter when the individual's measured ethanol concentrations is 0.20 or 0.15 when the prohibited threshold is 0.08.

SUMMARY

Evaluating ethanol concentration can be a complicated, sometimes paradoxical exercise. Understanding the sources of uncertainty and the fitness-to-purpose of the various specimen types will aid the consultant in providing a useful interpretation of analytical results.

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A Message from the President

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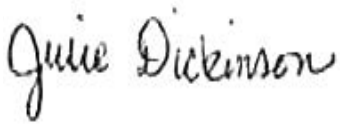
3. Develop a sound business model

- Created a new volunteer Vendor Coordinator role to work with sales staff to identify and secure vendors of value to legal nurse consultants and their businesses. This role is being initiated by AALNC Past President Jeannie Autry BS RN LNCC, CMI-I.
- Developed and approved 2015 budget
- Continued "Treasurer's Corner" report in periodic Member Updates to provide overview of AALNC's financials

I look forward to continuing to share other projects, initiatives, and accomplishments with you – all of which are made possible through the countless hours and effort of our many valued volunteers. On behalf of the Board of Directors, **thank you** to all who have and are serving AALNC!

Respectfully,



Julie Dickinson MBA, BSN, RN, LNCC
President, AALNC

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XXVI.2, June 2015 — Electronic Medical Records

XXVI.3, September 2015 — Expert Witnesses

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