Limited View of Forensic Pathology

- Law Enforcement
- Court Systems
- Legal Implications

Forensic Pathology
"Was the coroner able to establish the cause of death, constable?"
Forensic Pathology

- Research
- Quality Review
- Clinical
- Students
- Police, EMS, others
- Public Health
- Families

Classic Disease
Classic Disease

- 45 year old woman; celebrating New Years day with friends, “getting the flu”
- Jan 2/3: Co-worker called, “Bad flu, staying in bed”. Declined Urgent Care
- Jan 4: Did not show up at work; found moribund in home (in disarray and unlocked); “Drano” open next to body, spilled; Empty Theraflu and acetaminophen bottle; police reports of domestic assault in past; ? Fall / cut on face
Clinical Presentation

- BUN: 59 (Critical, high)
- CO₂ 8.8 (critical, low)
- Creatinine 2
- Mg 3.5
- Albumin 0.9
- AST 564
- Total Protein 2.8
- ALT 125
- Troponin I 11.92
- CPK 12,939
- CKMB: 372.7
- B- natriuretic peptide: 1790
- ABG:
  - pH: 7.04
  - pCO₂ 36 (normal)
  - pO₂ (100%, ambu) 59
  - HCO₃: 9.7

Electrolytes, Glucose, bilirubin, Alk Phos, CBC: Normal
Normal EKG
Glasgow Score: 6
Expired < 45 minutes after admission
Acute Bacterial Endocarditis
Summary

- *Staphylococcus aureus* acute bacterial endocarditis and sepsis, systemic seeding

- Cultures positive
  - Positive blood cultures from ER (2/2)
  - Culture + from valve vegetations at autopsy (within few hours of autopsy)

- Closure of police investigation promptly
Families – Case 1:

- Spry, widowed farmer in nineties
- Wanted to stay independently living on family homestead farm
- Decreasing driving ability

- Family agreed to his continued driving with conditions
  - Only drove in daylight
  - Only drove in his rural community
  - Promised to always wear seatbelt
Death Investigation

- Car ran off county road
- Catches fire in overgrown field
- Body extensively charred
  - Dental ID Confirmed
- Seatbelt burned but latched
Autopsy Findings

- Massive pontine hemorrhage
- Died before car fire
  - No soot in airway
  - Negative CO levels
- Died prior to traffic “accident”
  - No hemorrhage in body cavities, organs
- Natural death while driving a car
Families: Case 2

- 48 year old male, dx with cirrhosis
- Freely admitted to binge drinking – told to stop
- Cut back to “couple of beers” on weekend; red wine with meals, 1-2 x week

- Over next 6 – 12 months, developed shortness of breath, congestive heart failure – “Alcoholic cardiomyopathy”
- “Pre-diabetes”; mild elevation of random blood glucose

- Stop drinking
- Lose weight
- Exercise
Death Investigation

- Found deceased in home
- Cool, rigor, last seen 30 hours previously
- In bed, night clothing undisturbed

- Home neat, secure
- One empty beer in bedroom where decedent found; additional beer in refrigerator.
Death Investigation Considerations

- Potentially fatal natural disease present; irregular medical care
- Relatively young
- No scene suspicions
- History of ethanol abuse

- Release to funeral home?
- External exam and toxicology?
- Autopsy?
Liver: Cirrhosis with **brown pigmentation**

Positive for Iron Deposits
Hemochromatosis: NOT EtOH!

- Systemic iron storage disease from altered Fe metabolism
- Genetic disease – passed down in families
  - Autosomal recessive; 10% carriers in US (Celtic, North European higher)
  - Incidence: 1/300 in US; 1:68 in Celtic origin
- Clinical Presentation:
  - Appears mid life (40 – 50 males; 60 females) with total Fe > 20 grams
  - Symptoms: Cirrhosis, CHF, “bronze skin”, neurologic, diabetes – many mimicking EtOH Abuse
Follow-up

- Family tested
  - One brother and sister with disease
  - Therapy initiated (Normal lifespan with Rx)

- Role of ethanol
  - May increase severity and appear at early age
  - Red wine, more iron

- Critical Family Health Importance
Unexpected Answers

- 50 year old woman ran stop-light
- T-bone collision; died at scene
- Recent movement of temporary stop-light for road construction
- Cat in car; cell phone on; cigarette lighter out
The location of pineal gland may lead to critical compromises of vision if there is enlargement / tumor.
Possible consequences of pineal tumor

- Bi-temporal Visual field defects
- Compression on brain – inability / difficulty to elevate gaze
- Other neurologic and visual consequences
Case Conclusion

- Was it the cat, cell phone, cigarette
- .....or brain tumor
- ..... or any of the reasons for traffic accidents??
Public and Community Health

- New and emerging diseases
- Product safety / workforce safety
- Infectious disease
- Drug use changes and patterns
- Organ and tissue safety
- Regional exposure and disease
- Chronic disease
- Violence and trauma
- Transportation / aviation
- Suicide
- Vulnerable Populations
- Domestic Violence
Quality Review

- Middle aged woman, arrived in town with circus
- Found deceased in trailer, drug paraphilia at scene
- Two days prior, left at rest stop on interstate to seek medical attention
- ER visit of vague abdominal pain, nausea, demanded several narcotics; constipated, no food for 2 days
- Readily admitted to multiple drug use

Rehydrated and discharged as drug seeking addict
Findings and Correlation

- Acute bronchopneumonia with empyema

- Review of hospital records from ER visit 2 days prior, high normal range WBC, WITH BANDS AND LEFT SHIFT

- Drug seeking addicts can develop pneumonia and other illnesses
Undetected Disease Implications:

- 50 year old athlete found dead at home
- Just returned from vacation in South Pacific
  - 28 hour flight; severe leg cramps
  - Attempted workout on return, became short of breath
    - Stopped, called Family Doc for appointment
    - Found dead ~ 1 hour later
- Other minor risk factors
  - Family history of sudden cardiac death
  - Cholesterol 205 four years prior, no treatment.
  - Smoked as teen; none in 30 years
Assessment for Tissue Donation

- Pulmonary embolus presumed Cause of Death

- Body released for pre-autopsy tissue donation; Corneal donation done

- Tissue team arrived late in evening.
  - Question of hemodilution during resuscitation
    - (Internal decision for second donation)
  - Deferred most tissue procurement
Autopsy Findings

- Loose, pale clots, non-adherent, in some pulmonary vessels and heart (believed post-mortem, section taken)
- 575 gm heart, no dilation or gross infarction
  - Up to 75% occlusion in coronary arteries
  - Intramyocardial LAD for 1 – 2 cm.
- CNS: Edema, herniation, bilateral extrusion of hemorrhagic mass.
Heart: Gross – Mild cardiomegaly (575gm); Bridging coronary artery and 75% ASCD
Clot in large pulmonary vessels
LEUKEMIA!

CBC: Leukemic overload – see large white cell population in tube settling
   • (was actually the “dilution” seen by tissue procurement team)

Peripheral smear: Massive leukemic blast population

Post mortem WBC: 729,000; (Normal 4 – 12)
Larger Question

• Acute leukemia would be devastating if used for transplantation.
• How often is unsuspected cancer present at death?
  • “Forensic” vs. “Hospital” autopsies
  • If present, is it the cause of death?
• Can safety of tissue and organ supply be improved with autopsy on donors?
Five year study in Grand Forks
(including 7 mts as ND State Forensic Examiner)

- 412 autopsies (exclude stillbirths and skeletons)
  - 40 patients with cancer, 29 were unsuspected
  - Some patients with 2 different cancers
- 7% of Forensic cases had unsuspected Cancer
  - Caused death in 40%
- 16% of “medical” autopsies had unsuspected cancer
Unsuspected Cancer and Tissue Deferral

Deferral Reason:
- Infection
- Behavior
- Age
- Cancer Hx
- None

% Unsuspected Cancer Patients

- Likely
- Possible
- None
Types of Cancer / Neoplasia
All Cancer seen at Autopsy

- Pancreas
- Lung
- Renal
- Prostate
- GYN
- Thyroid
- Breast
- Larynx/Tongue
- Ureter / Pelvis
- Gallbladder
- Stomach
- Brain

- Unsuspected, malignant
- Clinical, discordant
- Clinical, confirmed
- Benign / Indeterminate
Unsuspected cancer

• Should autopsies be required on donors?

• Other advantages of autopsy
  • Family knowledge
  • Medical care review
  • Accuracy of death certification
  • Accuracy of cancer risks, clusters

• Public health implication with cancer exposures, particularly in low-population areas
Erionite

- Naturally occurring rock
- Class 1 Carcinogen by IARC; Asbestos like compound
- Present in ND; used as gravel in multiple uses (roads, playgrounds)

http://www.ndhealth.gov/EHS/erionite/
Erionite

- High incidence mesothelioma in Turkey with Erionite exposure
  - Strong genetic component (>50%)
  - Recent data 6% in non-risk families
- Are ND residents at risk?
  - Levels higher than Turkish villages
- Current mesothelioma is 1-2 annually in ND
  - Are we missing 1-2 or more a year?

http://www.ndhealth.gov/EHS/erionite/
UND Commitment to ND Citizens

- Partner with ND INBRE and NDMA
  - Transportation Expenses for Funeral homes

- Autopsy for any long term resident of affected area
  - Consent for autopsy
  - Tissue for erionite and other fibrous burden (EPA)
  - Questionnaire for potential exposure and occupational history

- Should answer question of latent disease
Other Areas of Public Health and Law

- Elder abuse
- Childhood deaths
- Fire deaths
- Cancer incidence and detection
- Product safety issues
- Farm and Agricultural Injury; other work injury/death
- Infectious disease – Community risks
National Picture in Forensic Sciences

Sweeping Changes in Forensic Sciences
Forensic Science in US

- National Academy of Sciences 2009 Report
- Main themes
  - Accredited facilities
  - Certified personnel
  - Evidence based practice
  - Removal from law enforcement & judicial influence/ administrative structure
- Research and Science in Forensic Practice / Activities
National Direction

  - Accredited facilities: NAME accreditation - NO
  - Certified individuals:
    - ABP in FP – 100%
    - Death Investigators: Now 5 in ND (ABMDI certified)
- Increased evidence base
- Independence of Investigations
- Increasing research and knowledge advancement
- Leahy bill – due for consideration in this session
- Medical advancements / Forensic based research
Past and Present in North Dakota

- Prior 1994: No Forensic Path base
- 1996 – 2006: Development
  - Recruitment of Dr. Mizell
  - Building of Office
  - Construction of new office
- 2007: Coroner legislation updated
- Current:
  - Dr. Massello (all of ND)
  - Grand Forks County: Drs. Sens and Koponen
North Dakota Forensic Autopsies

- GF Coroner Autopsies
- Bismarck Case Equivalent
- Bismarck Autopsies
Maverick Grand Forks?
Where we came from: UND Pathology

- Chair recruitment: 2000 – 2002, two searches: Education and research, no clinical service
  - Research base: Chair and 3 faculty
    - Two NIH grants; additional 2 shortly after arrival (~ 4M)
    - Continued grant development (INBRE 16M; STEER, AARA ~ 1.5M)
  - Education: Extensive med and grad school education base
- Altru supportive of clinical practice on first visit
  - Autopsy and forensic pathology? Renal pathology / cardiac / transplant pathology
  - Elected to provide autopsy and forensic pathology service – envisioned small % effort.
    - ~ 20 to 25 autopsies (200 considered full time)
    - Desired involvement in Quality Assurance and Outcomes Research
What happened

- SD
- MN
- Coroner
- Bismarck
- Autopsy

GOAL
2004 – 2005: Redefining Goals

- **Critical need for forensic services in region**
  - To serve the citizens, families, hospitals and law enforcement by establishing professional and nationally accredited death investigation
  - To provide excellence in forensic education and continuing education of students and professionals
  - To further an unwavering commitment to rural communities in service, access and education.

- **UND should target State needs** for specialty Pathology faculty that complements, not competes, with hospitals
  - Forensic, neuropathology, pediatric path, cardiac, renal, etc.
  - **UND needs practice site** capable of NAME accreditation and subspecialty needs
UNO Pathology (MD) Faculty

Forensic and Autopsy Pathology
• Two current; more planned as expansion occurs

Neuropathology
• Planned recruitment +/- FP; NP referrals from entire state; research collaboration, eating disorders, neurodegenerative diseases; partner with ND hospitals / neurology/neurosurgery

Pediatric Pathology
• Planned recruitment +/- FP, NP; referrals from region; research collaboration with developmental neuropath, eating disorders

Other Subspecialists
• Not high income specialties to avoid hospital competition
National Standards in Forensic Medical Science

- Regional professional death investigation systems
  - ABP Board Certified Forensic pathologists
  - ABMDI Certified Death Investigators
  - Accredited autopsy and office facilities
- Evidence based practice, national guidelines
- Research in forensic sciences
  - Applied research
  - Integration with “basic” research
# Medical Legal Death Investigators

## Key Personnel
- National shortage in Medical Examiner Offices

## Background
- No degree program; OTJ trained
- Nursing, EMS, Forensic Science, Law Enforcement, Others

## Training
- Week long training conferences (32 – 48 hours didactic)
- Mentorship/training during employment in home office

## Certification
- National exam (ABMDI) after field experience
Current Medical Legal Death Investigator Training and Career

- Excellent for large metropolitan systems
- Allows wide breadth of applicants
- National standards and certification for all

- "Orphan" career without University base
- Requires ME offices to assume large training duty
- Totally inapplicable to rural and frontier systems

Only 110 of 3117 counties in US (3%) could realistically support current system
Death Investigators

- Rural needs must be met:
  - Training at distant locations not practical
  - Certification requirements

- No university / college curricula – professional gap

- Career path and degree for current investigators

- Training standards for all investigators
Educational Opportunities

- NIJ competitive training award: Oct, 2010 (Active 5/11)
  - 1 Million, 3 year grant for development of distance education, aimed at part-time, rural practitioners
  - Focus on training of these para-professionals, law enforcement, coroners in modern death investigation

- Asynchronously delivered, standards based, on-line didactic training for death investigation

- Four (4) On-site focused workshops, 100 participants each

- Free to learners for grant development
Components of Online Training

- Basics of Death Investigation
  - Utilizing current NIJ, ABDMI and NAME guidelines
- Basic Forensic Pathology
  - Types of trauma and documentation
- Basic Forensic Science
  - Overview of disciplines, i.e. arson, fingerprints, ballistics, trace evidence, blood splatter, etc.
  - What to recognize at scene
Components of Online Training

- Case Studies: Integration of scene – crime lab – autopsy – courts – family/medical follow-up
- Cultural competencies and Next-of-kin services
- Mental health in death investigation
  - Taking care of responders
  - “First Aid” for recognizing high risk situations; resources for involving professionals
Strengths and Assets

- Strong cooperation with all agencies in state
- People of North Dakota
- Partnering potential is prime time
- Excellent base of people and facilities
- Base for translational studies and research opportunities with ND Universities, health systems
Challenges

- Rural distances
- Bismarck case load exceeds National Standards; precludes NAME accreditation
- Training of death investigators
- Work distribution
Unique Opportunities for ND

- New Facility in Grand Forks County
- Partnering with UND for provision of services
- Training for rural investigators
- Increased use of telemedicine, IT resources
New Facility in Grand Forks
UND Facility (Open late 2010; 7200 sq. feet)

NAME Accreditation: Two autopsy rooms, two coolers, (regular and decomposition), storage, dedicated personnel, extensive security and protocols.
Dual, secure Coolers
Coolers (warmer)
Main Autopsy Room
Specialized dissection area
Triage area

Also:

Secure garage
Waiting area for drivers
Conference room
“Smoking” room
Large, secure evidence / property room
Secure records room
Additional specialized autopsy room
Ease for students / trainees
Wired / place for LODOX scanner
Future

- Sentinel time in North Dakota history for integration of forensic services
- People and facilities largely in place
- Increased opportunity through cooperation across agencies in State.
Let Conversation Cease.
Let Laughter Flee.
This is the Place Where
Death Delights To Help
the Living