PEDIATRIC STRANGULATION

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https://www.familyjusticecenter.org/downloads/training-institute-on-strangulation-prevention

- Multiple FREE resource materials to download
  - Some included in this presentation
- Multiple archived webinars & videos including those for:
  - Medical providers including EMS
  - LE
  - Attorneys
    - “What civil attorneys need to know about strangulation” webinar series in partnership with the American Bar Association

What we will cover

- Anatomy
- Physiology of strangulation
- Signs & symptoms
- Long & short term risks
- How children are different
- Medical evaluation & the challenges
- Documentation

Key points:

- Strangulation creates risk of death
- Strangulation creates risk of brain injury
- Strangulation is often just one tool in the family violence toolbox
- Children get strangled
  - We don’t know as much about it
  - But it is still clearly dangerous
  - And they need to be evaluated

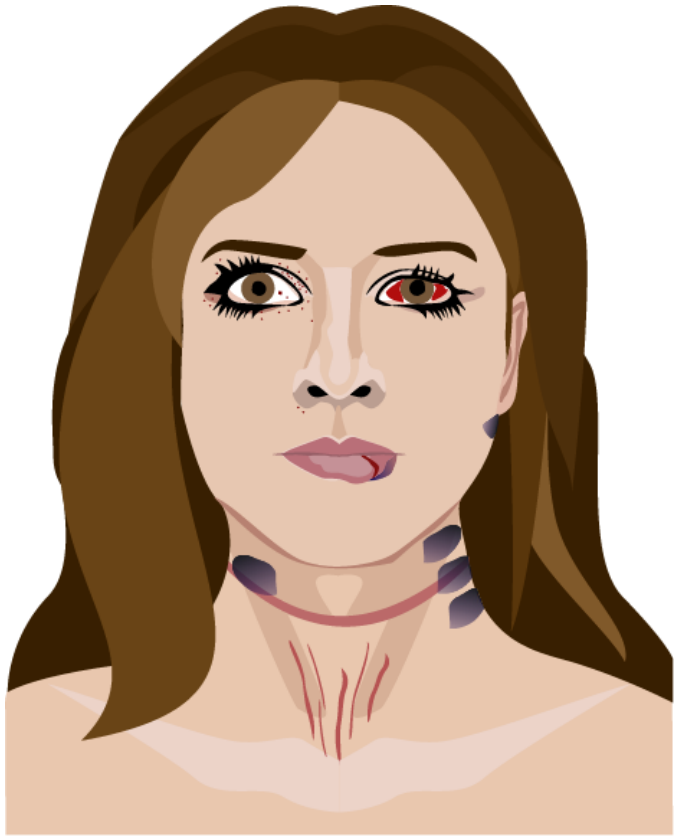
Where we will start:

- With background information mostly pertinent to adults
- Why?
  - Most research
  - Teens similar to adults in terms of anatomy, physiology (but not brain development…)
  - DV strangulation likely increases risk of child strangulation (part of the violence toolbox)
  - Important to help strangled moms understand their risk

THE BASICS

Who was strangled?

A



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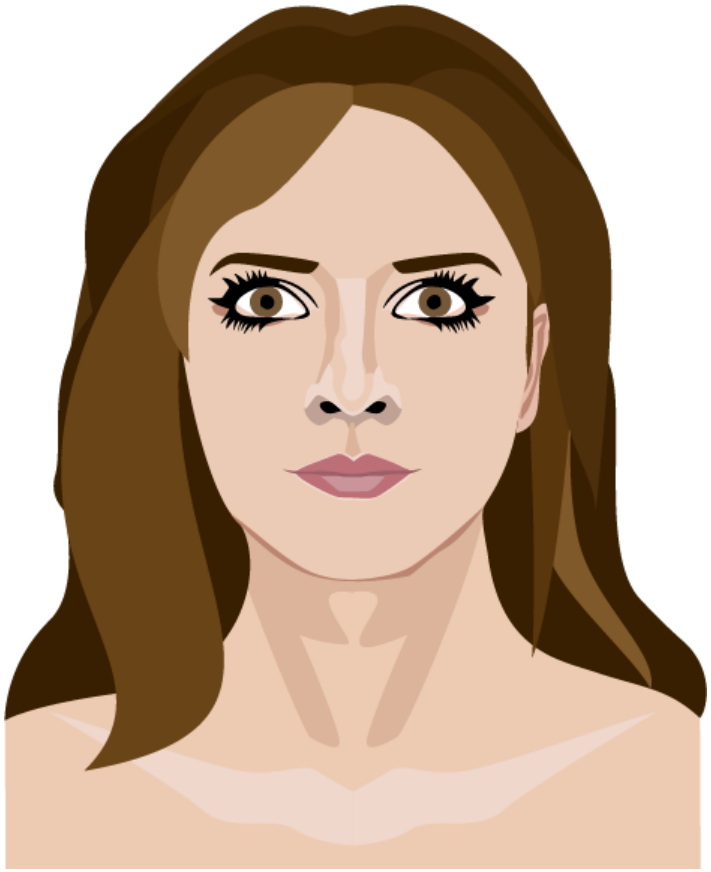
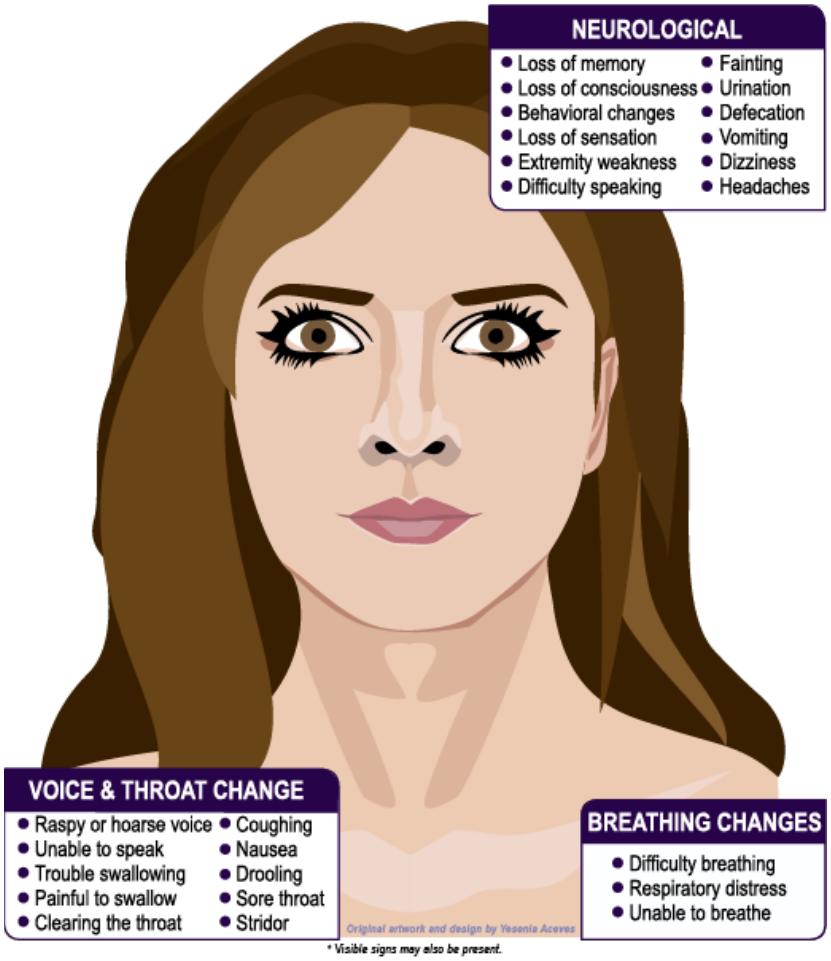
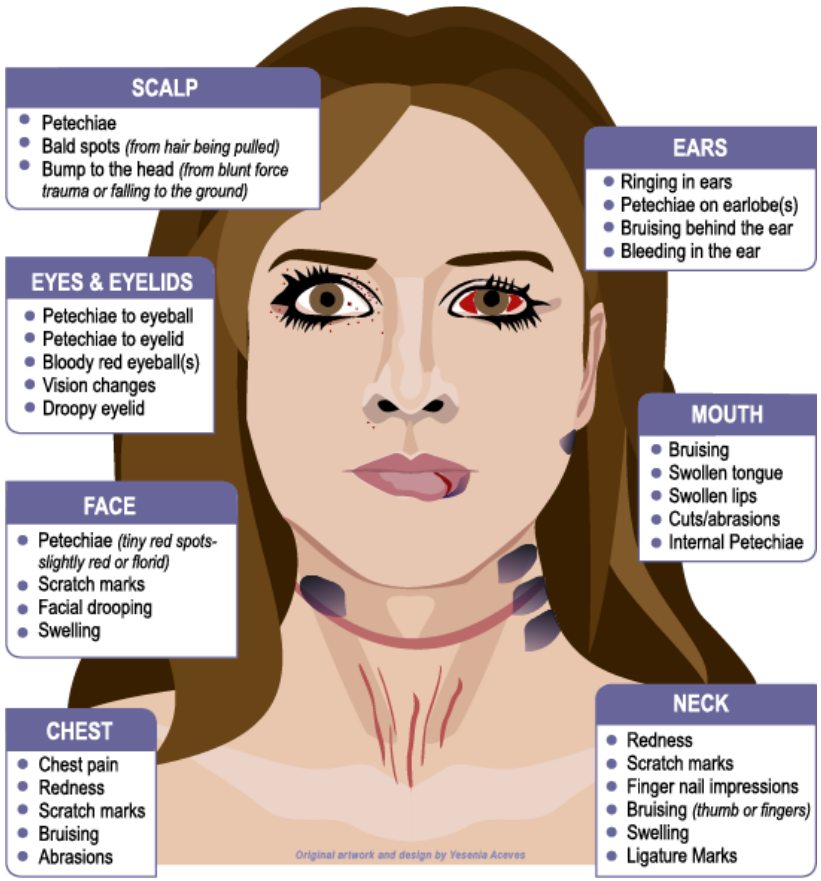


Both could have been





SYMPTOMS of Strangulation

Injuries not visible to the naked eye; may be observable only to the victim.*

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NEUROLOGICAL

- Loss of memory
- Loss of consciousness
- Behavioral changes
- Loss of sensation
- Extremity weakness
- Difficulty speaking
- Fainting
- Urination
- Defecation
- Vomiting
- Dizziness
- Headaches

VOICE & THROAT CHANGE

- Raspy or hoarse voice
- Unable to speak
- Trouble swallowing
- Painful to swallow
- Clearing the throat
- Coughing
- Nausea
- Drooling
- Sore throat
- Stridor

BREATHING CHANGES

- Difficulty breathing
- Respiratory distress
- Unable to breathe

* Visible signs may also be present.

Original artwork and design by Yesenia Aceves

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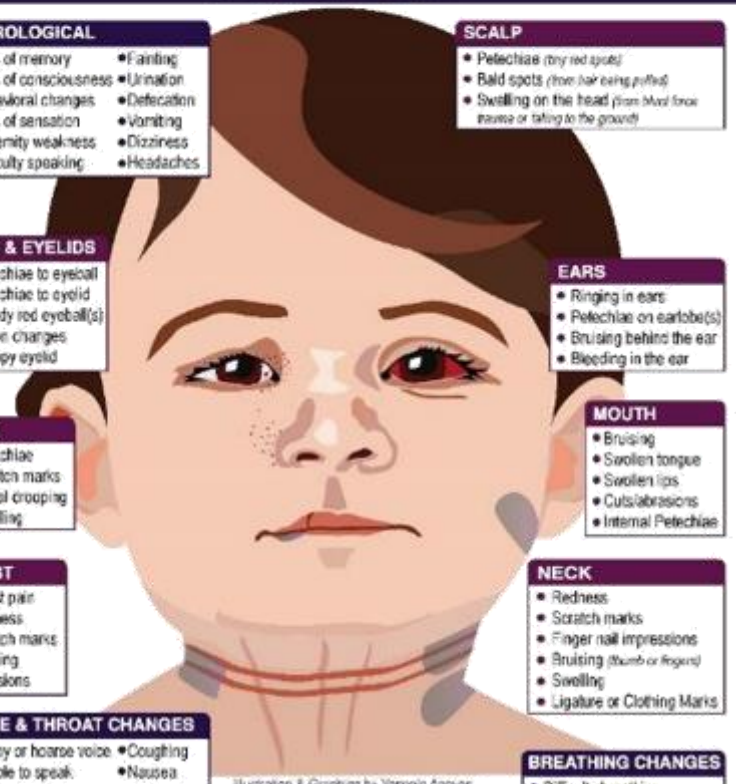
Signs and Symptoms of STRANGULATION



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SCALP

- Petechiae *(tiny red spots)*
- Bald spots *(from hair being pulled)*
- Swelling on the head *(from blunt force trauma or falling to the ground)*

EYES & EYELIDS

- Petechiae to eyeball
- Petechiae to eyelid
- Bloody red eyeball(s)
- Vision changes
- Droopy eyelid

EARS

- Ringing in ears
- Petechiae on earlobe(s)
- Bruising behind the ear
- Bleeding in the ear

FACE

- Petechiae
- Scratch marks
- Facial drooping
- Swelling

MOUTH

- Bruising
- Swollen tongue
- Swollen lips
- Cuts/abrasions
- Internal Petechiae

CHEST

- Chest pain
- Redness
- Scratch marks
- Bruising
- Abrasions

NECK

- Redness
- Scratch marks
- Finger nail impressions
- Bruising *(thumb or fingers)*
- Swelling
- Ligature or Clothing Marks

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Illustration & Graphics by Yesenia Aceves

Source: *Strangulation in Intimate Partner Violence: Chapter 16, Intimate Partner Violence.* Oxford University Press, Inc. 2009

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v 10.2017

FIVE MYTHS ABOUT STRANGULATION

Prepared by Gerald Fineman, Assistant District Attorney, Riverside County, and Dr. William Green, Medical Director, California Clinical Forensic Medical Training Center/ CDAA

MYTH 1

STRANGULATION AND CHOKING ARE THE SAME THING

FACT

STRANGULATION is the external application of physical force that impedes either air or blood to or from the brain.

CHOKING is an internal obstruction of the airway by a foreign object.

SOLUTION

Use a diagram.

Compare to the flow of electrical current.

Compare to the flow of air/water through a closed system (fish tank).

MYTH 2

STRANGULATION ALWAYS LEAVES VISIBLE INJURIES

FACT

Studies show that over half the victims of strangulation lack visible external injury. A victim without visible external injury can still die from strangulation.

SOLUTION

Demonstrate cutting off blood flow to your fingertips by squeezing your wrist with your other hand. Upon release of the grip, you will likely have no identifiable marks. If you do, they will be very short in duration.

MYTH 3

IF THE VICTIM CAN SPEAK, SCREAM, OR BREATHE, THEY ARE NOT BEING STRANGLED

FACT

Since strangulation involves obstruction of blood flow, a person can have complete obstruction and continue breathing until the moment they die from lack of oxygenated blood flow to the brain.

SOLUTION

Again, grab your wrist and squeeze. You can still breathe, yet blood flow is obstructed to the fingertips. If this was the victim's neck, they could still have an open trachea (windpipe) but have lack of blood flow to the brain.

MYTH 4

STRANGULATION CANNOT BE HARMFUL BECAUSE MANY PEOPLE PRACTICE IT (MARTIAL ARTS, MILITARY, LAW ENFORCEMENT)

FACT

Martial arts are a form of combat. The military and law enforcement use strangulation as a lethal form of force.

RISK

There are numerous incidents of death resulting from strangulation. This can even occur during otherwise supervised events, such as sporting events, law enforcement training, etc.

MYTH 5

STRANGULATION VICTIMS SHOULD BE ABLE TO DETAIL THEIR ATTACK

FACT

Trauma impacts the brains ability to store memory. In addition, the hippocampus (part of the brain where memory is stored) is the most sensitive to oxygen deprivation.

When a victim is strangled, both factors can impact the ability to recall.

SOLUTION

Give the example of how limiting the flow of electricity to a digital recording device will prevent it from recording.

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KEY TERMS

- Symptoms:
  - What people report about features concerning their
  - health
- Signs (medical term):
  - What can be seen objectively
- Hypoxia:
  - Deficiency in the amount of oxygen reaching tissue in the
  - body
- Anoxia:
  - Absence of oxygen supply to tissue
- Asphyxia:
  - The condition that arises when the body is deprived of oxygen, leading to unconsciousness or death

ASPHYXIA CAN BE:

- Mechanical = restriction of breathing by position of body or external compression on torso
- Positional/postural = position compromises ability to breathe
- Traumatic = external chest compression by heavy object
- Due to drowning
- Due to strangulation

STRANGULATION DEFINED

- A form of asphyxia characterized by closure of the blood vessels **and/or** air passages of the neck as a result of external pressure on the neck
- Can be restricting:
  - Blood flow
  - Breath
  - Or both

ASPHYXIATION

- If asphyxia persists, victim becomes unconscious and then dies
- How quickly you lose consciousness depends mostly on circulation of blood through brain
- Much less to do with ability to breathe
- Airway obstruction rarely a factor in death by strangulation

STRANGULATION IS NOT CHOKING

- Choking = partial or total blocking of an air passage by a foreign object
- **However,** assault event may include causing choking or suffocation

Strangulation is not suffocation

- Suffocation = obstructing oxygen from getting into the lungs:
  - Sealing off mouth, nose by manual compression
  - Head inside plastic bag
  - Pillow over mouth & nose
  - Compression of stomach/chest
  - However an assault can include suffocation

Forms of Strangulation

- Hanging
- Ligature
- Manual (majority of cases)
  - Forearm (carotid restraint)
  - C-clamp (one hand)
  - Two hands

Lifespan consideration: Additional methods

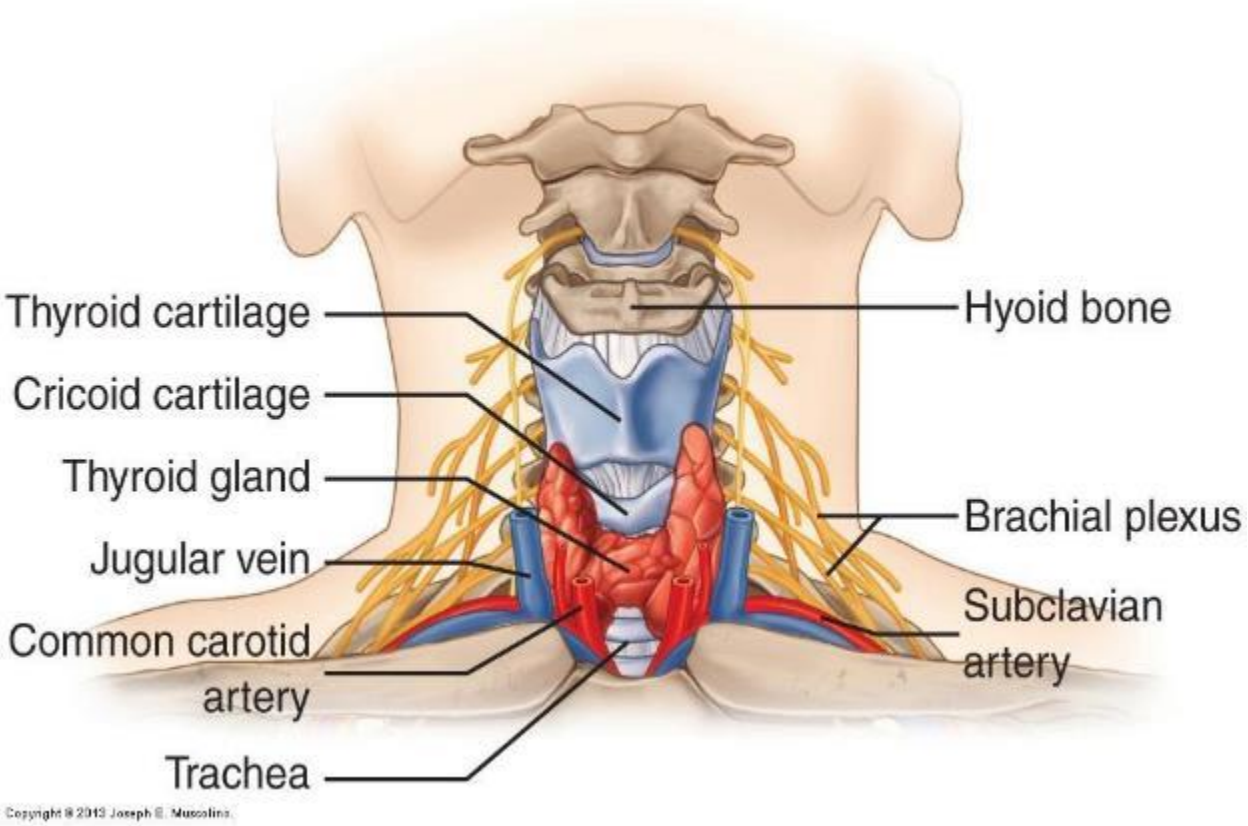
Assault/homicide vs hanging

- Ligature abrasions have a typical pattern horizontal about the neck
- Suicidal hangings have a suspension point which causes the ligature furrow to rise toward the ear

ANATOMY & PHYSIOLOGY OF STRANGULATION

Important structures in the neck

- Muscles
- Bones
- Cartilage
- Blood vessels
- Thyroid gland
- Nerves



Injuries to muscles

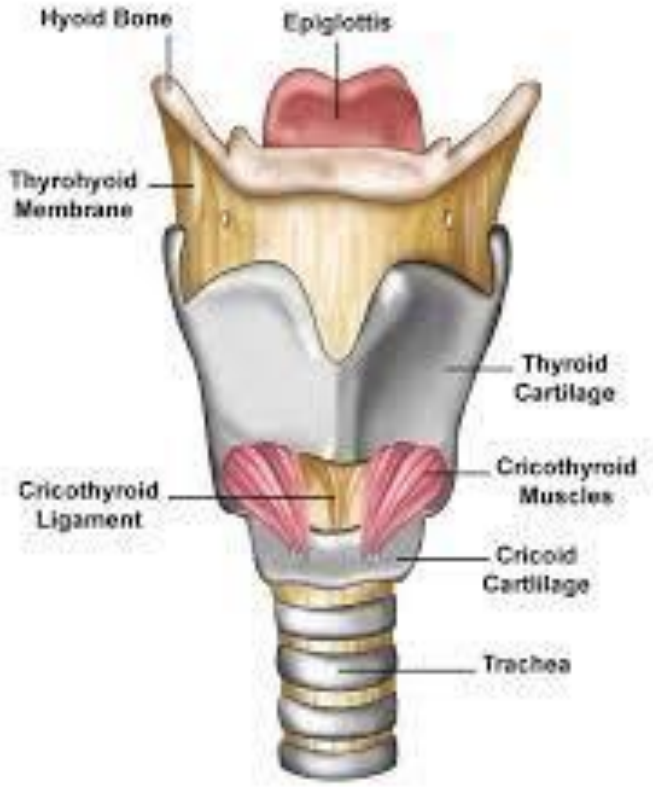
- Can see bruising behind ear from tearing of the sternocleidomastoid muscle attachments
- May also see from blunt force trauma, basilar skull fracture

Bone, cartilage & soft tissue injuries

- Internal injuries of strangulation may involve the larynx & structures adjacent
- Larynx = the tube for air
  - May have fractures
  - May have swelling – voice changes
  - Vocal cord paralysis from nerve injury – voice changes
- Esophagus = the tube for food
  - May have swelling – difficulty swallowing

Injuries to trachea/larynx

- At least 33 lbs. of pressure to completely occlude or fracture cartilage
  - Means someone can still breathe, talk
  - Usually minor (if any) in causing death
- (Fractures less common in children in non-fatal cases since less calcification of cartilage)



Fractures: Hyoid bone

- Seen due to direct trauma to neck: blunt trauma, projectiles, hanging, strangulation
- Primarily seen in fatal
- strangulation
- Neck pain, pain with swallowing, speaking
- Swelling, bleeding, spasm may cause life-threatening asphyxia
- ~6-7# lateral pressure to fracture

Laryngeal or hyoid injury

- Difficult or painful to swallow
- Difficult or painful breathing
  - May progress and cause death if fracture, swelling

Voice changes

- May be sign of injury to recurrent laryngeal nerve or soft tissue swelling
- Up to 50% victims
- May be dysphonia (hoarseness) or aphonia (loss of voice)
- May or may not recover completely

Oral injuries

- Petechiae
- Lip injuries
- Tongue injuries
- Tongue swelling

Injuries to blood vessels

- Cervical artery dissection
  - Not visible externally
  - May be no signs or symptoms
  - Risk of future stroke and/or death if untreated
  - May be to arteries in the front (carotid) or back (vertebral) of neck

Blood vessel occlusion

- **Jugular veins**
  - Lateral (side) neck
  - May be as little as 4 lbs. of pressure to occlude
- **Carotid arteries**
  - Anterior (front) neck
  - May be as little as 11 lbs. of pressure
  - Complete occlusion 5-10 seconds → unconsciousness

Relative pressures

- Firm Handshake: 20-100+ pounds depending on size of person (multiple studies)
- 1-15 pounds of pressure to pull a trigger

Injuries to the brain

- The brain needs a continuous supply of oxygen and glucose
- Without it, brain cells quickly malfunction and die
- Anoxia:
  - 32,000 neurons lost/second
  - 230 million synapses lost/second
- Most brain cells do not regenerate
- *Hypoxic brain injuries:*
  - *Increasing recognition*
  - *May get missed*

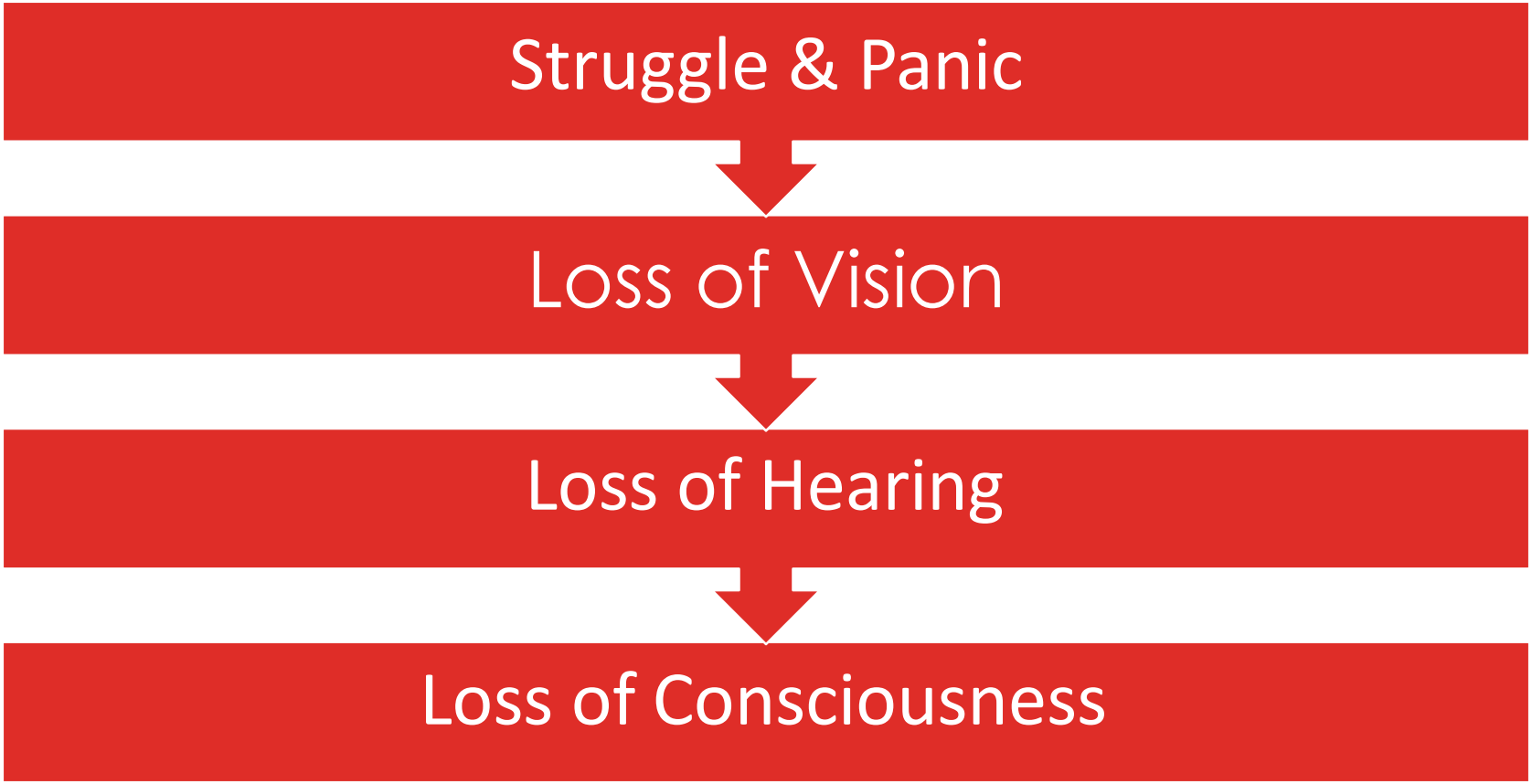
The hippocampus

- Critical for forming, organizing & storing memory
- Also associated with learning and emotions
- Very sensitive to:
  - Lack of oxygen
  - Lack of blood flow
  - No memory
  - Impact on feelings, reactions

(-) is actually a (+)

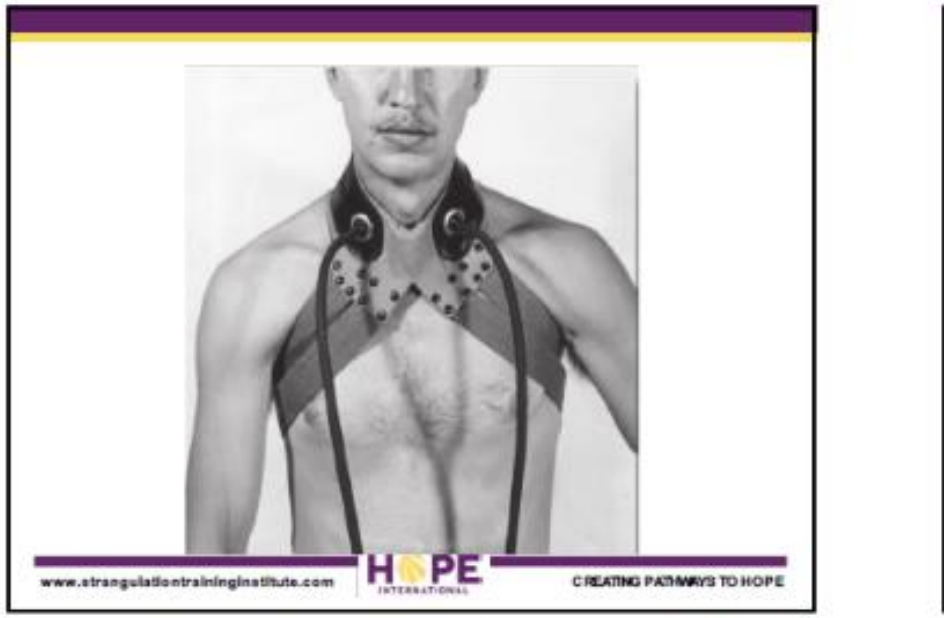
- Supportive of case:
  - Gaps in memory
  - Non-linear memory
  - Abnormal behaviors acutely

Physiologic responses to strangulation



How long to LOC?

- Acute arrest of cerebral circulation in man (Rossen, Kabat, Anderson Archives of Neurology and Psychiatry 1944)
- 11 schizophrenic patients & 126 “normal” inmates
- Raised pressure to 600 mm mercury w/in 1/8 sec
- >500 controlled strangulations
- Pressure released with LOC



How long to LOC?

- 5-10 seconds:
  - Fixation of eyeballs
  - Visual changes
  - Constriction of visual fields
  - Numbness/tingling/shooting pains
  - Loss of consciousness
  - Anoxic convulsions

- Schizophrenic patients:
  - After 20-30 seconds heart rate slowed “notably”
  - Development of abnormal reflexes
  - Loss of bladder control at 15-40 seconds in 7/11 patients
  - Loss of bowel control at 30 seconds in 2/11 patients
  - Seizures
  - “No improvement in psychiatric status after repeated and relatively prolonged periods of arrest of cerebral circulation”

CONSCIOUSNESS TO DEATH- 14 FILMED HANGINGS

Observations & average time:

- Unconscious: 10 +/- 3 seconds
- Anoxic convulsions: 14 +/- 3 seconds
- Loss of muscle tone: 77 +/- 25 seconds
- Last respiration: 111 +/- 30 seconds
- Last muscle movement: 4 minutes 12 seconds +/- 2 minutes 29 seconds

Sauvageau, Anny et al. (2010). Agonal Sequences in 14 Filmed Hangings with Comments on Role of the Type of Suspension, Ischemic Habituation, and Ethanol Intoxication on the Timing of Agonal Responses *Am J Forensic Pathol. 2011;32:104-107*

PHYSIOLOGICAL CONSEQUENCES OF STRANGULATION
Occlusion of Arterial Blood Flow: Seconds to Minutes Timeline

CREATED BY: Ruth Carter; Bill Smock, MD; Gael Strack, JD; Sean Dugan, MD; Marisol Martinez, MA ; Yesenia Aceves; and Ashley Peck

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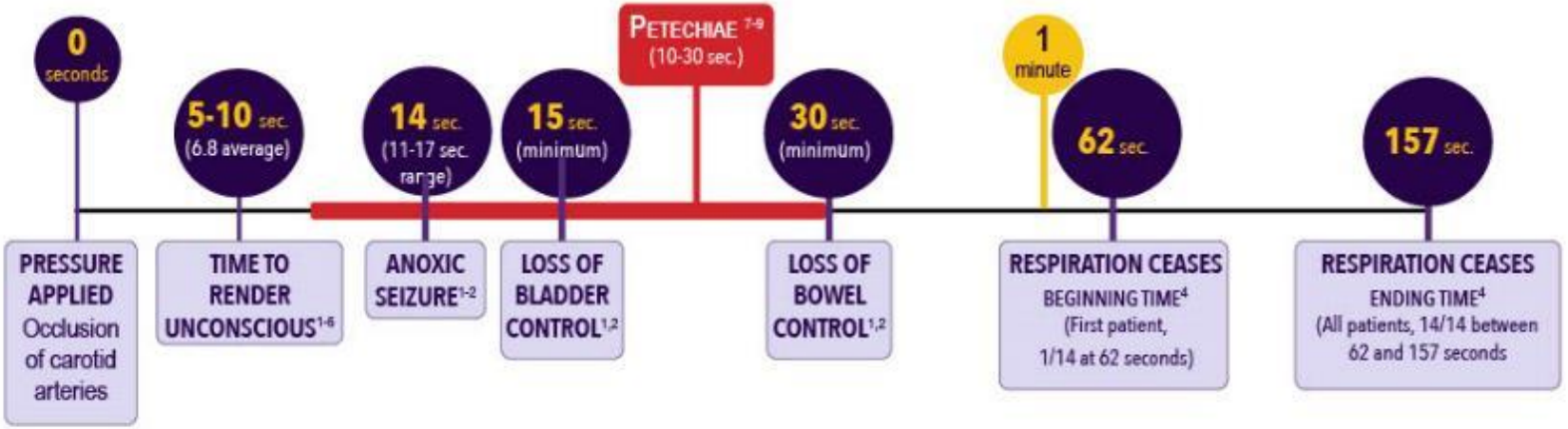

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HOPE

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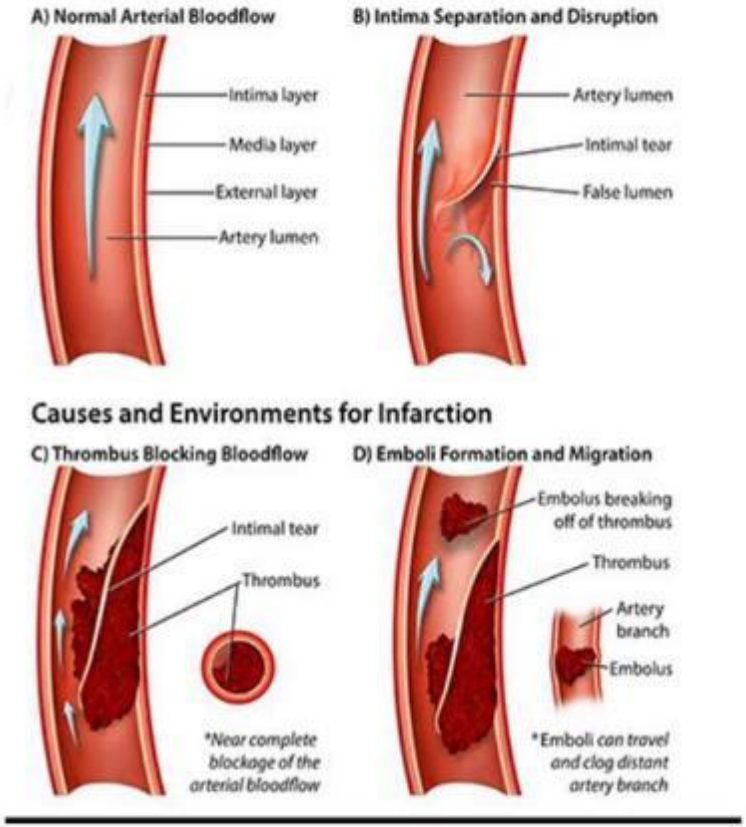
Why do people die at the time?

- Obstructing blood flow TO the brain (carotid arteries) = no oxygen to brain, unconsciousness, quit breathing
  - Potentially within 10 seconds if bilateral
- Obstructing blood flow AWAY from the brain (jugular veins) = blood backs up in brain, unconsciousness, quit breathing
  - Potentially within 30-45 seconds if bilateral
- Obstructing air flow = no oxygen to brain, unconsciousness, no return of breathing drive
  - Within 3-4 minutes

Why do people die later?

- Delayed injuries:
  - Hypoxic or traumatic brain injuries
  - Progressive swelling in soft tissues of neck
  - Lung injuries from aspiration, trauma
  - Carotid artery dissection

Causes of Delayed Death and Serious Neurologic Disability after Strangulation



- **Blunt Cerebrovascular Injury (BCVI)**
  - Compression, twisting or stretching of the artery may tear the lining (**intimal tear**)
  - Blood clot (**thrombus**) may form
  - Thrombus may grow and stop blood flow (**ischemic stroke**)
  - Thrombus may break off (**embolus**) and travel to block blood flow "downstream" (**embolic stroke**)

Rare but serious complications

- Severe trauma to the upper airway
  - Airflow can be compromised
  - Voice box fractured
  - Facial and neck swelling over days
- Air can escape from the air passages and leak into the soft tissues (subcutaneous emphysema)
  - May lead to death.
- Thyroid gland injury leading to thyroid storm

Increasing recognition:
it is rarely only strangulation…

- Shaking
  - Intracerebral acceleration/deceleration injuries
- Impact
  - Concussion
- Smothering/suffocation
  - Anoxic/hypoxic brain injury
- Other physical injuries
- Sexual assault

Study on prevalence of SA & NFS

- Review of 856 SA cases 2002 – 2017
- 5.1% SA + NFS
- Most victims female
- Partners 18.9%; strangers 16.6%
- NFS occurred more often when:
  - Weapons involved
  - Anal penetration
- Conclusions:
  - Increased risk lethality with SA + NFS
  - Need to screen for NFS when victims report SA

HTTPS://News.osu.edu/study-brain-injury-common-in-domestic-violence

- Ohio State University & Ohio Domestic Violence Network study
  - 81% women abused by partner and sought help had suffered a brain injury
  - 83% had been strangled
  - Brain injuries caused by blows to head & oxygen deprivation
  - Repeated episodes common:
    - ~1/2 reported being hit in head or head shoved into object "too many times to remember"
    - >1/2 choked or strangled "a few times"
      - 1/5 "too many times to remember"

“Survey results of women who have been strangled while in an abusive relationship”

- Difficulty breathing: 85%
- Scratches on neck: 44%
- Dysphagia: 44%
- Voice change: 45%
- LOC: 17%
- Ptosis: 20%
- Facial palsy: 10%
- L or R sided weakness: 18%
- Memory deficit: 31%
- Suicidal ideation: 31%

What if its “consensual”?

- Research from Debby Herbenick PhD, MPH, Indiana University School of Public Health
- Changing “norms”
  - 1 in 3 young adult women had been choked during their most recent vaginal sex
  - College students: 34% women, 6% men had been choked more than 5 times

Findings

- Couldn’t breathe 43%
- Couldn’t speak 38%
  - Implications for withdrawal of consent
- Neck pain 19%
- Neck swelling 4%
- Neck bruising 15%
- Involuntary loss of urine 2%
- Blurred vision 12%
- Vision loss 4%
- Dizzy/lightheaded like might pass out 15%
- Lost consciousness/passed out 3%
- TOTAL WITH SIGNIFICANT NEUROLOGIC SYMPTOMS 19%
- ***YOU CAN’T CONSENT TO SOMETHING THAT CAN KILL YOU***

HOW ARE CHILDREN DIFFERENT?

Pediatric strangulation: Challenges

- More likely to be under-appreciated by law enforcement, medical providers, prosecutors, judges/juries
- More likely to be under-reported
- More likely to have delay in care
- More vulnerable to injury
- Less able to protect themselves
- Less likely to clearly articulate what happened – language development
- Less research

Literature review

- Can’t take adult literature and apply across the board to children
- Most pediatric strangulation literature:
  - Accidental hangings
  - Suicidal hangings

Child abuse strangulation

- Strangulation victims <18 years of age occasionally mentioned in some articles
- Articles related to inflicted pediatric strangulation are case reports or small series
- Fatalities primarily due to:
  - Acute asphyxia
  - Hypoxic ischemic encephalopathy
  - Cerebral infarction
  - One death d/t carotid injury (bled out)
- Multiple forms of abuse common

Research on cervical artery dissection in children

- Mostly case reports, 3 reviews
  - Age range 1 month to 18 years
  - Onset of symptoms minutes to months
  - Vertebral may be more common than carotid
  - Etiologies reported:
    - Strangulation – one case report
    - Head/neck trauma (only one mentioned child abuse as potential cause)
    - “Vigorous physical activity” (including stretching the neck)
    - Underlying medical condition
      - Connective tissue disorders, thrombophilia
    - “Spontaneous”
- Imaging used/recommended:
  - MRA/MRI
  - CTA

VULNERABILITY TO INJURY

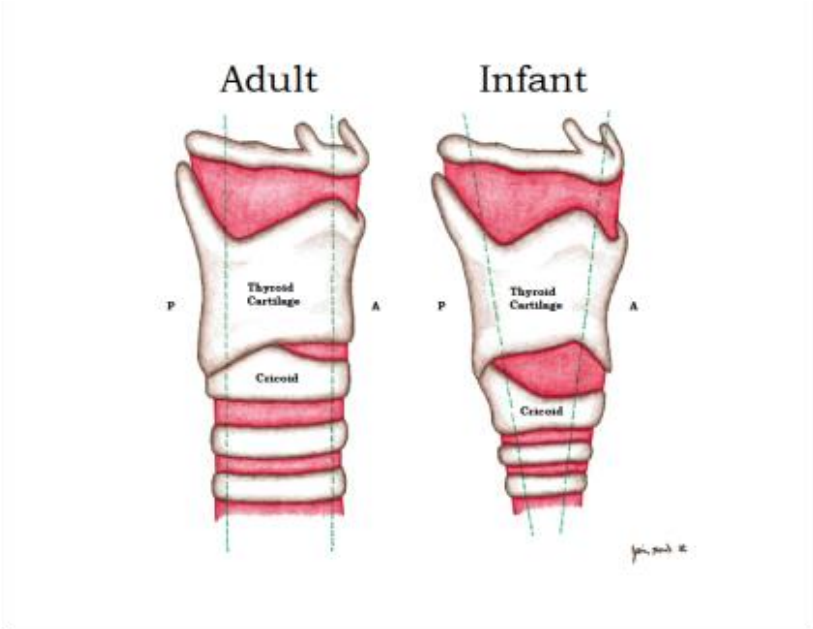
Differences in anatomy, physiology, mechanisms

Airway differences

- Bigger head
- Larger tongue
- Weaker neck

Airway differences, cont.

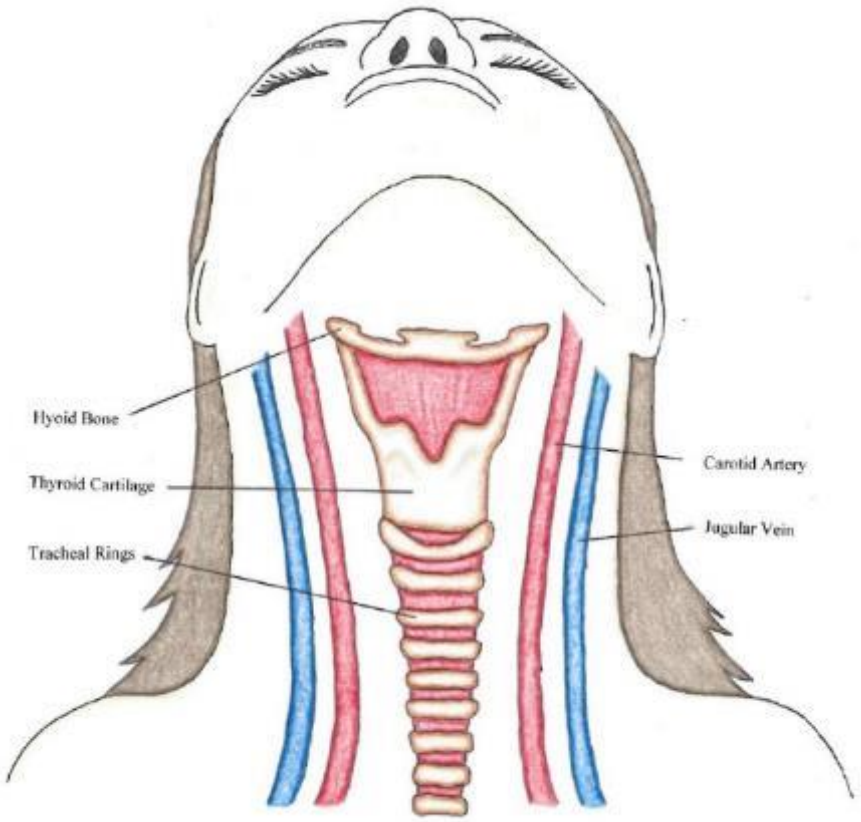
- Funnel shaped airway located higher in neck
- Narrower, softer epiglottis
  - Until age 4-5
- Smaller cricoid cartilage
- Mucosal edema can severely compromise airway



Pressures required likely less

- No studies on living children…
- Koors et al 1982 cadaver study- 9 yo child, 2 young women:

- "When strangling children, due to the small circumference of the neck and the soft, cartilaginous nature of the larynx, significantly lower forces are required to close the airways and the arteries."
- (Translated from German – thanks to Dr. Sean Dugan)



Other differences:

- Infants: much easier to obstruct airway
- Cartilage less calcified: less likely to find fractures
- May be at greater risk of:
  - Pulmonary complications
  - Cerebral edema (especially late)
  - Severe hypoxic-ischemic encephalopathy

Mechanism may be different

- May be manual, choke hold, ligature HOWEVER:
  - Easier to lift children off the ground:
    - By neck
    - By clothing
  - Verma 2007 78% ligature by clothing, possessions
- Female caregivers as perpetrators
- Motivation (of perpetrator) may be different

HOW KIDS PRESENT

Clinical presentation

- May present for care days to weeks after strangulation
  - Just like other forms of child abuse
- Clinical spectrum range from mild self-limiting symptoms to severe neurologic sequelae or death
- Some symptoms in adults may not be as helpful in young children (i.e. incontinence)
- May describe symptoms in ways different than adult but that are developmentally appropriate
  - “I talked like a duck”; “I talked like my grandpa”; “I fell asleep”

Presentation

- May present due to physical findings noted by:
  - Teachers
  - Daycare providers
  - Neighbors
  - Family members
- Report then made to child protection and/or law enforcement

Typical symptoms reported by children similar to adults:

- Voice changes
- Sore throat or neck pain
- Headache (may be more common in children)
- Difficulty breathing
- Problems swallowing
- Dizziness
- Loss or near loss of consciousness
- Older children: urinary and/or fecal incontinence

Other ways children may present:

- Hypoxic brain injury resulting in:
  - Seizures or altered level of consciousness
  - Altered mental status including agitation or confusion
  - Respiratory depression
- Respiratory distress due to:
  - Acute lung injury
  - Aspiration
- Ischemic stroke symptoms from carotid occlusion or dissection

Physical findings reported in children:

- Petechiae of face, neck, conjunctivae
- Takes ~15-30 seconds sustained occlusion of jugular vein to cause facial petechiae
- If only carotid occlusion: NO PETECHIAE AT ALL

Petechiae

- The bursting of capillaries usually caused by a restriction of venous return
- Petechiae can occur anywhere above the point of occlusion
- Need to check scalp, behind ear, inside mouth
- May be seen on internal organs & structures as well

Petechiae

- May only take 15-30 seconds sustained occlusion of jugular vein to cause facial petechiae
- If carotid occluded: NO petechiae

Petechiae

- Petechiae on the face & head likely indicate petechiae on/in the brain

Petechiae vs acne

- Petechiae are smooth & flat
- Acne is usually raised or bumpy
- Medical history, follow up exam very helpful

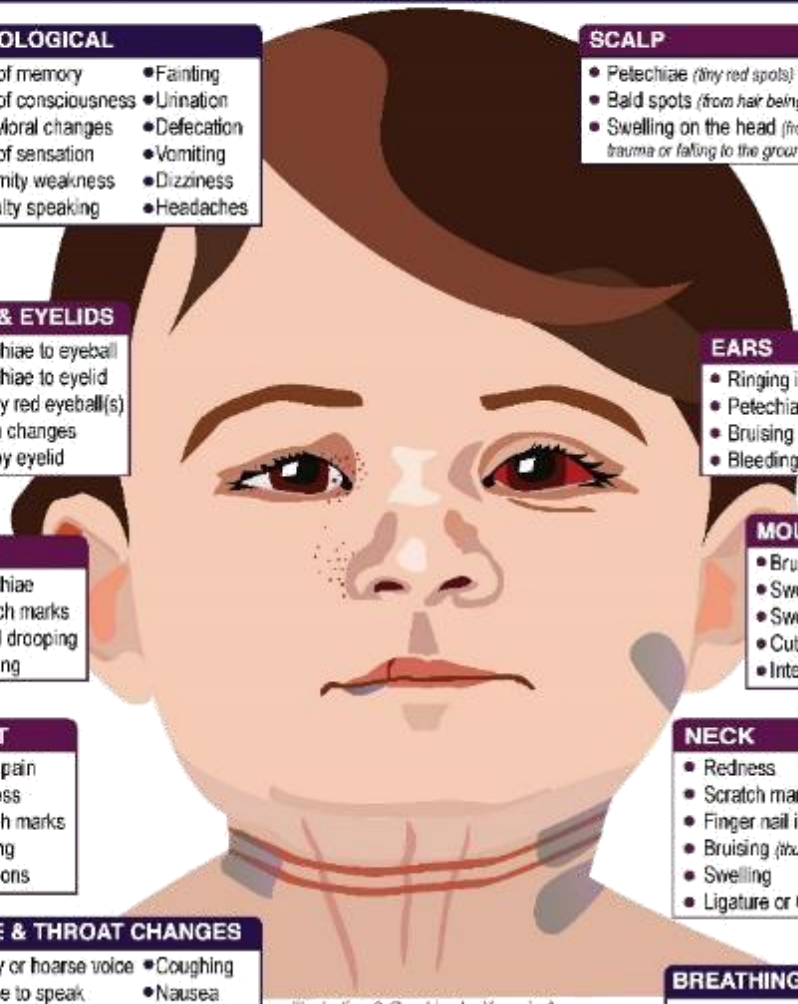
Other causes for petechiae

- Labor & delivery
- Scuba diving
- Severe coughing or vomiting
- Leukemia
- Blood thinners
- Bleeding disorders

Other physical findings

- Bruising of neck
  - May be patterned from fingers, thumb, ligatures, clothing
- Swelling in neck, face
- Defensive scratch marks on neck
- Abrasions or patterned injury from jewelry worn by child or assailant
- Injuries elsewhere on child's body
- Or NO findings on exam…

Signs and Symptoms of STRANGULATION



NEUROLOGICAL

- Loss of memory
- Loss of consciousness
- Behavioral changes
- Loss of sensation
- Extremity weakness
- Difficulty speaking
- Fainting
- Urination
- Defecation
- Vomiting
- Dizziness
- Headaches

SCALP

- Petechiae *(tiny red spots)*
- Bald spots *(from hair being pulled)*
- Swelling on the head *(from blunt force trauma or falling to the ground)*

EYES & EYELIDS

- Petechiae to eyeball
- Petechiae to eyelid
- Bloody red eyeball(s)
- Vision changes
- Droopy eyelid

EARS

- Ringing in ears
- Petechiae on earlobe(s)
- Bruising behind the ear
- Bleeding in the ear

FACE

- Petechiae
- Scratch marks
- Facial drooping
- Swelling

MOUTH

- Bruising
- Swollen tongue
- Swollen lips
- Cuts/abrasions
- Internal Petechiae

CHEST

- Chest pain
- Redness
- Scratch marks
- Bruising
- Abrasions

NECK

- Redness
- Scratch marks
- Finger nail impressions
- Bruising *(thumb or fingers)*
- Swelling
- Ligature or Clothing Marks

VOICE & THROAT CHANGES

- Raspy or hoarse voice
- Unable to speak
- Trouble swallowing
- Painful to swallow
- Clearing the throat
- Coughing
- Nausea
- Drooling
- Sore throat
- Stridor

Illustration & Graphics by Yesenia Aceves

BREATHING CHANGES

- Difficulty breathing
- Respiratory distress
- Unable to breathe

Source: *Strangulation in Intimate Partner Violence, Chapter 16, Intimate Partner Violence. Oxford University Press, Inc. 2009.*

TRAINING INSTITUTE on STRANGULATION PREVENTION

strangulationtraininginstitute.com

v 10.2017

Findings in the eyes

- Subconjunctival hemorrhages (essentially petechiae in the whites of the eye or underside of the eye lids)
- May progress – importance of follow up exams

Neck Injuries

- Case series with imaging:
  - Up to 25% pediatric strangulation **deaths** had fractures of bony & cartilaginous structures in neck
  - Including thyroid cartilage & hyoid bone
- Other studies (**living victims**) found bone/cartilage injuries less common in children than adults
- Soft tissue edema in neck more common in children

Neuroradiology 2018

- Unilateral anoxic brain injury due to strangulation
- 4 year old and 12 month old – multiple injuries
- Neuroradiologist posited temporary occlusion of carotid artery creating ischemic stroke
- Confirmed with investigation

Rarely just one bad thing…

May have a normal exam

- So a good history is critical

LONG TERM RISKS

The most vulnerable organ

- Needs continuous blood flow
- Without it, brain cells quickly malfunction and die
- Hippocampus very sensitive to O2 loss (memories/emotions)
- Hypoxic brain injuries being missed – long term effects

Injuries to the brain

- May not be readily apparent
- May manifest as:
  - Behavioral changes
  - Memory loss
  - Mental health problems
- Medical evaluation, imaging may identify

Severe delayed effects of strangulation reported in children:

- Vocal cord paralysis – increased risk aspiration
- Hypoxic-ischemic encephalopathy
- Cerebral edema (swelling)
- Cerebral infarction (stroke)
- Chronic brain injury
  - May manifest as behavioral changes, cognitive challenges, mental health problems
  - The challenge: what is from
    - Strangulation
    - Other TBIs
    - Chronic stress/accumulation of ACEs

Fatalities due to strangulation

- Deaths – acute or delayed
  - Most felt to be related to asphyxia/hypoxia
  - Dayapala et al 1992 – 3 yo delayed death due to carotid laceration (bled out)
  - Yadav et al 2009 – 8 yo fatality d/t asphyxia – strangulation during sexual assault – carotid sheath hematoma incidental finding on autopsy

Fatalities due to strangulation, cont.

- 20 year study in Mexico of homicides of children <10 published 2021:
  - 5188 homicides
  - 13.9% overall due to hanging or strangulation
    - Rate 12.7% boys & 15.4% girls
    - Highest rate in girls <1 – 23.2%

DIFFERENTIAL DIAGNOSIS

What else could it be?

The “Choking Game”

- CDC:
  - 82 deaths 1995-2007 (likely underestimate)
- 2016 “The Choking Game on YouTube”:
  - 1% ligature, 9% sleeper hold, 10% pressure on neck, 39% pressure on chest
  - 23% seizures
- Recent deaths US, Italy, India r/t Tik Tok Choking Challenge

The “Choking Game”

- Activity in which persons strangle themselves or others to achieve euphoria through brief hypoxia (including autoerotic asphyxiation)
- Busse et al 2015 systematic review:
  - Median lifetime prevalence 7.4%
  - Most fatalities when engaging on own & using ligatures
  - Associated with other high-risk behaviors
  - Associated with chronic headaches, confusion, amnesia, neurological problems, death

Influence of social media

- 2016 “The Choking Game on YouTube”:
  - 1% ligature, 9% sleeper hold, 10% pressure on neck, 39% pressure on chest
  - 23% seizures
- Recent deaths in news:
  - USA, Italy, India, England r/t Tik Tok Black Out Challenge

Accidental

- Infants and young children are especially vulnerable
- Entanglement in furniture, ropes/cords, clothing, playground equipment
- Careful history, scene investigation, re-enactment critical
- (1980 Feldman review)

Suicide

- May be challenging to distinguish strangulation suicide from the “choking game” or auto-erotic asphyxiation
  - Age distribution older
- Careful history, scene investigation critical

Medical

- Facial petechiae from significant Valsalva maneuvers
- Underlying bleeding problem
- Thorough medical evaluation critical

“Consensual”

- Teen girls being seen at our CACs
- Disclosing consensual sexual relationships with “choking” during sex
- Importance of screening – opportunity for education!

TALKING TO KIDS ABOUT THEIR STRANGULATION

Forensic interview considerations

- Open ended as much as possible
- Give permission to be confused, recall more details later:
  - “Just do the best you can for now”
  - (Remember this may be a sign of a hypoxic brain injury)
- Getting to LOC:
  - How did it stop?
  - Did you wake up somewhere else?
  - Is there any part of what happened that you can’t recall?
- What did you think was going to happen?
- Has this happened before?
- Remember: incontinence is embarrassing...

http://www.sdfi.com/downloads/SDFI_Adult_Non -Fatal_Strangulation_Protocol.pdf

SDFI Secure Digital Forensic Imaging

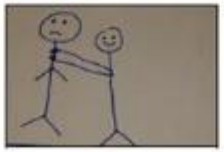
Secure Beyond Reasonable Doubt®



The examiner should always be sensitive to how the child may react in using this method and should follow what the child is comfortable doing. The examiner could also use a toy doll to have the child show what happened or even ask the child to draw a representation using a crayon and paper.

A good rapport with the child is important during this part of the examination. Communicating with a calm tone while giving the child specific and easy to understand instructions will help the examiner get better results. Example: *"This is a teddy bear. Can you show me what happened to you?"* In many places, it will be a forensic interviewer (Child Advocacy staff, law enforcement or even a child protection worker) who will be doing the interview rather than the forensic examiner. Take photos of the ligature that might have been used if it is available. Follow your local protocol.


Sometimes children will not have the words to describe the incident but they are able to draw from memory what happened to them.




SDFI Secure Digital Forensic Imaging

Secure Beyond Reasonable Doubt®

Non-Fatal Manual Strangulation Chart

Trauma Informed Patient Care: Often times your patient may have difficulty showing the position of the perpetrator's hands on their neck. This 8 pack will help the patient describe the event by pointing to one of the eight positions similar to what happened to them. The positions are numbered 1-8 for ease of documentation by the provider.

Left Hand – Front	Right Hand – Front	Two Hands – Front	Two Hands – Back
			
1	2	3	4
Left Arm	Right Arm	Left Elbow	Right Elbow
			
5	6	7	8

Examiner's Notes: _____

_____

Indications for need for medical evaluation!!

- Restlessness
- Combativeness
- Feeling dizzy
- Feeling faint
- Loss of memory
- Loss of consciousness
- Mental status changes
- Involuntary urination
- Involuntary defecation
- Nausea/vomiting
- Vision faded
- Reported “seeing stars”
- Voice changes
- Swallowing changes
- Breathing changes

THE MEDICAL EVALUATION OF STRANGLED CHILDREN

WHEN DO KIDS NEED A MEDICAL EVALUATION?

Hint: Have a low threshold

Never just one Bad Thing

- Always evaluate for concurrent additional types of child abuse:
  - Sexual abuse/assault
  - Abusive head trauma
  - Other forms of physical abuse
  - DV exposure (is mom getting strangled too?)
  - Substance abuse in home

What to expect with a medical evaluation

- History of event
- Past medical history
- Complete medical evaluation
- Forensic evidence collection if indicated
- Medical assessment
- Recommendations including appropriate diagnostic testing
- Patient education
- Documentation
- Follow up

Medical history

- Will include more than history of event
  - Past & current medical and surgical history that may impact exam findings
  - Medications
  - Allergies
  - Review of systems
- Why ask those questions?
  - It's good medical care
  - Discover symptoms of other injuries
  - Differential diagnosis considerations
  - Assist in safety planning
  - Keeps provider in medical lane = exemption to hearsay

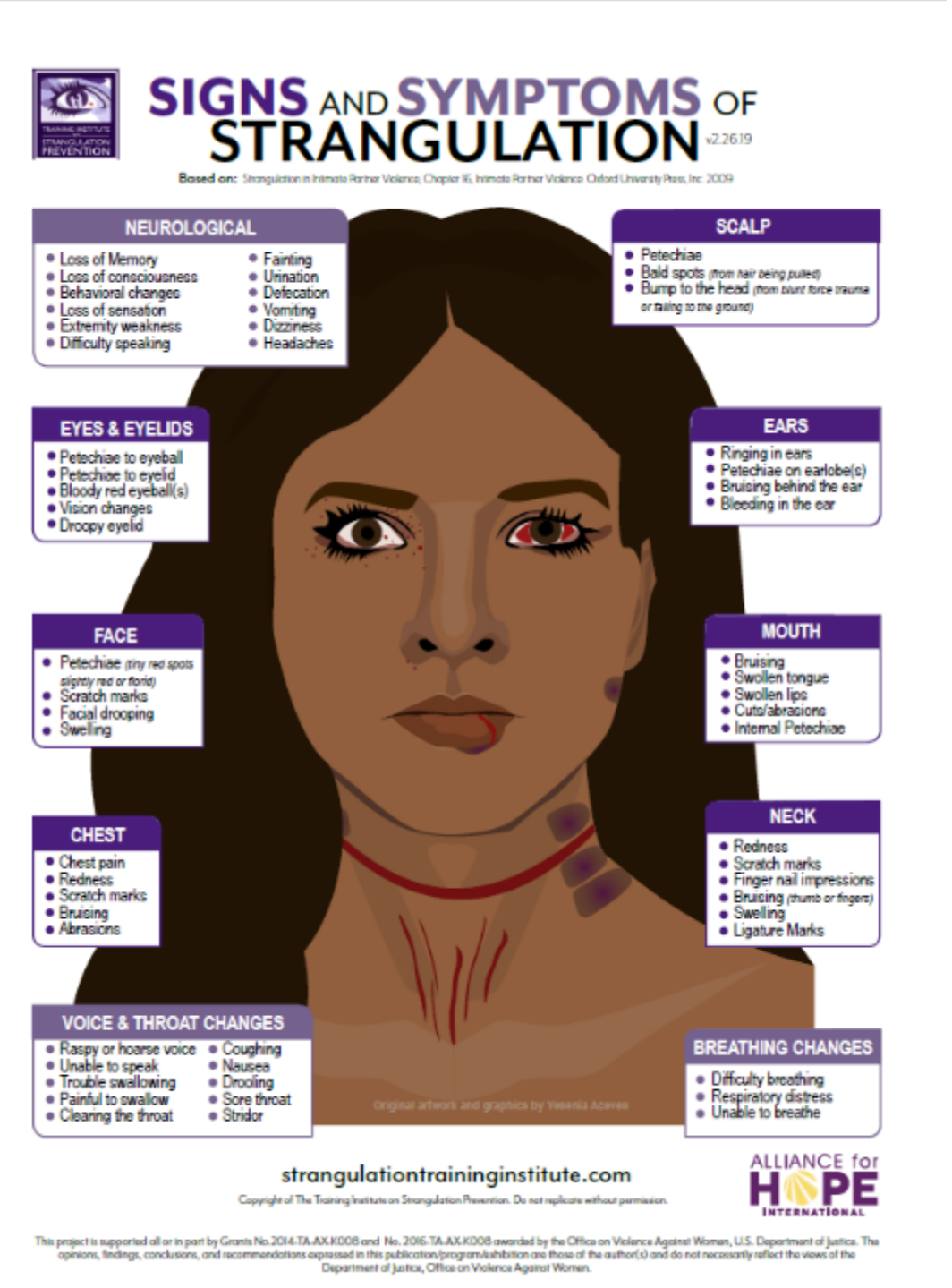
Medical history

- Situation in which strangulation occurred
- Method of strangulation
- Symptoms the child experienced during and after strangulation
- Current symptoms
- Time elapsed between strangulation episode and presentation to care
- Presence of any medical conditions that might predispose child to petechiae
- Child’s developmental level

Medical exam

- Head to toe (or whatever patient consents to)
  - Remember findings may be subtle, not readily apparent
- Forensic evidence collection if indicated
  - Examples:
    - Stranger assault
    - Clear grab marks
    - Sexual assault
- Appropriate diagnostic testing
  - Labs
  - Imaging

REMINDER:
It may be more difficult to see skin injuries when more pigment present in skin

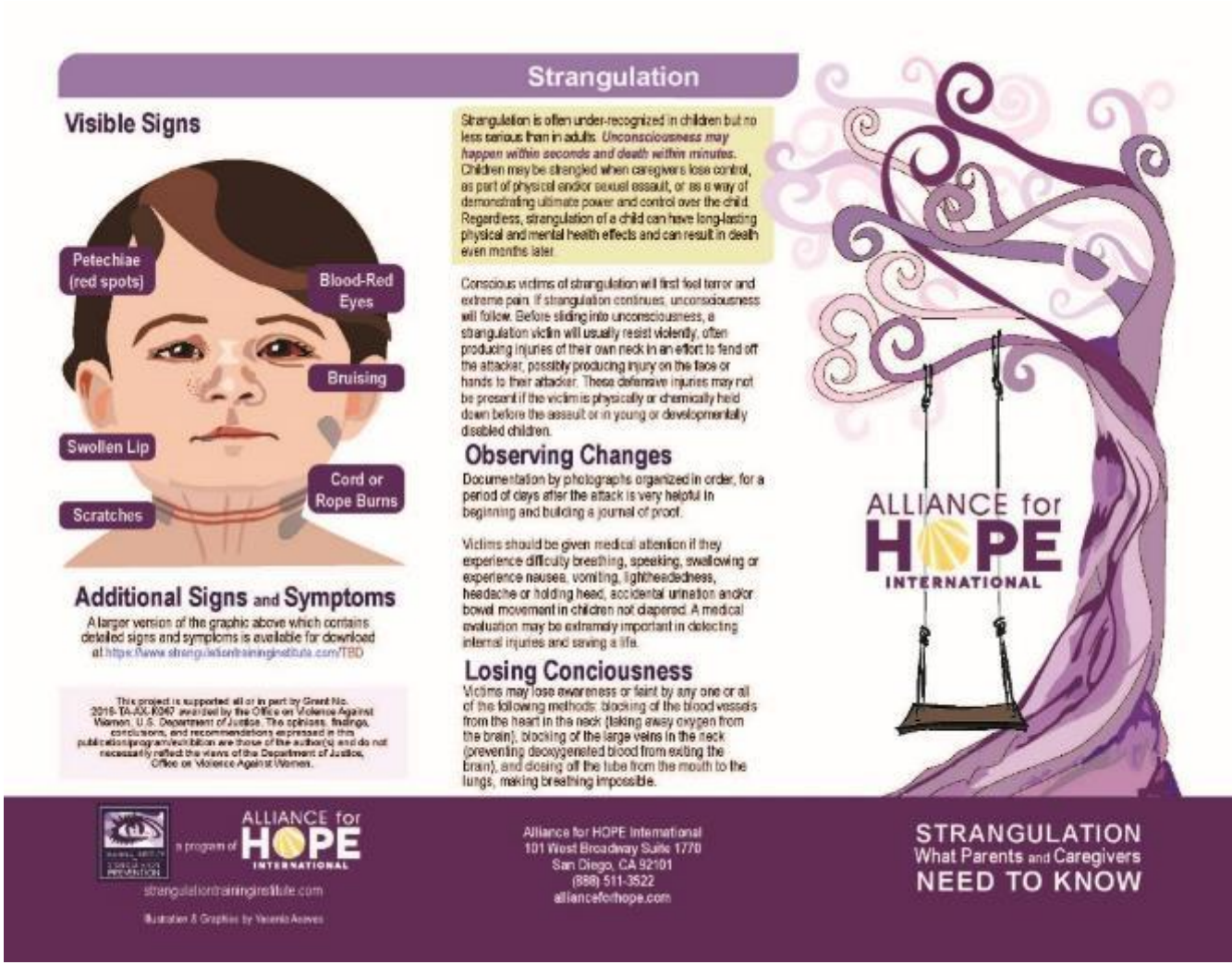


Observation/Follow-up

- Consideration for 24 hour observation
  - Especially if clinical indications for imaging
- All patients should be offered follow up
  - For evolution of injuries
  - For re-assessment of symptoms and signs
- Patient/parent education about risks, warning signs/symptoms
- Patients/parents should be encouraged to log symptoms

Additional recommendations

- Parent education
- Close out- patient follow up if not admitted



- Provide written discharge instructions

PEDIATRIC STRANGULATION DISCHARGE INSTRUCTIONS

Because your child has reported being **"choked" or strangled**, we are providing you with the following instructions:

Consider a small ice pack to the neck area for relief of pain.
Offer popsicles or offer fluids that are cooling to the throat. Kids like this.
Make sure someone is with your child for the next 24-48 hours.

Please report to the nearest ER or call 911 immediately if you notice the following symptoms or changes in your child:

- Difficulty breathing or shortness of breath
- Loss of consciousness or "passing out"
- Changes in your child's voice or difficulty speaking
- Difficulty swallowing, lump in throat, or muscle spasms in throat or neck
- Tongue swelling and/or drooling
- Swelling to throat or neck, new, worsening or persisting throat pain ("My throat still hurts")
- Prolonged nose bleed (greater than ten minutes)
- Continues to cough or coughing up blood
- Continues to vomit or vomiting up blood
- Left or right-sided weakness, numbness, or tingling (child cannot use arm or leg)
- New or Worsening headache
- Seizures (Abnormal, rhythmic or shaking movements)
- Behavioral changes or memory loss
- Thoughts of harming self or others ie: ("I do not want to live") ("I am going to hurt him")

It is important that the above symptoms be evaluated by a physician.

After your child's evaluation, keep a list of any changes in symptoms for your child's physician and law enforcement.

If symptoms worsen, report to your child's physician or nearest ER. You should follow-up with law enforcement regarding documentation of any and all information about your child's symptoms.

It is important that you have a follow-up medical screening in 1-2 weeks at the clinic or with your child's physician. Make sure to bring these discharge instructions with you.

IF you misplace these instructions call _____ or your provider for a copy.

I have been made aware of and understand the importance of following the above outlined instructions.

Patient/Parent Signature	Provider Signature	Date
1 copy patient file	1 copy patient	

Recommendations for follow up medical care

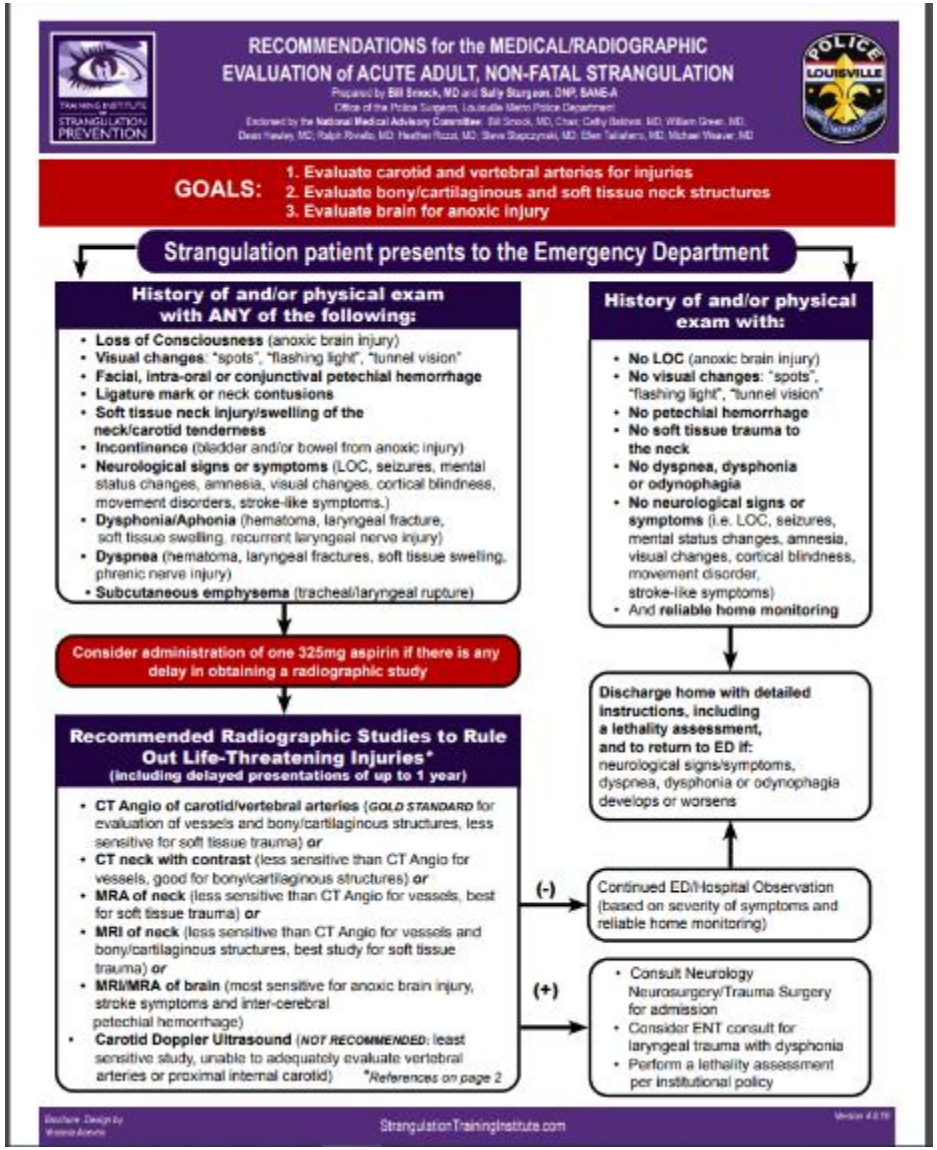
- Primary care follow up
  - With education for PCP, parent
    - Long term complications
    - Traumatic brain injury
- If concerns:
  - Neurodevelopmental evaluation
  - Elective brain imaging
- Mental health referral

IMAGING

Imaging guidelines from TISP

- Adult literature:
  - CT angiogram for carotid/vertebral arteries considered gold standard by many to evaluate vessels, bony/cartilaginous structures; not as sensitive for soft tissue trauma
  - Zuberi et al Emergency Radiology May 2019:
    - 2.1% of 142 non-fatal strangulation cases had vascular injuries identified
  - Matusz et al Annals of Emergency Medicine March 2020:
    - 1.3% of 149 non-fatal strangulation cases with imaging had carotid dissection
    - 4% had serious injuries identified with imaging

Imaging Recommendations with additional references



RECOMMENDATIONS for the MEDICAL/RADIOGRAPHIC EVALUATION of ACUTE ADULT, NON-FATAL STRANGULATION

Prepared by Bill Smock, MD and Sally Sturgeon, ONP, SANE-A
Office of the Police Surgeon, Louisville Metro Police Department
Endorsed by the National Medical Advisory Committee: Bill Smock, MD, Chair; Cathy Bellows, MD; William Green, MD; Dean Hawley, MD; Ralph Rivello, MD; Heather Rizza, MD; Steve Stapczynski, MD; Ellen Taliaferro, MD; Michael Weaver, MD

GOALS:
1. Evaluate carotid and vertebral arteries for injuries
2. Evaluate bony/cartilaginous and soft tissue neck structures
3. Evaluate brain for anoxic injury

Strangulation patient presents to the Emergency Department

History of and/or physical exam with ANY of the following:

- **Loss of Consciousness** (anoxic brain injury)
- **Visual changes**: "spots", "flashing light", "tunnel vision"
- **Facial, intra-oral or conjunctival petechial hemorrhage**
- **Ligature mark** or neck **contusions**
- **Soft tissue neck injury/swelling of the neck/carotid tenderness**
- **Incontinence** (bladder and/or bowel from anoxic injury)
- **Neurological signs or symptoms** (LOC, seizures, mental status changes, amnesia, visual changes, cortical blindness, movement disorders, stroke-like symptoms.)
- **Dysphonia/Aphonia** (hematoma, laryngeal fracture, soft tissue swelling, recurrent laryngeal nerve injury)
- **Dyspnea** (hematoma, laryngeal fractures, soft tissue swelling, phrenic nerve injury)
- **Subcutaneous emphysema** (tracheal/laryngeal rupture)

History of and/or physical exam with:

- **No LOC** (anoxic brain injury)
- **No visual changes**: "spots", "flashing light", "tunnel vision"
- **No petechial hemorrhage**
- **No soft tissue trauma to the neck**
- **No dyspnea, dysphonia or odynophagia**
- **No neurological signs or symptoms** (i.e. LOC, seizures, mental status changes, amnesia, visual changes, cortical blindness, movement disorder, stroke-like symptoms)
- And **reliable home monitoring**

Consider administration of one 325mg aspirin if there is any delay in obtaining a radiographic study

Recommended Radiographic Studies to Rule Out Life-Threatening Injuries*
(including delayed presentations of up to 1 year)

- **CT Angio of carotid/vertebral arteries** (*GOLD STANDARD* for evaluation of vessels and bony/cartilaginous structures, less sensitive for soft tissue trauma) *or*
- **CT neck with contrast** (less sensitive than CT Angio for vessels, good for bony/cartilaginous structures) *or*
- **MRA of neck** (less sensitive than CT Angio for vessels, best for soft tissue trauma) *or*
- **MRI of neck** (less sensitive than CT Angio for vessels and bony/cartilaginous structures, best study for soft tissue trauma) *or*
- **MRI/MRA of brain** (most sensitive for anoxic brain injury, stroke symptoms and inter-cerebral petechial hemorrhage)
- **Carotid Doppler Ultrasound** (*NOT RECOMMENDED*: least sensitive study, unable to adequately evaluate vertebral arteries or proximal internal carotid) **References on page 2*

Discharge home with detailed instructions, including a lethality assessment, and to return to ED if: neurological signs/symptoms, dyspnea, dysphonia or odynophagia develops or worsens

(-) Continued ED/Hospital Observation (based on severity of symptoms and reliable home monitoring)

(+)
- Consult Neurology Neurosurgery/Trauma Surgery for admission
- Consider ENT consult for laryngeal trauma with dysphonia
- Perform a lethality assessment per institutional policy

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(Recommendations based upon case reports, case studies, and cited medical literature)
Click below for hyperlinks - please note that some sources may require purchase or subscription

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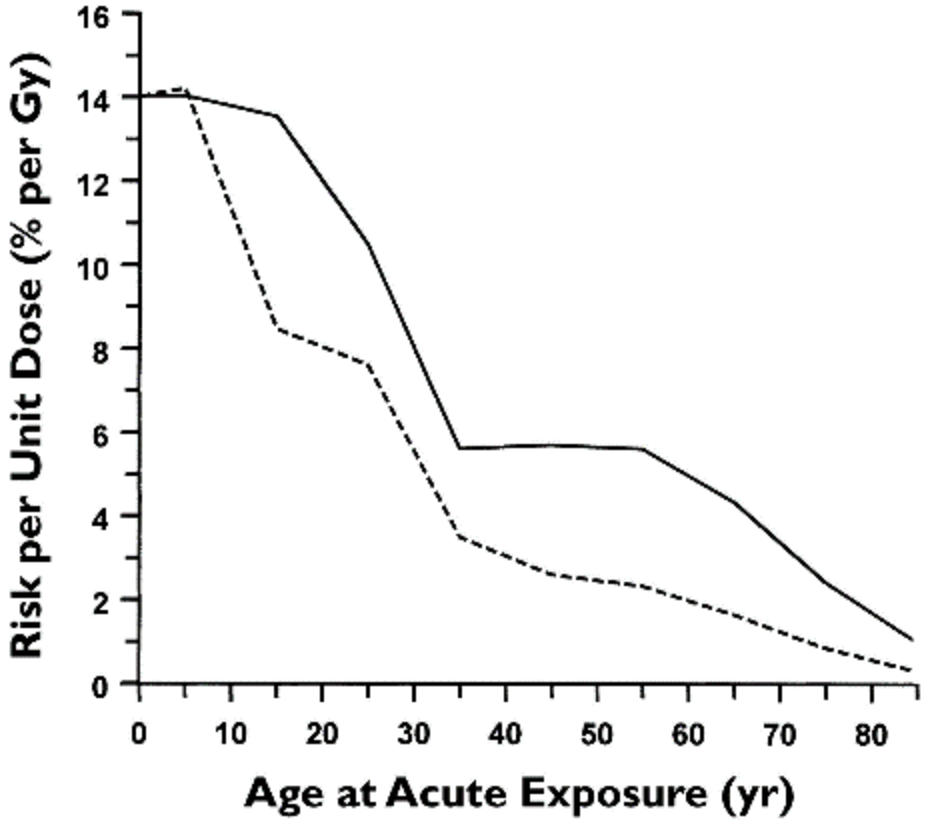
Other Imaging Options

- CT of the neck with contrast
  - Less sensitive for vasculature injury
- MRA of the neck
  - Also identifies soft tissue neck trauma
- MRI of the neck
  - Less sensitive for vasculature and bony/cartilaginous injury
  - Best for soft tissue neck trauma
- MRI/MRA of the brain
  - Best for anoxic brain injury, stroke symptoms and intracerebral hemorrhage
- Carotid doppler ultrasound
  - Not sensitive enough

For pediatric patients:
First do no harm

- Radiation risks
- Need for sedation
  - Risks
- Costs to family

Estimated lifetime attributable cancer mortality risks per unit dose as a function of age at a single acute exposure



Brenner et al Estimated risks of radiation-induced fatal cancer from pediatric CT Am J Roent 2001 176(2)

- Current literature offers little guidance for imaging modalities & recommendations in strangled children
- Vascular injuries in current literature appear rare in children

What the literature does say about imaging kids:

- 2003 Child Abuse & Negl
  - 15 children w/infarction r/t AHT vs accidental head injury
  - NO vascular injuries on 7 autopsies, 2 angiograms
- 2013 Int J Pediatr Otorhinolaryngology
  - 16 children w/"near hangings", 10 CTAs
  - NO vascular injuries identified
- 2013 J Pediatr Orthop
  - Cervical arterial injury after blunt trauma in children
  - 61 patients, 19 with imaging (CTA and/or MRA)
    - 11 MVC; 8 sports related
    - 11.5% cervical vascular injury
      - One dissection
      - ALL had cervical spine injuries
      - No delayed-onset ischemic neurological events

Literature, continued

- 2017 J Neurosurgery Pediatrics
  - 282 children with AHT, 28% CVA – some possibly due to “choking maneuver”
  - NO vascular injuries identified
- 2021 Pediatric Radiology
  - 66 children age 1-18 – hanging or strangulation (4% assault)
  - 60 w/CTAs – NO vascular injuries identified
- 2023 The American Surgeon
  - 179 children age 1-17 s/p hanging present to ED with signs of life, 82 had CTA – 5 dx with cervical vascular injury
    - 104 intubated, 58 died
- Caveat: limited cases d/t strangulation child abuse

Other differences:

- Appear to have greater risk for:
  - Pulmonary (lung) complications
  - Cerebral edema (especially late)
  - Severe hypoxic-ischemic encephalopathy

So what to do for kids?

- Older adolescents: consider adult guidelines IF INDICATED BY HISTORY, EXAM
- Younger children presenting acutely with symptoms or exam findings:
  - Low threshold for admission for close observation
  - Brain imaging probably the priority
    - MRI best
    - Add MRA of neck if clinically indicated

What to do for kids?

- Younger children presenting non-acutely:
  - Get detailed history about event(s), symptoms & signs during/since
  - Low threshold for elective imaging of brain if:
    - LOC and/or neurologic symptoms
    - Behavior changes
    - Recurrent episodes of strangulation

Additional diagnostic studies to consider:

- Skeletal survey in children <2-3 years of age
- EEG if concerns for abusive head trauma, hypoxic-ischemic encephalopathy

DOCUMENTATION

Written documentation

- “SOAP” note
  - Subjective: What is said
    - History of event from patient, others
    - Medical history
  - Objective: What is seen
    - Exam
    - Diagnostic testing results
  - Assessment: Interpretation
  - Plan:
    - Recommendations
    - Follow up

Documentation considerations

- Document breathing, vision, hearing, voice, swallowing, neurologic changes, headaches, nausea, vomiting, pain, loss of bladder/bowel control:
  - During the strangulation, right after & now
- Use “strangulation” not choke (unless quoting the victim)
- Use “non-fatal strangulation” not “attempted strangulation”
- Use standardized documentation
- Use diagrammatic as well as photo documentation

Date/Time of Assessment:

Method/Manner of Strangulation:

- ☐ One hand — Estimated length of time: ____seconds ____minutes
- ☐ Two hands — Estimated length of time: ____seconds ____minutes
- ☐ "Chokehold" — Estimated length of time: ____seconds ____minutes
- ☐ Approached from the front
- ☐ Approached from behind
- ☐ Multiple strangulation attempts during incident — How many? ____
- ☐ Jewelry on patient's neck during strangulation
- ☐ Ligature used — Describe if possible: ____
- ☐ Smothering attempt — Describe: ____
- ☐ Other — Describe: ____

During the strangulation did the patient note any of the following:

- ☐ Loss of consciousness/blacking out/passing out — Number of times: ____
- ☐ Incontinence of urine ☐ Incontinence of stool
- ☐ Bleeding — Describe: ____
- ☐ Patient's feet lifted off the ground
- ☐ Patient's shirt was tightened around their neck

Since the strangulation, has the patient noted any of the following symptoms:

- ☐ Coughing ☐ Drooling ☐ Dyspnea ☐ Dysphagia ☐ Odynophagia ☐ Headache
- ☐ Lightheadedness ☐ Neck pain ☐ Neck swelling ☐ Nose pain ☐ Nausea ☐ Vomiting
- ☐ Crepitus ☐ Uncontrolled shaking ☐ Combativeness ☐ Irritability ☐ Restlessness
- ☐ Otherwise altered mental status — Describe: ____
- ☐ Voice changes — Describe: ____
- ☐ Vision changes — Describe: ____
- ☐ Bleeding — Describe: ____
- ☐ Weakness/numbness of extremities — Describe: ____

Pressure and Pain Assessment

Pain score: ____ ☐ Numbered scale used ☐ Wong Baker scale used

On a scale of 0-10, with 0 being no pressure and 10 being the worst pressure you can imagine, how strong was the grip during your strangulation (Circle one):

0 1 2 3 4 5 6 7 8 9 10

Patient Label

Examination (Strangulation specific – a full physical exam should be documented elsewhere)

Is the patient pregnant? ☐ Yes; How many weeks? ____ ☐ No

Oxygen Saturation

Saturation: ____ Time: ____
Saturation: ____ Time: ____

Lung sounds: ☐ WNL ☐ Abnormal: ____
Heart sounds: ☐ WNL ☐ Abnormal: ____
Carotid pulse: ☐ WNL ☐ Abnormal: ____

☐ Petechiae
(Locations: ☐ Conjunctivae ☐ Face ☐ Ears ☐ Neck ☐ Chest)

☐ Tongue or oral cavity injury — Describe: ____
☐ Neurological findings
☐ Ptosis ☐ Facial droop ☐ Paralysis ☐ Unilateral weakness ☐ Loss of sensation
☐ Other: ____
☐ Absence of normal crepitus when manipulating cricoid cartilage
☐ Visible injury (describe on body maps below)
☐ Digital photography complete

Glasgow Coma Scale

Best eye response (E)	Spontaneous--open with blinking at baseline	4
	Opens to verbal command, speech, or shout	3
	Opens to pain, not applied to face	2
	None	1
Best verbal response (V)	Oriented	5
	Confused conversation, but able to answer questions	4
	Inappropriate responses, words discernible	3
	Incomprehensible speech	2
	None	1
Best motor response (M)	Obeys commands for movement	6
	Purposeful movement to painful stimulus	5
	Withdraws from pain	4
	Abnormal (spastic) flexion, decorticate posture	3
	Extensor (rigid) response, decerebrate posture	2
	None	1

Patient Label

Cranial Nerve Assessment

Nerve	Assessment	Notes
CN I Olfactory	Identifies a familiar scent with eyes closed (coffee)	☐ WNL ☐ Unable to assess
CN II Optic	Read one eye at a time, visual fields tested by having patient cover one eye and identifying number of fingers in each visual field	☐ WNL ☐ Unable to assess
CN III Oculomotor	Check pupillary response with light, check accommodation by moving your finger towards the patient's nose, check for EOMs	☐ WNL ☐ Unable to assess
CN IV Trochlear	Have patient look down and in	☐ WNL ☐ WNL ☐ Unable to assess
CN V Trigeminal	Ask patient to open mouth while you attempt to close it, have them attempt to move jaw laterally. Have patient close their eyes, touch their face with cotton and have patient identify where they were touched.	☐ WNL ☐ Unable to assess
CN VI Abducens	Have patient move their eyes from side to side	☐ WNL ☐ Unable to assess
CN VII Facial	Ask patient to smile and raise eyebrows, ask them to keep eyes and lips closed while you try to open them	☐ WNL ☐ Unable to assess
CN VIII Acoustic/Vestibular	Test hearing with rubbing fingers or whispering	☐ WNL ☐ Unable to assess
CN IX Glossopharyngeal	Observe patient swallow and check gag reflex	☐ WNL ☐ Unable to assess
CN X Vagus	Assess gag and swallowing with IX, assess patient's voice characteristics	☐ WNL ☐ Unable to assess
CN XI Spinal Accessory	Have patient shrug shoulders with resistance, have patient move head from side to side.	☐ WNL ☐ Unable to assess
CN XII Hypoglossal	Have patient stick out toungue and move it internally from right to left, assess articulation.	☐ WNL ☐ Unable to assess

Describe abnormalities here: _____

☐ Cranial nerve assessment normal

Patient Label

TRACK YOUR CASES

- We need more data
- Track:
  - De-identified demographics
  - Symptoms
  - Exam findings
  - Imaging results
  - Outcomes
- Share your knowledge

Photo-documentation

- https://www.familyjusticecenter.org/resources/pediatric-non-fatal-strangulation-photodocumentation-protocol/

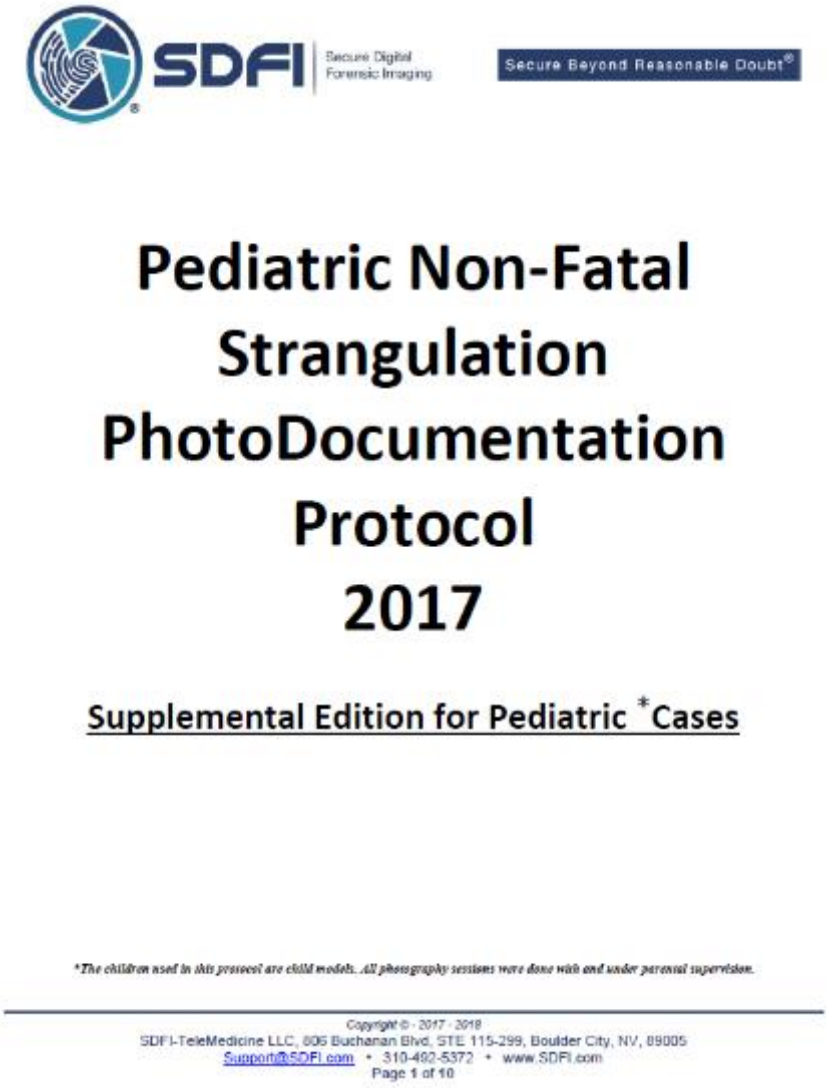


Photo-documentation considerations

- If any localized pain or tenderness, photograph, consider ALS, do follow up
- Photograph at 90 degree angle to reduce distortion
- Follow “Rule of 3’s”
- 360 degree photos of neck
- All eye fields
- Follow up exams for positive findings

What about ALS?

- May enhance ability to document injuries you can see (or have already seen)
- May be helpful in follow up, demonstrating patterns
- False positives can occur
- Current science still does not support diagnosing injury in absence of ability to see without ALS (despite several studies)

Last recommendations

- Routinely ask possible child abuse victims about strangulation
- Keep child abuse strangulation in your differential for “spontaneous” cervical artery dissection in otherwise healthy children
- **Start tracking your pediatric cases and share your findings**

Summary:

- Strangulation creates risk of death
- Strangulation creates risk of brain injury
- Strangulation is often just one tool in the family violence toolbox
- Children do get strangled
  - We don’t know as much about it
  - But it is still clearly dangerous
  - They need to be medically evaluated
  - And we need to be sharing information about our cases & outcomes

Thank you!

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