



Natural Causes of Death



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Definitions



What do we mean by
natural death?

Introduction

Sudden Death (SD) is defined as 'natural', apparently healthy unexpected fatal event in a subject or one whose disease was not so severe enough as to predict such an abrupt outcome.

WHO definition: death occur within 24 hrs of the onset of symptoms

Forensic science view:

- most of these deaths die in **minutes or even seconds of the onset of symptoms.**
(Rapid!)
- Natural: primarily attributed to natural agents, usually an illness or an internal malfunction of the body [NOT suicide, external accident, homicide...etc]

Sudden VS Expected death

It is crucial to remember that a sudden death is not necessarily unexpected, and an unexpected death is not necessarily sudden, but these are often combined. (example cancer patients)

The description 'sudden' or 'unexpected' means that the clinician was unable to offer a cause for the death. When the physician can't certify that the death was caused by the disease, then medicolegal investigations must be done. Sometimes even after autopsy, the cause of death may still be unknown.

-There is a small % of cases that could be due to unnatural factors. It is to identify & exclude these unnatural causes, that a medicolegal investigation (not autopsy) is MANDATORY in all cases of sudden deaths.

سبحان من قهر عباده بالموت

Medicolegal Importance



1. To know the cause of death
 2. To exclude violence or traumatic deaths (unnatural)
 3. Profound effects on the health & welfare of the family of the decease
 4. Screening certain people for certain illnesses (for society screening athletes /pilots)
 5. Reconstructing the event of death when a proper eyewitness account or a history is not available
 6. For benefits of hospital authorities (malpractice /suspecting certain illnesses)
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Causes of SND

Heart and vessels



Central Nervous System



02

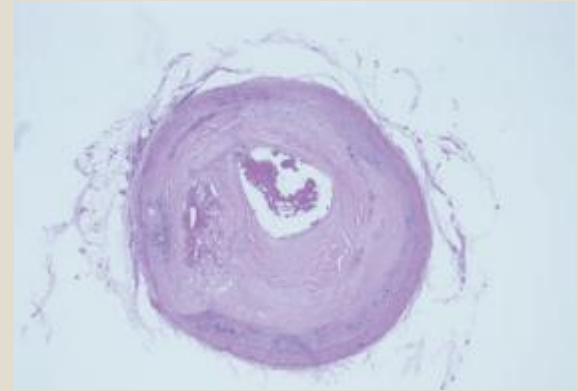


CVS



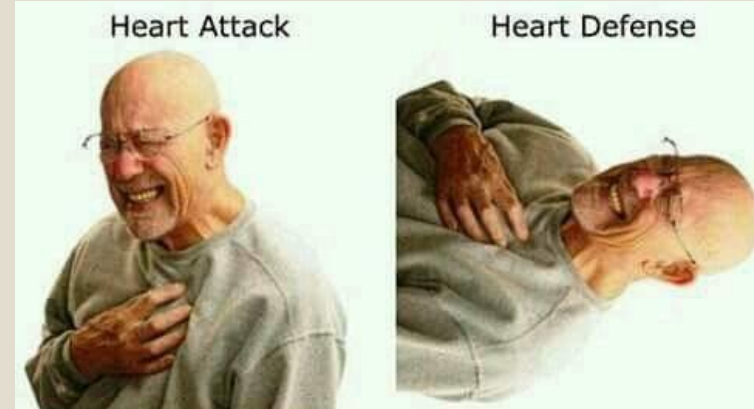
Cardiovascular System causes

- It is the Most common cause of sudden unexpected deaths in adults
- Most of CV diseases related deaths are mainly due to coronary atherosclerosis.



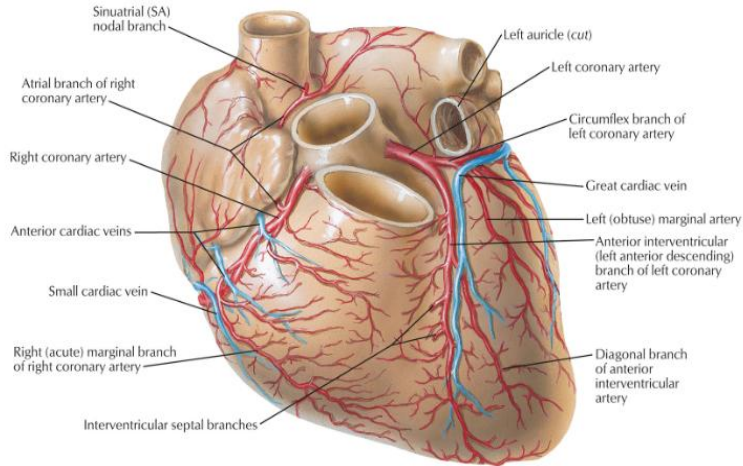
a. Heart diseases

- Coronary artery disease
- Hypertensive heart disease
- Cardiomyopathies
- Valvular heart disease
- Myocarditis
- Infective endocarditis

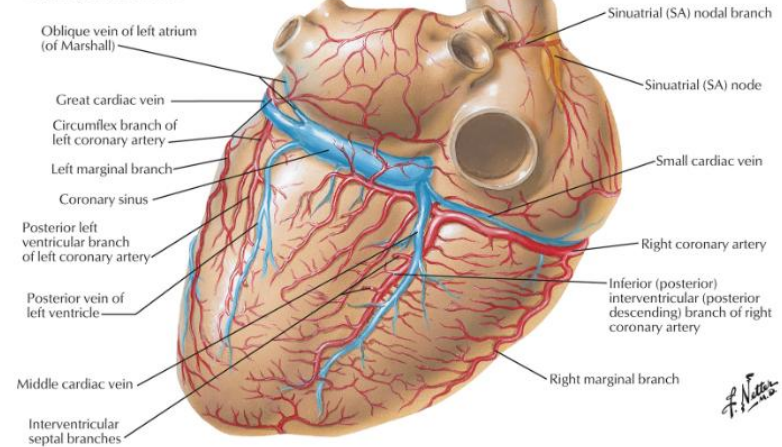


Anatomy Quick Revision

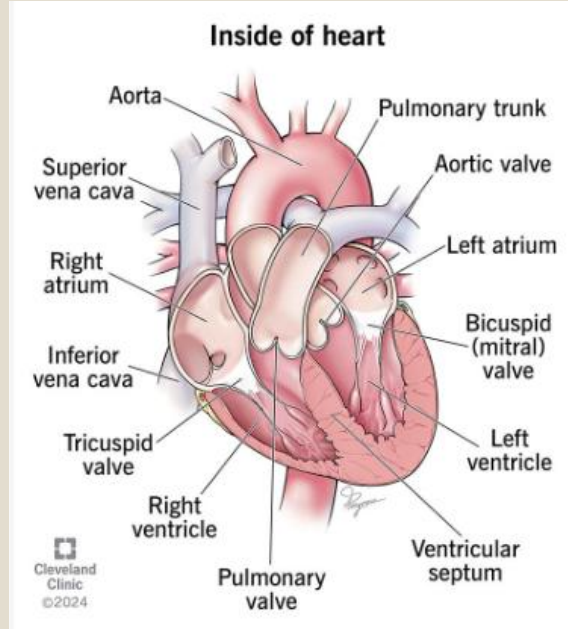
Sternocostal surface



Diaphragmatic surface



Anatomy Quick Revision

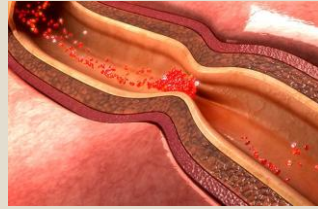


Causes of Coronary Artery diseases

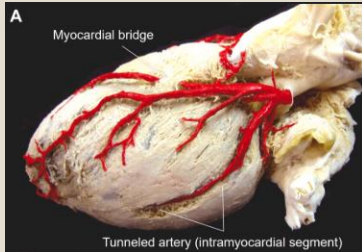


Atheroma

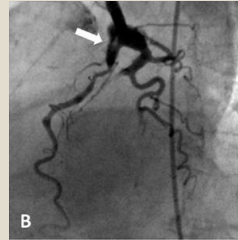
Causing Coronary stenosis or complete occlusion



Coronary artery spasm



Myocardial bridging



Dissecting coronary aneurysm

Atheroma

A fatty deposit in the **intima** (inner lining) of an artery resulting in atherosclerosis.

The most common cause of death from cardiovascular diseases coronary atherosclerosis
~Approximately 1/2 of individuals with coronary artery disease die suddenly.

Atheroma causes stenosis or occlusion to one or more of the major branches of the coronary arteries. It may be focal or diffuse. Resulting in reduced blood flow, either by atheromatous lesion itself or by its complications [ulceration, rupture, hemorrhage or thrombosis]



Sites of coronary artery occlusion

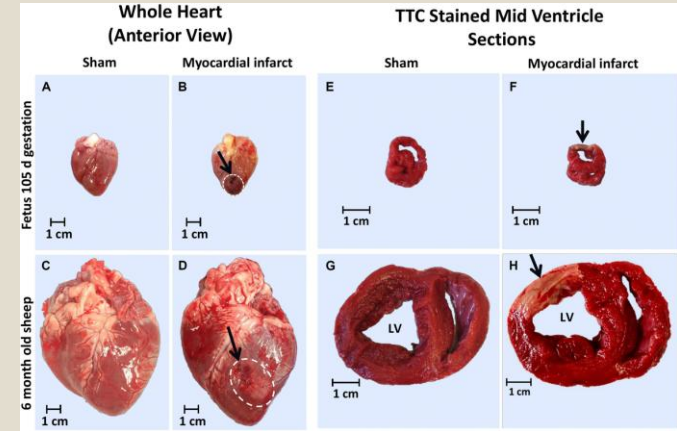
1. First 2 cm of left anterior descending
2. Right coronary artery
3. Circumflex coronary artery

Effects of coronary artery disease

1. Fatal cardiac arrhythmia
2. Myocardial infarction
3. Myocardial fibrosis

Postmortem findings

Coronary atheroma, areas of myocardial fibrosis, areas of recent infarct (rare)

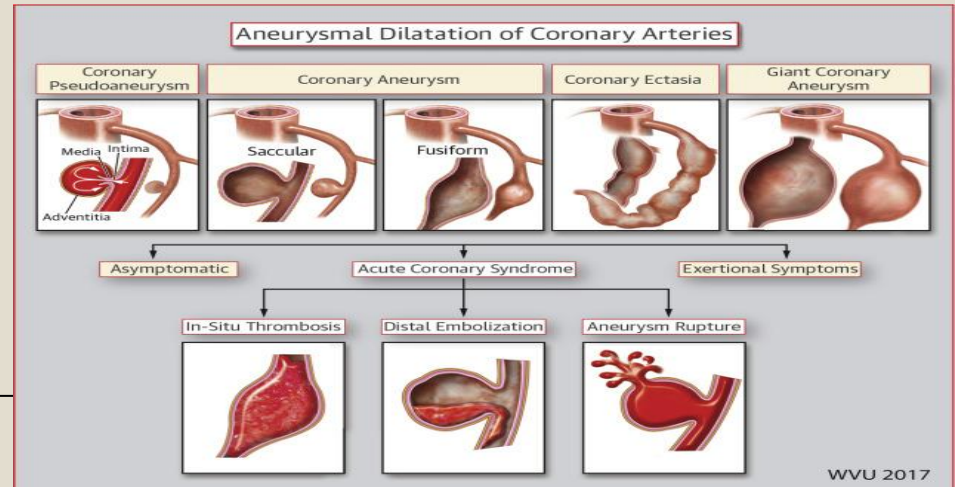


Coronary Artery Spasm

- At autopsy-> **no infarct** and coronary arteries are found to be patent, without significant atherosclerosis or congenital anomalies .
 - Death is believed to be due to transitory coronary spasm.
 - Coronary arteries spasm without anatomical narrowing, in association with angina.
-

Coronary Artery Aneurysm

- An intramural hematoma of the media of blood vessel wall, which flattens & occludes the lumen, **reducing** the blood flow.
- A **dissecting** aneurysm of coronary artery may be, either secondary to extension of an aortic root dissection, or primary and limited to coronary artery



Primary Dissecting Aneurysms

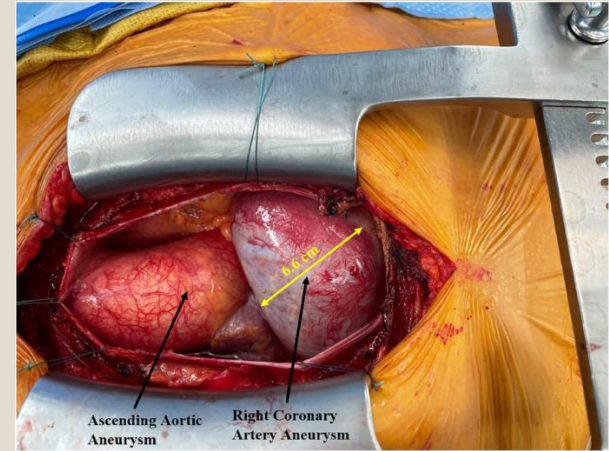
casues

Trauma

{e.g. chest trauma,
coronary
angiography}.

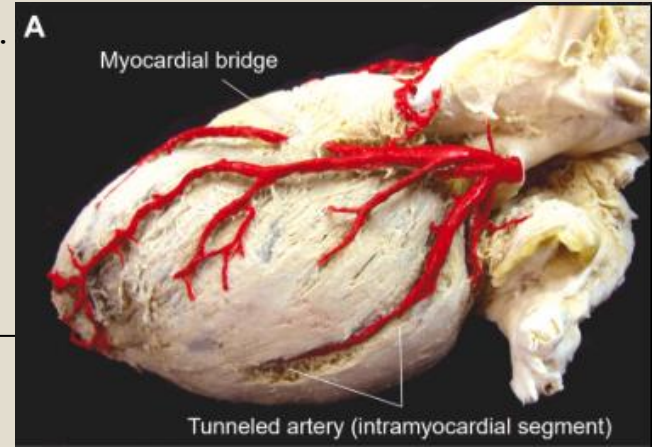
Spontaneous

are a rare condition, mostly in
females, particularly in
peripartum(the time immediately
surrounding childbirth) period.
Usually presenting as sudden
death.



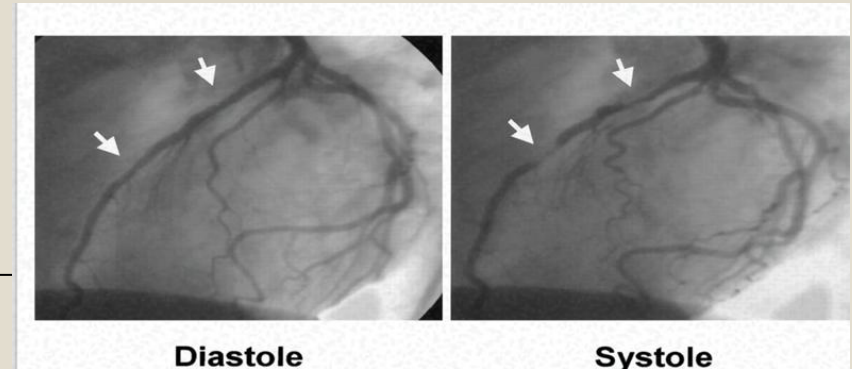
Myocardial Bridging

- Occurs when one of the coronary arteries (LAD coronary artery, rarely the right) **tunnels through the myocardium** rather than resting on top of it .
- Typically, the arteries rest on top of the heart muscle & feed blood down into smaller vessels that populate throughout the myocardium. But if the muscle grows around one of the larger arteries, then a myocardial bridge is formed.



Myocardial Bridging

- As the heart squeezes to pump blood, the muscle exerts pressure across the bridge and constricts the artery.
- This defect is present from **birth**.
- This condition can cause complications such as : **Vasospasm, Arrhythmia, or Angina pectoris which results in sudden death**



Hypertensive Heart Disease

- Sudden death in individuals with hypertension is usually associated with and in most instances due to, accompanying atherosclerosis
 - Hypertension may kill in several ways, such as renal failure, ruptured aneurysm, or cerebral hemorrhage, but here we are concerned with **primary heart failure**, a quite common cause of death.
-

Cardiomyopathy

The hallmark here is myocardial dysfunction. These diseases are **not** the result of arteriosclerotic, hypertensive, congenital, or valvular disease. Cardiomyopathy result in sudden death (during exercise) due to arrhythmia.

catagories

Dilated

combination

Hypertrophic

associated with
HFrEF >> low
EF, high vent.
compliance

combination of the 2.
due to low EF & low
vent. Compliance
restrictions on
myocardium

associated with
HFpEF >> normal
EF, low compliance

Types of heart failure

Right-sided heart failure

Failure to pump blood properly causing blood to back up in the body's veins

Congestive heart failure

Fluid builds up around the heart causing it to pump inefficiently



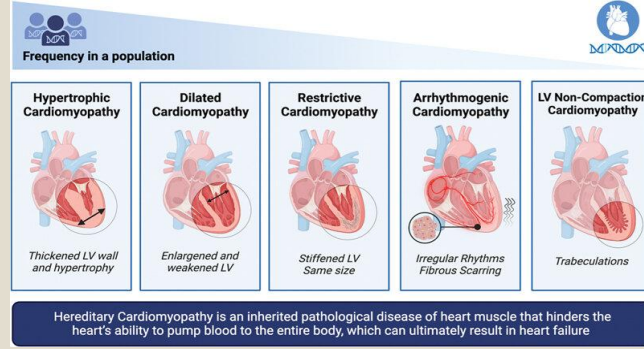
Left-Sided Heart Failure

Reduced ejection fraction (HFrEF)
- Heart muscle cannot pump with sufficient force to push enough blood into circulation

Preserved ejection fraction (HFpEF)
- Heart muscle stiffens so the heart cannot fill with enough blood between beats

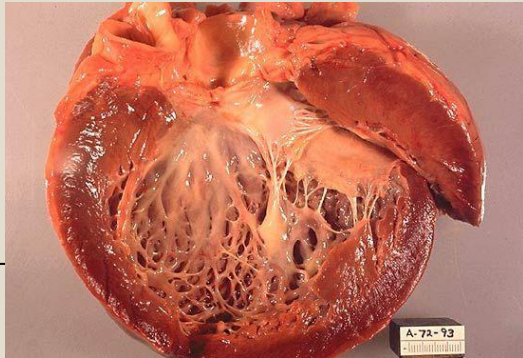


Source: AHA



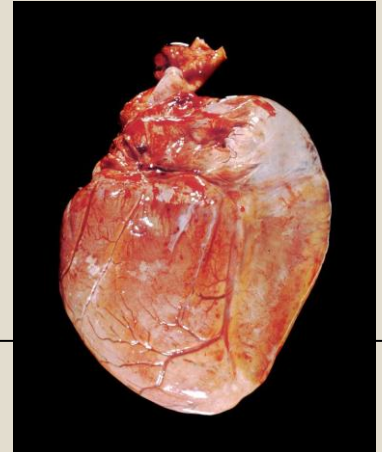
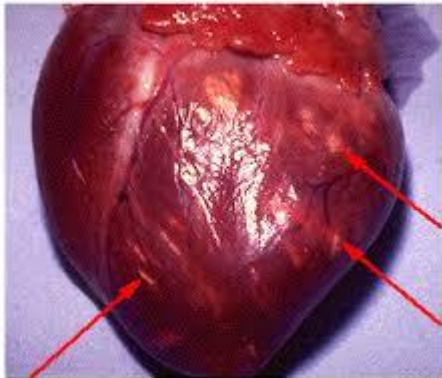
Valvular Heart Disease

- SD associated with valvular disease usually involves a floppy mitral valve or aortic stenosis. Rarely, sudden death will be due to acute bacterial valvulitis.
- Postmortem findings: 1) the valve is thickened & rigid, with fusion of commissures in most cases. 2) The whole valve may be unrecognizable, chalky mass, with a stenosed lumen. 3) Left ventricular hypertrophy & Increase heart weight, up to [800-1000gms]



Myocarditis

- Many infectious diseases produce an acute **myocarditis** (muscles inflammation) which may be an acute cause of death.
- The criteria for diagnosis: to find **inflammatory & infiltrative degenerative or necrotic myocytes**.
- Viruses (e.g. Influenza) infections are the most common cause of myocarditis.



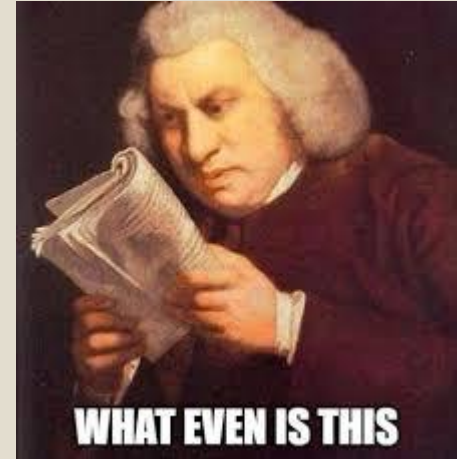
Infective Endocarditis

- The commonest cause are various types of bacteria, though viruses & other microorganism may also be responsible.
- The symptoms are often vague, so the condition may not be diagnosed during life.



b. Vascular diseases

- Dissecting aortic aneurysm
- Ruptured atheromatous aortic aneurysm
- Cerebrovascular disease



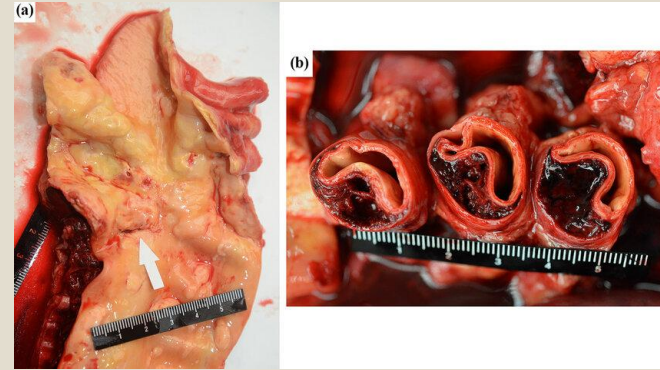
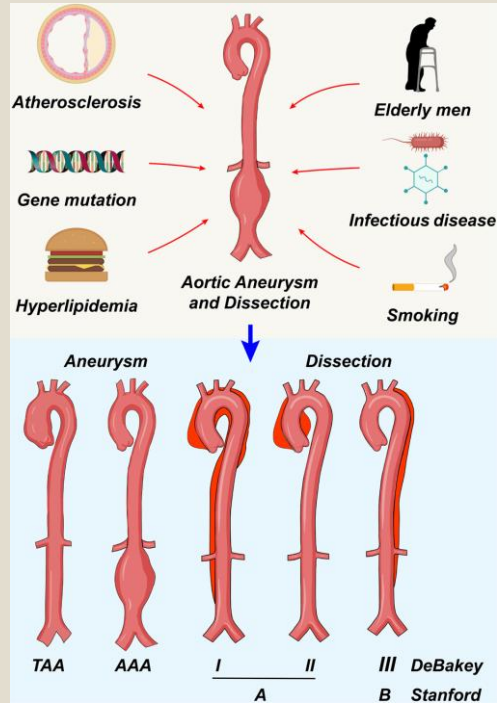
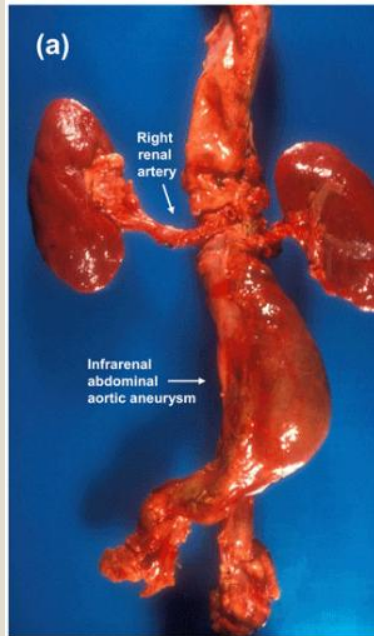
Dissecting Aortic Aneurysm

A tear in tunica intima results in blood splitting the tunica media. This produces a false lumen that can progress in an anterograde or retrograde direction.

Rupture may occur back into the lumen or externally. The result of an intimal tear is the formation of a false lumen.

Over 90% occur in ascending aorta either just distal to the aortic valve or the left subclavian artery.

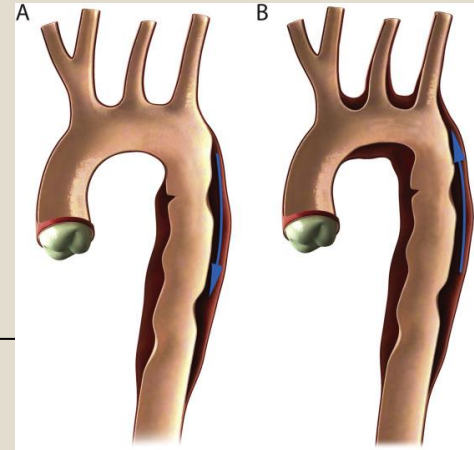
Dissecting Aortic Aneurysm



Dissecting Aortic Aneurysm

It can rupture but more commonly dissection propagates distally, involving vessels branching off the aorta producing ischemia in the kidneys, lower extremities, viscera, or spinal cord [in descending order].

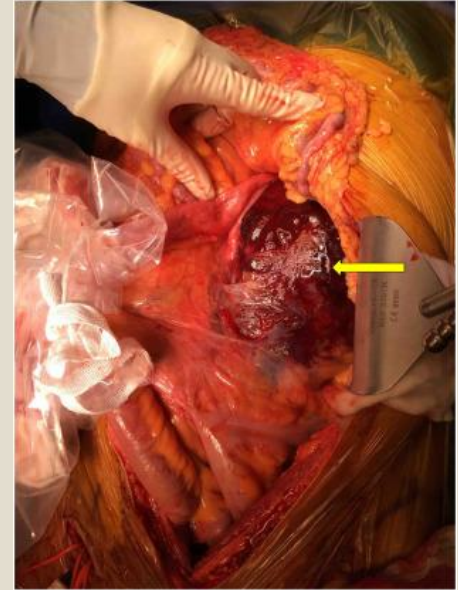
Can also undergo retrograde extension to produce acute aortic regurgitation, MI, & cardiac tampon



Ruptured Atheromatous Aortic Aneurysm

The aorta is such a large blood vessel that, if it ruptures, death is very rapid although the process might be slow enough to permit emergency surgery.

First signs may be rupture, rapid exsanguination, & death.



03



CNS



Dissecting Aortic Aneurysm

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Rupture may occur back into the lumen or externally. The result of an intimal tear is the formation of a false lumen.

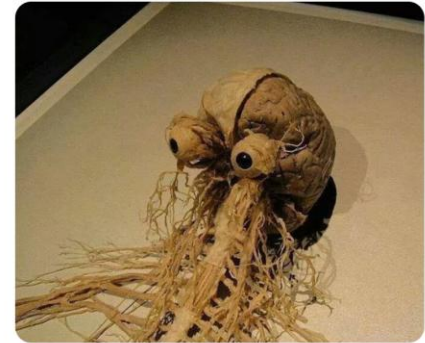
Over 90% occur in ascending aorta either just distal to the aortic valve or the left subclavian artery.

Central nervous system causes of death

- Epilepsy
- Subarachnoid hemorrhage
- Intracerebral hemorrhage
- Valvular heart disease
- Meningitis
- Tumors

Friend: "Just go talk to her.
Dont be nervous"

Me while talking to her:



Epilepsy

Sudden unexpected death in epilepsy is when a person with epilepsy dies suddenly, in whom a postmortem examination **fails to uncover gross anatomical, toxicological, or environmental causes of death.**

Death in epilepsy could be by asphyxia - suffocation - during a fit in bed when the face is pressed into pillow OR due to traumatic deaths because of fits occurring when a patient is in some vulnerable position OR antiepileptic drug overdose

Epilepsy

In Autopsy:

- Should always include a search for **bites** on the tip & distal tongue which suggest fit.
- Examination of the brain is essential: to search for any cause of **post-traumatic epilepsy**.
- On heart examination: **patchy myocardial fibrosis** caused by episodic hypoxia from apnea from fits

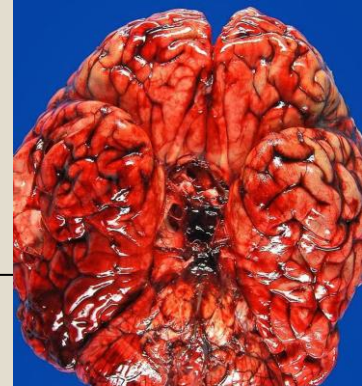


Subarachnoid Hemorrhage

SAH is a very serious neurological emergency, and it is the 4th most common intracranial cause of death. This may occur spontaneously or may result from head injury.

85% of spontaneous SAH is caused by rupture of saccular berry aneurysms.

Aneurysms are usually found at the bifurcation of the cerebral arteries, particularly in the region of circle of Willis.



Subarachnoid Hemorrhage

SAH typically presents with:

- 1) With sudden severe headache (often occipital) that lasts for hours or even days, sometimes accompanied by vomiting.
 - 2) There may be loss of consciousness at onset.
 - 3) Any rise in blood pressure will cause rupture of the apex of aneurysm. Also occurs after emotions, exercise, alcohol, sexual intercourse, & direct trauma to the neck
 - 4) Most cases of death are due to vasospasm following the rupture.
-

Subarachnoid Hemorrhage

In Autopsy:

- Point of bleeding in the circle of Willis is denser at the base of brain, especially basal cisterns.
- Bright red in fresh blood, brown in older bleeding.



Figure 6.6 Berry aneurysm of the proximal middle cerebral artery and associated subarachnoid haemorrhage.



Intracerebral Hemorrhage

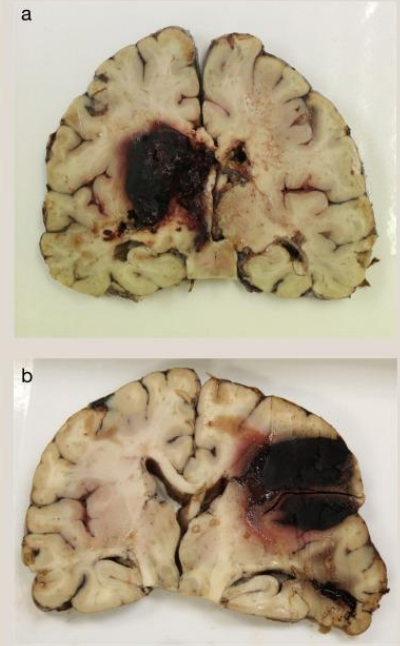
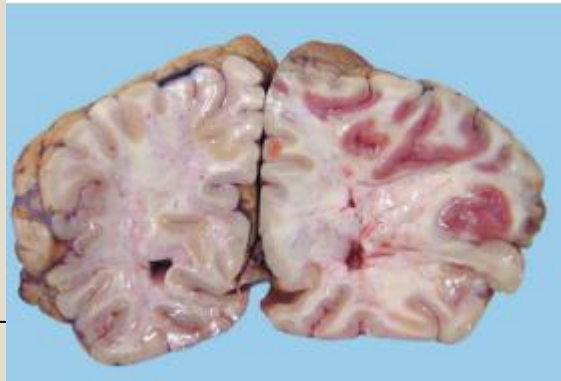
ICH is bleeding directly into the brain parenchyma. The most common cause is hypertension by damaging the small intracerebral arterioles, or acute rise in BP which causes rupture of penetrating arteries.

Other causes: 1) Trauma 2) Drugs related {anticoagulants, cocaine or amphetamines}
3) Vascular malformation 4) Bleeding in an underlying brain tumor.

Intracerebral Hemorrhage

In Autopsy:

- Deep hemorrhage anywhere within the hemisphere.
- Rupture inside the ventricular system.
- Severe contrecoup lesion: large hematoma



Meningitis

Mortality rate: 5% in children, 25% in neonates. The severity depends on the causative organism. E.g. untreated TB meningitis is fatal **in few weeks**. The patient may have chills, high fever, dizziness, N/V, headache, or weakness. Petechiae appear on body in 75%.

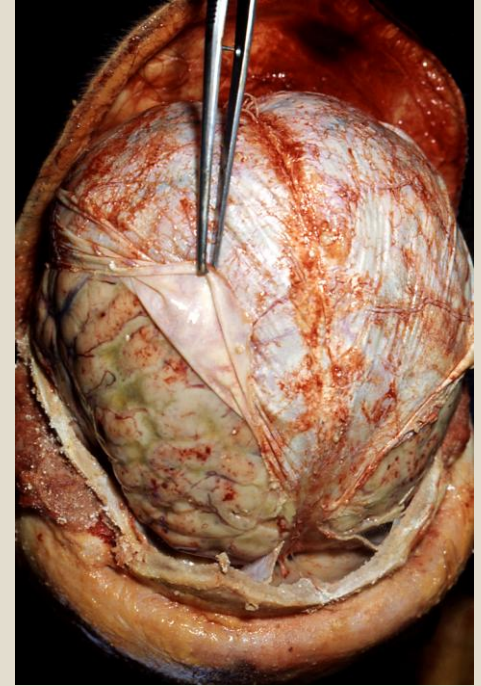
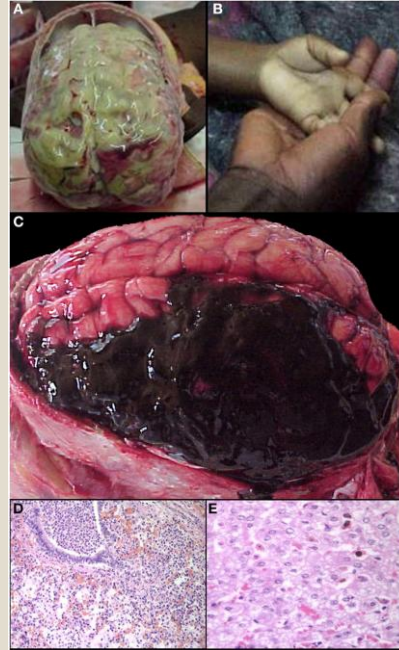
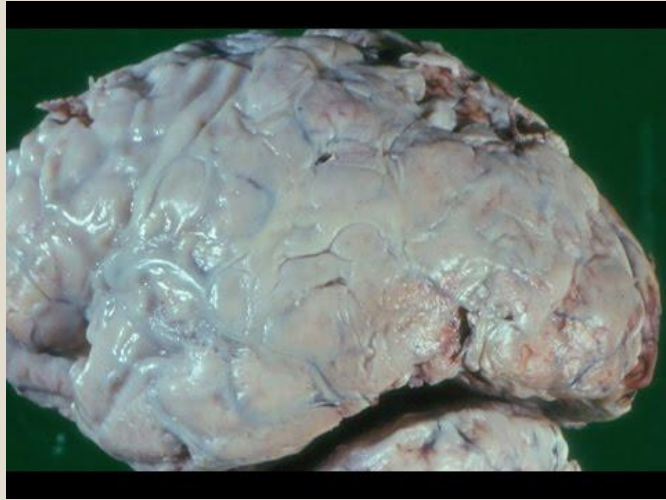
In 10% of cases>> rapidly progressive with toxemia, shock, & collapse. The individual may die in **less than 10 hours from onset of symptoms**. Sometimes, a person who is walking around will collapse and die.

Meningitis

In Autopsy:

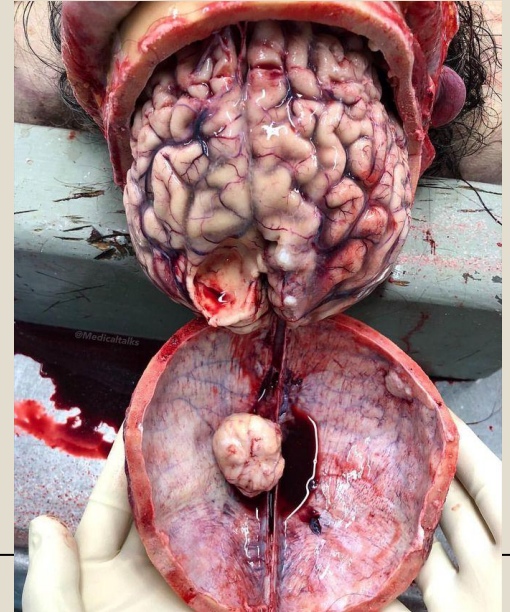
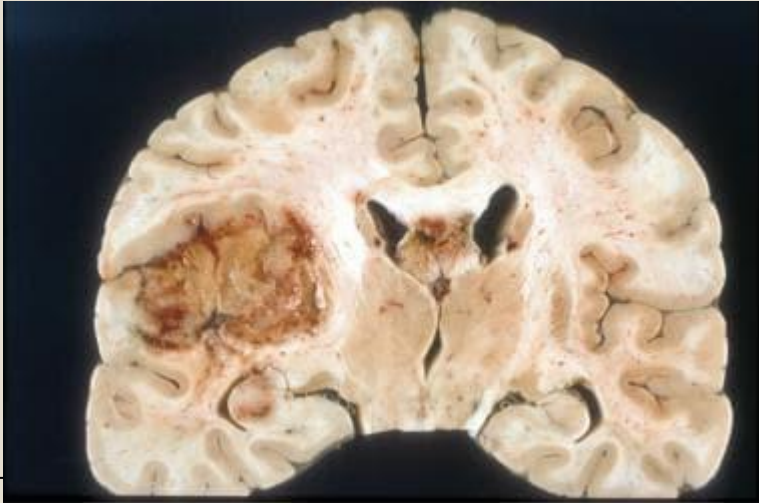
- Diffuse inflammation of the pia-arachnoid area.
 - Neutrophils, leucocytes tend to migrate to CSF & base of the brain
 - Also cranial nerves & spinal cord may be surrounded with pus as may the meningeal vessels.
 - There may be cyanosis, petechiae, purpura of the skin, acute bilateral hemorrhagic adrenal necrosis. [Meningococemia]
-

Meningitis



Tumors

High mortality rate associated with grade 4 glioma (glioblastoma multiforme). 20% of glioma cases survive **for 1 year**.



04



Respiratory



3-Respiratory system

sudden death due to diseases of RS compromise only a **small proportion** of all sudden death.

Common causes of sudden death:

- Pulmonary thromboembolism
- Asthma
- Pneumonia
- Hemoptysis

1. Pulmonary thromboembolism

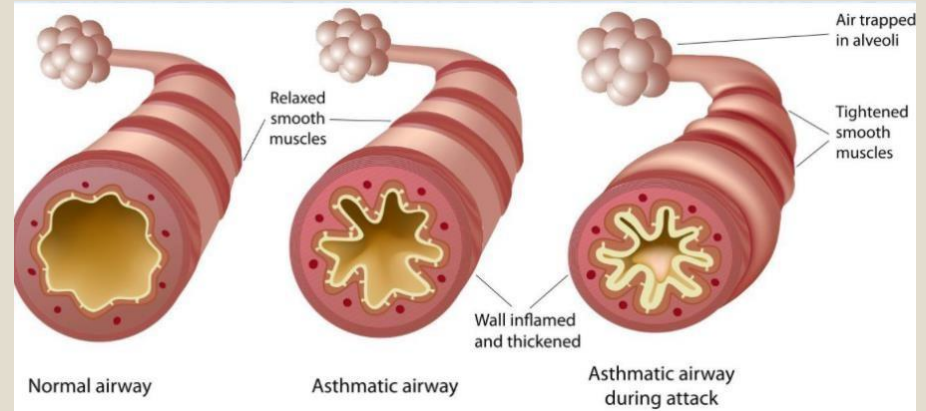
A major cause of sudden death in RS. It is a common cause of death in patients with **cancer** & **stroke**, and remains the most **common cause of death in pregnancy**. 75% of PE arises from the propagation of lower limb DVT. Predisposing factors {immobility, pregnancy, trauma, surgery..}

Small emboli break off and impact in the **peripheral** branches of pulmonary arteries → pulmonary infarction. **Massive** emboli occlude **major** pulmonary vessels.



2.Asthma

- Death occurs suddenly, with no findings at autopsy except in a chronic asthma state.
- Some cases are apparent due to **status asthmaticus**, others due to **drug overdose**.



3. Hemoptysis

-The bleeding causes death by sudden filling of the larynx with blood, causing asphyxia.

1. Pulmonary TB

2. Bronchial tumors >>rarely cause a fatal hemoptysis, unless a major vessel is eroded.



05



GI



4-Gastrointestinal System

Sudden death usually occurs due to lack of medical attention Fatal abdominal problems:

1. **Mesenteric thrombosis** , infarction & embolism
2. **Strangulated intestine** which may lead to gangrene formation
3. **Fulminating peritonitis** , chemical peritonitis, perforation of colon through a diverticulum
4. **Bleeding** from gastric & duodenal ulcers

Two most common modes of SD involving GIS are massive hemorrhage & peritonitis.

1. Massive Bleeding

Less with the resuscitatory methods

1. **Esophageal varices** (most common)

*They collapse after death, so they're difficult to 3.

identify Gastric & duodenal **ulcers** eroding a large vessel

3. **Gastric tumor** perforating large vessel

4. **Colonic lesion** {carcinoma, UC}

5. Hemorrhage from small intestine {Crohn's}

6. Bleeding from surgical operations (Rare)

2.Peritonitis

- Undiagnosed or **untreated acute appendicitis** & appendix abscess (rare)
- Perforated **colon** through the diverticulum
- Perforation by **carcinoma**
- Perforated **PU**

Autopsy: turbid fluid found in peritoneal cavity, Early inflammatory changes



06



Gynecological system



5-Gynecological system

Ruptured tubal ectopic pregnancy

Ruptured uterus

Air embolism

Amniotic fluid embolism

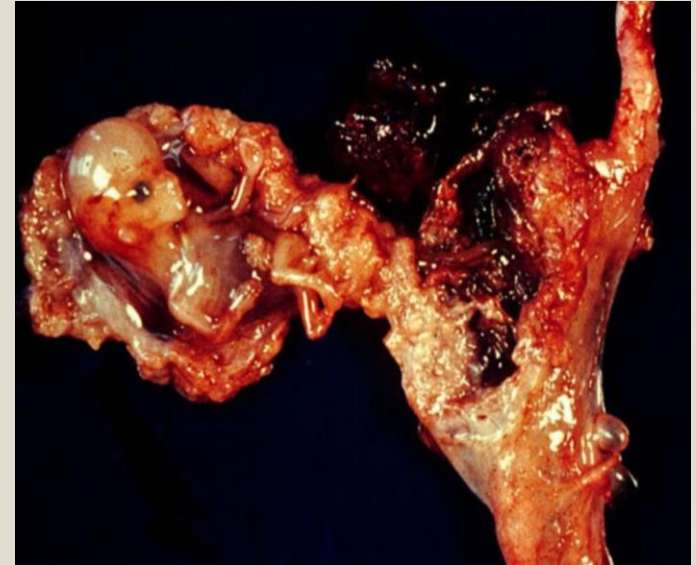
1. Ruptured tubal ectopic pregnancy

Abnormal pregnancy that occurs outside the uterus, within one of the tubes-more than 90% occur in fallopian tube

Symptoms: Abnormal vaginal bleeding/Amenorrhea/Breast tenderness/Lower abdominal pain.

***The most common complication is rupture with internal bleeding that leads to shock**

Death from rupture is rare.



2.Ruptured uterus

- Catastrophic event where **full thickness tear** develops,
- **opening the uterus directly into the abdominal cavity.**
- ***Bradycardia** seen on fetal heart rate monitoring is the most common & often the only manifestations of uterine rupture.
- ***Sudden gross hematuria**
- ***Increasing pain & bleeding/ signs of hypovolemic shock and hemoperitoneum.**

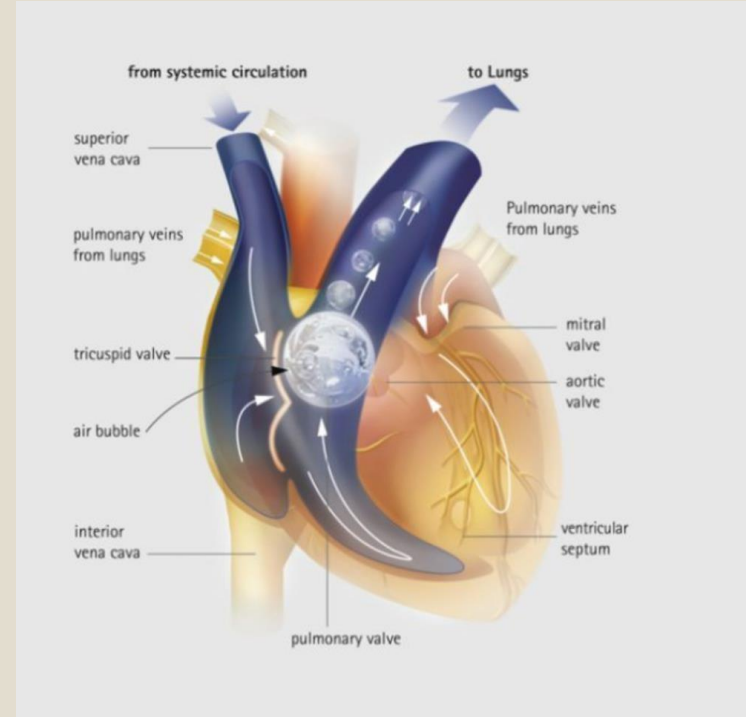
3. Air embolism

Air embolism can occur whenever a **blood vessel is open**, and a **pressure gradient exists** favoring entry of gas. An air embolus does not always happen when a blood vessel is injured, because the pressure in most arteries & veins is greater than atmospheric pressure. In the veins above the heart, such as in head & neck, the pressure is less.

Most common **criminal abortion** by insufflation of uterus by is syringe a Interruption of circulation by bubble of air that gain access, usually through the venous side.

Mechanism>>by muscular rebound of the uterus sucking air into the cervix

**veins→Rt heart→
failure of
contraction to
move the bolus→
Pulmonary air
embolism→death**



07

Special
cases



Autopsy-negative causes of death (hx dependent?)

- **Endocrinopathies:** DM (diabetic ketoacidosis, hypoglycemia), Thyroid storm & thyrotoxicosis, Adrenocortical insufficiency and hyperaldosteronism
 - **Electrolyte abnormalities:** Dehydration, diarrhea, vomiting, uremia, water intoxication, hypokalemia, endocrine dysfunction[Addison disease, Schmidt syndrome]
 - **Cardiac dysrhythmia:** channelopathies, drug induced, electrolyte imbalance
 - **Other:** Seizure disorder (e.g. Epilepsy), Anaphylaxis, Neuroleptic malignant syndrome, Serotonin syndrome
-

Sudden Infant Death Syndrome (SIDS)

Crib death, syndrome in which healthy infants die from unknown causes (usually during sleep). Most deaths due to SIDS occur between **2 and 4 months of age**, and incidence increases during cold weather. (hypothermia?)

More boys than girls fall victim to SIDS.



Sudden Infant Death Syndrome (SIDS)

Risk factors

Prenatal

- Smoking, drinking, or drug use during pregnancy
- Poor prenatal care
- Poor prenatal nutrition
- mothers <20 years old

Natal & Postnatal

- prematurity or low birth weight
- no breastfeeding
- Smoke exposure following birth
- overheating from excessive sleepwear & bedding
- stomach sleeping

Sudden Infant Death Syndrome (SIDS)

Possible hx scenarios:

- History of respiratory tract infections or GI upset
- Story records that the infant was put to sleep in the evening, and was found dead in the morning
- Most infants are found dead in the first half of the day

The scene of death and findings:

- Few infants have edema fluid exuding from the mouth, and may become blood tinged
 - The hands are often found to be grasping fibers from the bedclothes
 - The face may be pale or slightly cyanosed or congested
-

Sudden Infant Death Syndrome (SIDS)



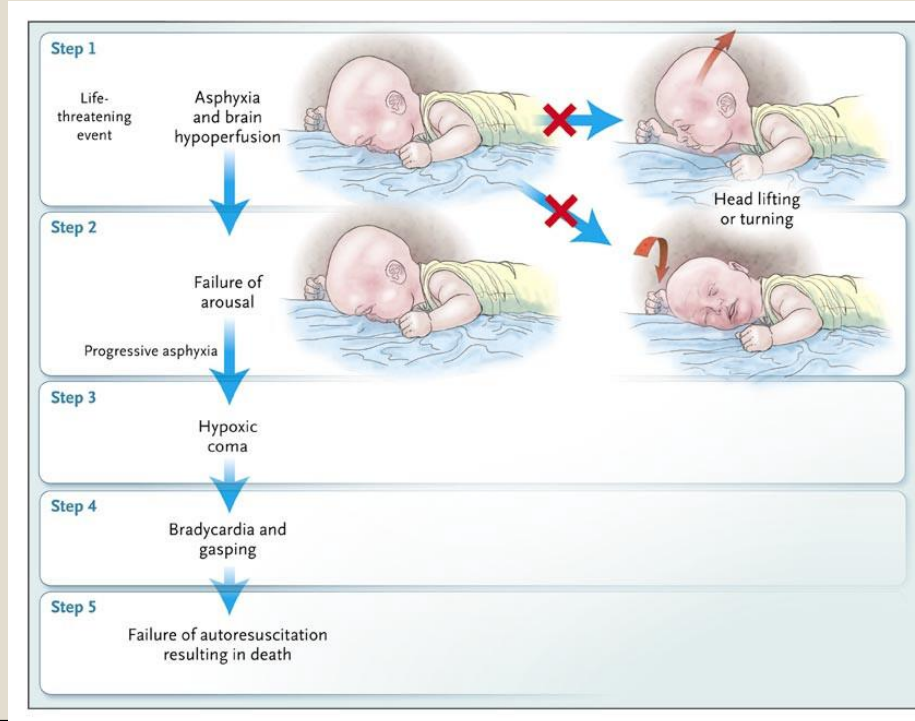
Figure 36.2 Infant found prone in a crib. Facial lividity with sparing of right cheek.

Baby died, bleeding nostrils
(Asphyxia)



Fig. 1. Gross external examination. Location of the postmortem hypostasis on the dependent front surfaces of the cadaver

Sudden Infant Death Syndrome (SIDS)



Differentiating SIDS from external suffocation

The signs of an infant suffocating or with SIDS are usually nil. So, in a completely negative autopsy, you can never know if the cause of death was suffocation or SIDS.

Petechiae in the thymic cortex may be helpful, they are usually absent in known suffocation, yet 70% of SIDS have serosal petechiae.

> Arch Pathol Lab Med. 1984 Jan;108(1):77-9.

The microscopic distribution of intrathoracic petechiae in sudden infant death syndrome

H F Krous

PMID: 6546345

Abstract

The microscopic distribution of thoracic visceral petechiae in 100 consecutive victims of sudden infant death syndrome (SIDS) was retrospectively analyzed. Thymic and cardiac petechiae were more numerous near their surfaces than in the central parenchyma, suggesting that abnormal intrathoracic pressure changes were important in their pathogenesis. Low intrathoracic pressures may have preferentially distended, to the point of rupture, the outer rather than central microvasculature of these two organs. The distribution of pulmonary petechiae in association with lung congestion and edema indicated left ventricular failure. Low intrathoracic pressures generated by breathing against an occluded airway could have caused heart failure by increasing the afterload and decreasing the compliance of the left ventricle. These petechiae occur in more than 80% of SIDS cases, suggesting that abnormal intrathoracic pressure, perhaps caused by breathing against an obstructed airway, is a common terminal event.

PubMed Disclaimer

Special problems

Special problems arise in certain cases and situations, because require more investigation they than usual, and because they have the most potential for serious error:

- No Identification
 - No cause of death
 - Environmental exposure
 - Decomposed body & Skeletal remains
 - Deaths in police custody & police Shootings
 - Mass disaster
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Investigations



Preliminary steps in the investigation

Clinical and investigation information:

- Death can be certified by an attending physician who has seen the patient recently and is convinced that the death was caused by a lethal disease that he knew the patient was suffering from.
 - When the physician **can't certify** that the death was caused by the disease, then medicolegal investigations must be done.
 - Sometimes **even after autopsy**, the cause of death may still be unknown.
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The Medicolegal Investigation

Scene Investigation

Examination at the scene of the death may present potential solutions to the problems of the death's classification.

- Any suggestion for "foul play" (crime or violence)
- Eliminate suggestions of electrocution.
- Evidence of planning for death(ex. suicide notes)
- Evidence of medication containers.

Special Procedures

- Photographs.
- Radiographs.
- Collection and preservation of evidence and/or specimen.
- Toxicological examinations.

Postmortem Examination (External and Internal)

There should be careful examination of :

External surface:

For evidence of injury and resuscitation.

Internal examination:

Will be extremely important in a death considered sudden and unexpected.



Thanks!

Do you have any questions?

Please Keep them for yourself 😊

