ED Pitfalls Series:

Cardiovascular Problems as Examples

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Preface

- The duty and specialty of emergency physicians are correct and immediate diagnosis.
- Physiological approach for non-traumatic patients and Anatomical approach for traumatic ones
- Logics: comparable with chief complaints.
- To err is human who includes the patients.

Preface: Sources of Errors

- Atypical presentations
  - Typical is sometimes minor whereas atypical is major.
- Missing the key points
  - What causes him (she) visit the ED? (What is the true chief complaint?)
- Incorrect exclusion
- Finding one abnormality is sometimes not enough. (Tip of the Iceberg)
- The first minute is not the same as the last minute.
- Consultation does not mean resolution.

Preface: Major Principles

- Revisiting means Complete Study.
- Always keep clinical suspicion.
- Keep flexible attitude.
- Always re-evaluate from the very beginning.
- Review carefully the old charts or records.
- Keep what should be maintained.
- Learn from READ triage.

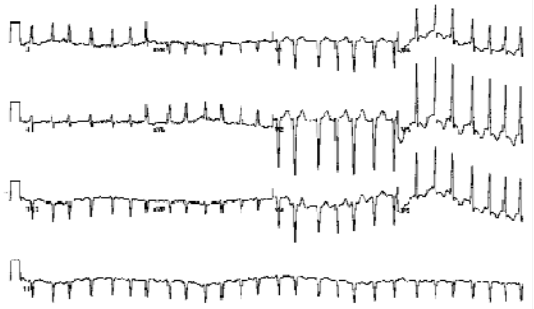
Case 1

- A 45-year-old female presented with diarrhea for several days. Vital signs were BP 142/98, PR 147 bpm, RR 20 /min, BT 38'C, SaO2 97%. Breathing sound was clear. Heart sounds revealed irregular-irregular heart beats. Your colleague told you that this is a case of infectious diarrhea.
- What do you think about her?

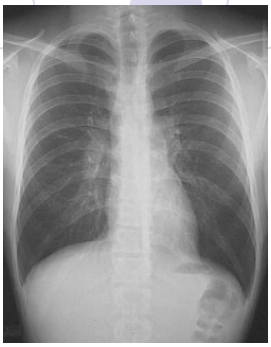
Case 1

- Irregular Rhythm (Pulse)
  - Regular-irregular
  - Irregular-irregular: TWO Big
    - Atrial fibrillation (AF) → Cardiac problem (CHF)
    - Multifocal Atrial Tachycardia (MAT) → Lung problem (COPD)

Case 1



Case 1



Case 1

- Chronic AF
  - Always cardiomegaly
- Paroxysmal AF
  - Usually small heart
  - Look for underlying causes before idiopathic AF is diagnosed.

Case 1

- Secondary AF
  - Also in those with no other risks of heart problem
  - Precipitating factors
    - Hyperthyroidism: beta blocker; anti-thyroid
    - Fever
    - Pain
    - Anxiety
    - Sympathomimetic Agents
    - Vagolytic agents

Treat underlying

Case 1

- Thyroid function revealed that increased T3 and free T4, and significantly low TSH. Hyperthyroidism was diagnosed.
- Propranolol and PTU were then prescribed.

Case 1

- Two days later, the patient felt dyspnea. Bilateral rales were noted. Chest film revealed lung edema.
- What is the treatment modality?

Case 1

- High-Output Heart Failure
  - Profound anemia
  - Thyrotoxicosis
  - Myxedema
  - Paget disease of bone
  - Albright syndrome
  - Multiple myeloma
  - Glomerulonephritis
  - Cor pulmonale
  - Polycythemia vera
  - Obesity
  - Carcinoid syndrome
  - Pregnancy
  - Nutritional deficiencies (eg, thiamine deficiency, beriberi)

Case 1

- Thyroid storm
  - Precipitating factors
    - Infection
    - Surgery
    - Trauma
    - Radioactive iodine treatment
    - Pregnancy
    - Anticholinergic and adrenergic drugs
    - TH ingestion
    - Diabetic ketoacidosis (DKA)

Case 1

- Thyroid storm
  - Treatment
    - (1) ameliorating hyperadrenergic effects of TH on peripheral tissues with use of beta-blockers (eg, propranolol, labetalol);
    - (2) decreasing production of TH with antithyroid medications (eg, propylthiouracil [PTU], methimazole), thereby blocking further synthesis of THs;
    - (3) decreasing hormonal secretion from the thyroid, using iodides; and
    - (4) preventing further TH secretion and peripheral conversion of T4 to T3, using glucocorticoids.

Case 1 (comments)

- Don't believe completely what your colleague tells you because to err is human.
- Re-evaluate every patient and integrate the clinical information again and again.

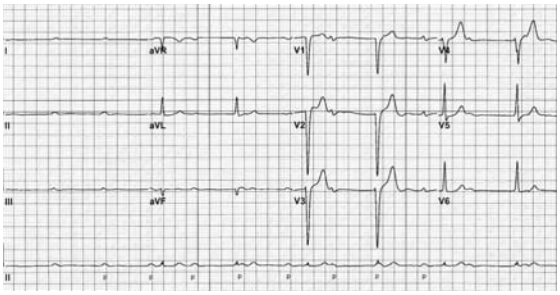
Case 2

- A 68-year-old male patient consulted our ED due to fever for 2 days. Vital signs were BP 122/64, PR 57 bpm, RR 22 /min, BT 39'C, SaO2 95%. Breathing sound was coarse with right rhonchi.
- What do you think about him?

Case 2

- Laboratory findings were leukocytosis (WBC 18,200, band 5%, seg 81%), Hb 12.3, platelet 68K. In addition, BUN 59, Cre 2.4, Na 138, K 5.8, Cl 94 and ABG revealing metabolic acidosis with partial respiratory compensation. CRP was 4.5. CXR revealed RLL pneumonia.
- What else examination should be ordered?

Case 2



Class I (立即處理)

- 意識程度下降
- 生命現象：
  - 收縮壓：≤80mmHg或≥220mmHg
  - 心跳：≥150bpm或≤50bpm
  - 呼吸：≥30rpm或≤8rpm
  - 體溫：≥41℃或≤32℃
- 內科：異物阻塞;已插氣管內管或胸管者;呼吸窘迫;發紺;心因性胸痛;正在抽搐;內出血併生命現象不穩定者
- 外科：外傷出血無法控制者;大於5cm的開放性傷口;疑呼吸道(顏面)灼傷;電灼傷;化學性灼傷;三度TBSA>10%；二度TBSA>15%；骨盆或股骨骨折;開放性骨折;疑頸椎骨折;頭部嚴重畸形;腦組織外露;內臟外露;皮下氣腫;胸腹開放性傷口;毒蛇;虎頭蜂咬傷;槍傷或穿刺傷
- 婦產科：急產;性侵害
- 精神科：攻擊性行爲

Class II (十分鐘內處理)

- 生命現象：
  - 收縮壓：180-220mmHg
  - 呼吸：20-30rpm
  - 體溫：39-41℃或32-35℃
- 內科：呼吸喘;呼吸困難;胸痛原因不明者;疼痛併嚴重症狀者(劇痛、臉色蒼白);暈眩(Vertigo);突發性神經症狀;內出血併HR>100bpm;吐血;嘔吐、腹瀉、脫水致HR>100bpm
- 外科：小於5cm的開放性傷口;疑有骨折;關節腫脹;疑頭骨骨折;其他昆蟲、動物咬傷;急性尿滯留(≥6小時)
- 精神科：自殺行爲或傾向
- 眼科：眼內異物
- 耳鼻喉科：耳鼻喉道內異物

Class III (三十分鐘內處理)

- 生命現象：
  - 體溫：38-39℃
- 內科：抽搐已停止者;疼痛但無嚴重症狀者;頭暈(dizziness);血便、黑便、咳血但生命徵象穩定者;嘔吐、腹瀉但生命徵象穩定者;疑似或輕微中風
- 外科：無傷口之軟組織傷害;動物抓傷;血尿;尿路結石;解尿困難
- 精神科：失眠

Class IV (可延後處理)

- 不符合急診以上條例，如：
  - 頭痛、喉痛、咳嗽、流鼻水等感冒症狀。
  - 中風後遺症。
  - 中風已數日，在別處已處理過，來本院等住院者。
  - 已知癌症的病患，其主訴顯然與癌症有關者，且生命徵象正常。
  - 自門診轉來做常規檢查的治療者。
  - 自門診轉來等住院者，但生命徵象正常者。
  - 主訴某種症狀已有相當時日，但生命徵象正常者。

Case 2 (comments)

- Triage should be made by integration of all available parameters instead of judgment one by one.
- In this case, relative bradycardia in consideration of the presence of fever may be the most important clue!
- Other examples: Case A-K

5-Tier READ Triage

- TTAS by Triage Nurses
  - Can modify according to clinical judgment
- Re-triage by Emergency Physicians
  - Register in HIS system
  - 1st re-triage should NOT be lower than TTAS
- Dynamic Triage: (color codes as internationally designed)
  - **Triage I: Red**
  - **Triage II: Orange**
  - **Triage III: Yellow**
  - **Triage IV: Green**
  - **Triage V: Blue**
  - Changing Triage should be treated as an Order!

TTAS檢傷可能衍生問題

- Under-Triage
  - Esp. for Those without Adequate Compensation Mechanisms
  - Difficulties between Triage I and II
- Negative Impact on Efficiency
  - D2B Time
  - Fibrinolytics for New-Onset Ischemic Stroke

Case A

- A 70 year-old male complains of general weakness for 1 day.
- Vital signs: BP 112/70 mmHg, PR 61 bpm, RR 22/min, BT 39.9ºC, SpO2 95%. GCS E4M6V5
- PMH: Hypertension with medications

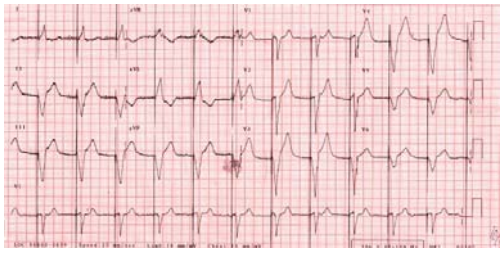
Case A

- Different vital signs should be integrated together instead of reading separately!
- Everyone's normal range may not be the individual's "normal range".
- In case 1, TTAS II → Should be modified as Triage I

Case B

- A 77 year-old female has been noted tarry stool for 1 day.
- Vital signs: BP 106/78 mmHg, PR 69 bpm, RR 24/min, BT 36.2ºC, SpO2 96%. GCS E3M6V3-4
- PMH:
  - Dementia for 5 years
  - some kind of heart problem (according to her Indonesia care-giver)

Case B

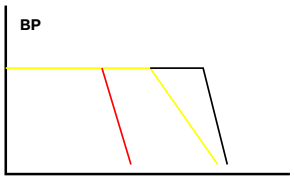


Case B

- Those who lack adequate compensation mechanisms
  - Known sympathovagal imbalance
  - Diabetes: sympathovagal imbalance
  - Drugs: Beta-adrenergic agents
  - Extreme elderly
  - Pacemaker for symptomatic bradycardia
  - Heart transplant recipients

Case B

- Those who have too good compensation mechanisms
  - Little kids
  - Athlete



Triage Decision Scheme (Trauma)

- STEP 1: Measure Vital Signs and Level of Consciousness
  - GCS<14
  - SBP<90
  - RR<10 or >29 (<20 for infant less than 1y)
  - RTS<11
  - PTS<9

Triage Decision Scheme

- STEP 2: Anatomic and Physiologic Approach
  - All penetrating injuries to head, neck, torso, and extremities proximal to elbow and knee
  - Flail chest
  - Two or more proximal long-bone fractures
  - Crush, degloved, or mangled exremity
  - Amputation proximal wrist/ankle
  - Pelvic fractures
  - Open and depressed skull fractures
  - Limb paralysis
  - Combined with burn

Triage Decision Scheme

- STEP 3: Trauma Mechanisms
  - Falls
    - Adults: >20 ft (1 story = 10 ft)
    - Children: >10 ft or 2 or 3 times the height of the child
  - High-risk auto crash
    - Intrusion into passenger compartment >12 inches (30cm); occupant site: > 18 in, any site
      - Major auto deformity >20 inches (50cm)
      - Extrication time > 20 minutes
    - Ejection (partial or complete) from auto
    - Death in same passenger compartment
    - Vehicle telemetry data consistent with high risk of injury (Initial speed >40mph (64 kph))
    - Auto vs. Pedestrian / bicyclist thrown, run over, or with significant (>20 mph) impact
      - Auto-pedestrian injury with > 5mph (8kph) impact
      - Motorcycle crash > 20 mph (32 kph) or with separation of rider and bike

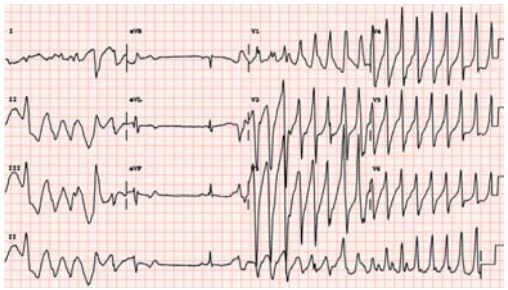
Triage Decision Scheme

- STEP 4: Special Patient or System Considerations
  - Age
    - Older adults: Risk of injury / death increases after age 55
    - Children: Should be triaged preferentially to pediatric-capable trauma centers (<5 y)
  - Anticoagulant and bleeding disorders
  - Time-sensitive extremity injury
  - Pregnancy >20 wks
  - EMS provider judgment
  - End-stage renal disease requiring dialysis
  - Immunosuppressed patients
  - Cardiac disease; respiratory disease
  - Insulin-dependent diabetes; cirrhosis; morbid obesity

Case C

- A 26-year-old female has found falling down 20 minutes ago. She regained consciousness 3 minutes later.
- Vital signs: BP 120/68, PR 62, RR 20, BT 35.8, SpO2 98% GCS E4M6V5
- PMH: PID/leukorrhea under treatment

Case C



Case C

- Long QT syndrome (LQTS)

Type of LQTS	Chromosomal Locus	Mutated Gene	Ion Current Affected
LQT1	11p15.5	*KVLQT1*, or *KCNQ1* (heterozygotes)	Potassium (I_{Ks})
LQT2	7q35-36	*HERG*, *KCNH2*	Potassium (I_{Kr})
LQT3	3p21-24	*SCN5A*	Sodium (I_{Na})
LQT4	4q25-27	*ANK2*, *ANKB*	Sodium, potassium and calcium
LQT5	21q22.1-22.2	*KCNE1* (heterozygotes)	Potassium (I_{Ks})
LQT6	21q22.1-22.2	*MiRP1*, *KNCE2*	Potassium (I_{Kr})
LQT7 (Andersson syndrome)	17q23.1-q24.2	*KCNJ2*	Potassium (I_{K1})
LQT8 (Timothy syndrome)	12q13.3	*CACNA1C*	Calcium ($I_{Ca-L-type}$)
LQT9	3p25.3	*CAV3*	Sodium (I_{Na})
LQT10	11q23.3	*SCN4B*	Sodium (I_{Na})
LQT11	7q21-q22	*AKAP9*	Potassium (I_{Ks})
LQT12		*SNTA1*	Sodium (I_{Na})
JLN1	11p15.5	*KVLQT1*, or *KCNQ1* (homozygotes)	Potassium (I_{Ks})
JLN2	21q22.1-22.2	*KCNE1* (homozygotes)	Potassium (I_{Ks})

Case C

- Acquired long QT
  - Antibiotics
  - Antidepressants
  - Antifungals
  - Antihistamines
  - Diuretics
  - Heart medications
  - Lipid-lowering medications
  - Oral hypoglycemics (for diabetes)
  - Psychotropic medications

Case C

- Medications that triggers TdP in inherited LQTS
  - Appetite suppressants
  - Bronchodilators
  - Catecholamines
  - Certain common antibiotics (e.g., erythromycin)
  - Decongestants
  - Uterine relaxants
  - Vasoconstrictors

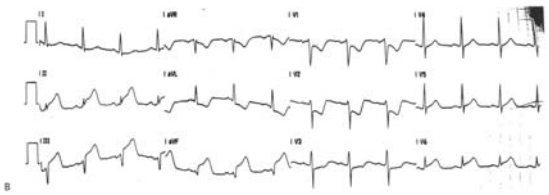
Case C

- Conscious Change
  - GCS 14-15 → TTAS Triage III-V
  - GCS 9-13 → TTAS Triage II
  - GCS 3-8 → TTAS Triage I
- Syncope right now or just before
  - Always implicates Triage I
    - TTAS Triage III-V (can be modified as Triage I)

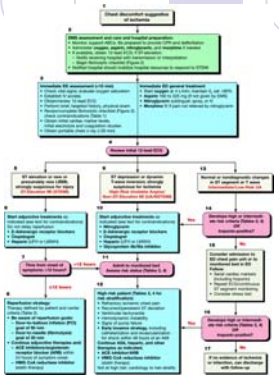
Case D

- A 45-year-old male complains of chest pain and cold sweating for 30 minutes
- Vital signs: BP 140/82, PR 80, RR 18, BT 36.5, SpO2 97% GCS E4M6V5
- PMH: smoking

Case D

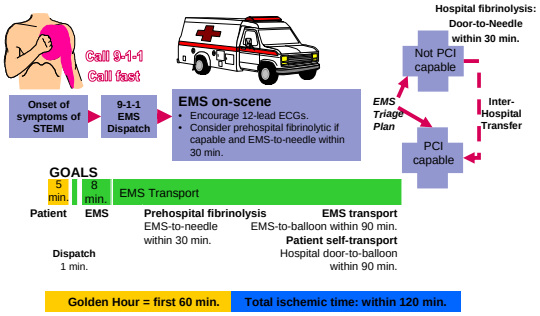


Case D



Circulation 2005;112:IV-89-IV-110

Options for Transport of Patients With STEMI and Initial Reperfusion Treatment



Antman EM, et al. *J Am Coll Cardiol 2008.* Published ahead of print on December 10, 2007. Available at http://content.onlinejacc.org/cgi/content/full/j.jacc.2007.10.001. Figure 1.

Case D

- Role of Emergency Physician on STEMI
  - Prompt and Correct Diagnosis
    - Atypical presentations: DM, Female, Elderly, medical modifications
    - Unusual ECG findings: hyperacute T, BBB
  - Successful Resuscitation for Witnessed VF/VT (Cardiac Arrest)
    - Peak of VF/VT vs. AMI
  - Always implicates Triage I
    - TTAS Triage II (can be modified as Triage I)

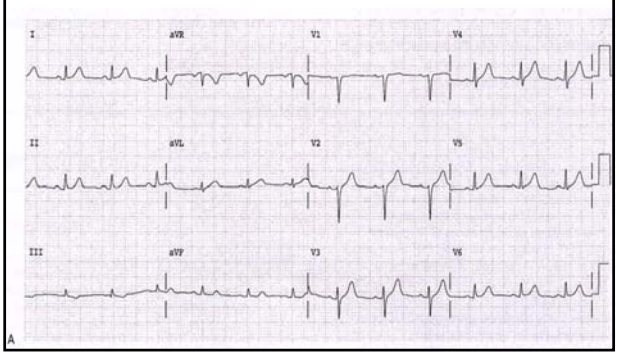
Case D

- Role of Cold Sweating
  - Excess Activation of Sympathetic Tone
  - Extreme Physical Stress
  - Atypical Presentations: Masking by Underlying Conditions or Medications
  - Always implicates Triage I
    - TTAS Triage II (can be modified as Triage I)

Case E

- A 60-year-old female complains sudden onset of epigastralgia 30 minutes ago
- Vital signs: BP 126/74, PR 75, RR 22, BT 36.3, SpO2 95% GCS E4M6V5
- PMH: diabetes under OHA for 7 years

Case E



Case E

- Unusual presentations
  - Sudden onset
  - Severe symptoms that never experienced
  - Extreme gaps between symptoms and signs
  - Sense of dying (or end of the world)
  - Illusion or hallucination of ghosts / gods
- Esp. in
  - those with atypical presentations
  - Low socio-economic status or special culture background

Case F

- A 25-year-old female complains gradual onset of headache and general weakness for 1 hour. She found her cat also sick.
- Vital signs: BP 98/54, PR 98, RR 22, BT 36.3, SpO2 98% GCS E4M6V5
- PMH: Nil

Case F

- Limitations for Pulse Oximetry
  - motion artifact
  - abnormal hemoglobins (primarily carboxyhemoglobin [COHb] and met-hemoglobin [metHb])
  - intravascular dyes
  - exposure of measuring probe to ambient light during measurement
  - low perfusion states
  - skin pigmentation
  - nail polish or nail coverings with finger probe
  - inability to detect saturations below 83% with the same degree of accuracy and precision seen at higher saturations
  - inability to quantitate the degree of hyperoxemia present
  - Hyperbilirubinemia has been shown *NOT* to affect the accuracy of SpO2 readings

Case F

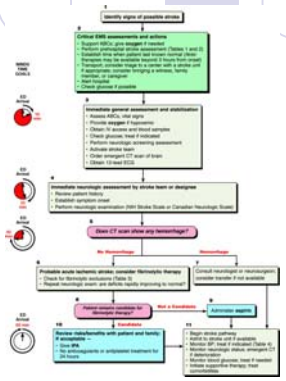
- Hypoxia
  - Hypoxemia (reduced arterial oxygen content)
    a. Reduced PaO2
    b. Reduced SaO2
    c. Reduced hemoglobin content (anemia)
  - Reduced oxygen delivery
    a. Reduced cardiac output
    b. Left-to-right systemic shunt (e.g., septic shock)
  - Decreased tissue oxygen uptake
    a. Mitochondrial poisoning (e.g., cyanide)
    b. Left-shifted hemoglobin dissociation curve (e.g., abnormal hemoglobin structure)

Case G

- A 68-year-old male was noted to have acute onset of right-sided weakness and speech difficulty 45 minutes ago.
- Vital signs: BP 170/122, PR 64, RR 22, BT 36.0'C, SpO2 96% GCS E4M6V5
- PMH: Nil

Case G

Seven D's



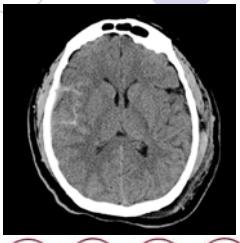
Circulation 2005;112:IV-111-IV-120

Case H

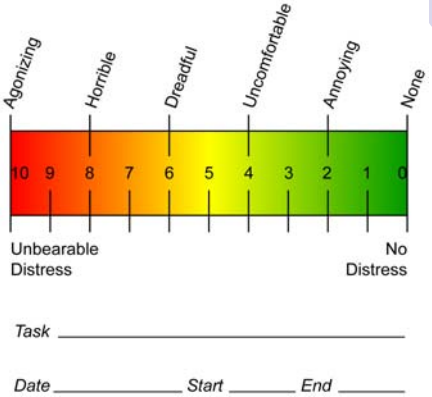
- A 21-year-old female complains sudden onset of severe headache (grade 10/10) for 1 hour.
- Vital signs: BP 140/96, PR 70, RR 24, BT 36.5'C, SpO2 98% GCS E4M6V5
- PMH: Nil

Case H

Pain Scale is Usually Under-estimated!



Case H



Case H

- Life-Threatening Pain
  - AMI, DAA, PE, Cardiac Tamponade, Tension Pneumothorax, Esophageal Rupture
  - Hollow organ perforation, SMA Occlusion, Internal Hernia
  - Necrotizing Fasciitis
  - SAH
- Organ-Threatening Pain
  - Glaucoma
  - PAOD

Case I

- A 45-year-old female was injured by her husband 1 hour ago. Multiple bruising over her trunk and left forearm deformity were noted.
- Vital signs: BP 122/68, PR 95, RR 22, BT 35.6'C, SpO2 98% GCS E4M6V5
- PMH: Nil

Case I

- Social Indication as Triage I
  - Domestic Violence
  - Child Abuse
  - Sexual Assault
  - Attempted Homicide
- Highly Clinical Suspicion
- Usually Under-triaged

Case I

- Child Abuse
  - Screening
    - More than 3 episodes of trauma from ED recordings
    - Inconsistent medical history
    - Inconsistence between history and physical findings
    - Delayed transportation / consultation
    - Any fracture or head injury for those < 1y

Case I

- Child Abuse
  - Physical Findings
    - Skin: Blunt Injury, Burn, Bite
    - Face: Raccoon Eye, ENT, Teeth, Lip, Hair
    - Head: Abusive Head Injury, Shaken Baby
    - Abdomen: Liver Laceration, Duodenal Hematoma, Traumatic Pancreatitis, Mesentery Laceration
    - Fracture:
      - Much younger; Multiple; Varying stages; Spiral or Oblique
      - Eg: post. ribs; scapula; sternum; complex skull

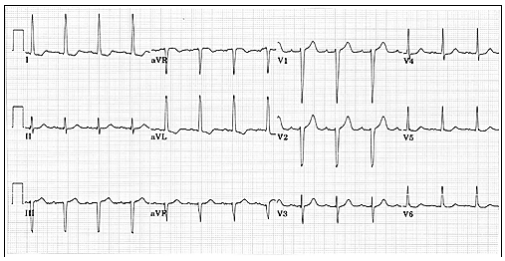
Case I

- Child Abuse
  - High Specificity (for example)
    - Metaphyseal fractures
    - Rib fractures
    - Scapular fractures
    - Fractures of the outer end of the clavicle
    - Fractures of differing ages
    - Vertebral fractures or subluxation
    - Digital injuries in non-mobile children
    - Bilateral skull fractures
    - Complex skull fractures

Case J

- A 70-year-old patient was transferred to our ED under the diagnosis of ACS. His present chief complaint is SOB for more than 2 days (R1 recorded). He consulted another ED and has gotten the treatment of Clexane for 2 days.
- BP 136/72, PR 100/min, RR 18/min, SpO2 97%, GCS E4M6V5
- PMH: Hypertension

Case J



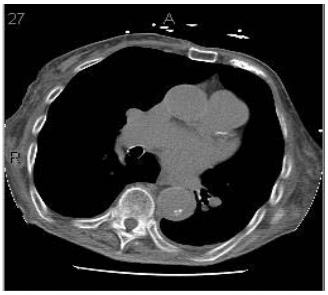
Case J

- MONA
- ECG Monitoring
- Continue Bokey, Clexane

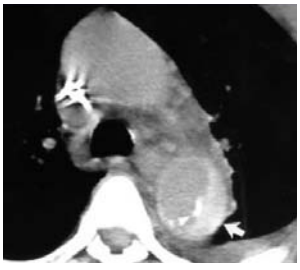
Case J

- Review his history, sudden-onset unexperienced chest pain that radiated from anterior chest to middle back with cold sweating was noted initially 3 days ago.

Case J



Case J



Crescent Sign

Case J

- Inter-Hospital Transfer
  - Usually treated as Triage I
  - Over-triage rather than Under-triage
- Complete history taking
  - From the very beginning
    - Chief complaint at the 1st visit
  - Complete exclusion or NOT
    - Life-threatening chest pain
      - ACS
      - DAA
      - PE
      - Tension pneumothorax
      - Cardiac tamponade
      - Esophageal rupture

Case K

- A 63-year-old male suffered from sudden onset of left eye blindness.
- BP 158/92, PR 84/min, RR 20/min, SpO2 96%, GCS E4M6V5
- PMH: DM and Hypertension for 10 years

Case K

- Amaurosis Fugax
  - Embolic and hemodynamic origin
    - Atherosclerotic carotid artery
    - Atherosclerotic ophthalmic artery
    - Cardiac emboli due to (1) atrial fibrillation, (2) valvular abnormalities including post-rheumatic valvular disease, mitral valve prolapse, and a bicuspid aortic valve, and (3) atrial myxomas.
    - Temporary vasospasm
    - Giant cell arteritis
    - Systemic lupus erythematosus
    - Periarteritis nodosa
    - Eosinophilic vasculitis
    - Hyperviscosity syndrome
      - Polycythemia
    - Hypercoagulability
      - Protein C deficiency
      - Antiphospholipid antibodies
        - Anticardiolipin antibodies
        - Lupus anticoagulant
    - Thrombocytosis
    - Subclavian steal syndrome
    - Malignant hypertension
    - Drug abuse-related intravascular emboli
    - Iatrogenic

Case K

- Amaurosis Fugax
  - Occular origin
    - Iritis
    - Keratitis
    - Blepharitis
    - Optic disc drusen
    - Posterior vitreous detachment
    - Closed-angle glaucoma
    - Transient elevation of intraocular pressure
    - Intraocular hemorrhage
    - Coloboma
    - Myopia
    - Orbital hemangioma
    - Orbital osteoma
    - Keratoconjunctivitis sicca
  - Neurological origin
    - Optic neuritis
    - Compressive optic neuropathies
    - Papilledema
    - Multiple Sclerosis
    - Migraine
    - Pseudotumor cerebri
    - Intracranial tumor
    - Psychogenic

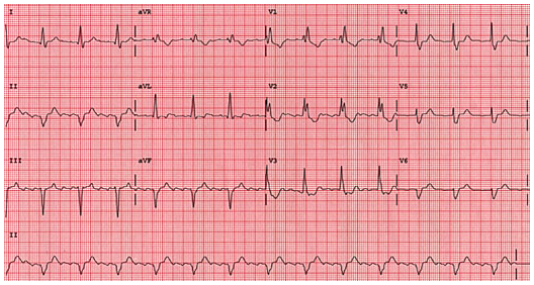
Case K

- A 12-year-old boy was sent to ED due to progressive dyspnea for several hours. He was just discharged 1 week ago after successful extubation.
- BP 110/66, PR 120/min, RR 28/min, SpO2 92%, GCS E4M6V5. No wheezing
- PMH: Asthma

Case 3

- A 68 y/o female patient was brought to our ED due to persistent chest oppression and diaphoresis for more than 2 hours. BP was 96/48, PR 98, RR 20, SpO2 95%, and minimal bilateral basal crackles were audible. PMH included renal insufficiency and diabetes mellitus.
- What is your impression and initial management?

Case 3



Case 3

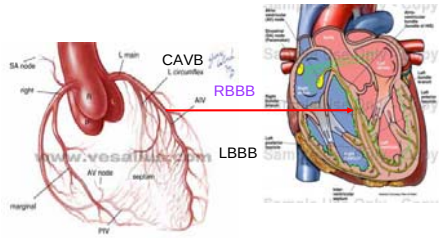
- ECG: RBBB; susp. Atrial Flutter with 4:1 AVB
- O2 and aspirin were given.
- Cardiac enzymes revealed CK 452, CKMB 38, TnI 8.92. AMI with Killip II was diagnosed.
- Is fluid resuscitation indicated for her deteriorating hemodynamics? Should she treated as RV infarct with hypotension?

Case 3

- RBBB in AMI
  - Incidence: 3-29%
  - 37.8% new RBBB, 34.1% old RBBB, and 28.1% with an indeterminate time of origin
  - New-onset RBBB → 50% permanent RBBB
  - More high incidence of heart failure, pacemaker due to AVB, and 1-year mortality
  - Early mortality:
    - New RBBB(43%-76%) > Intermediate RBBB
    - New RBBB > New LBBB

Case 3

- RBBB in AMI
  - Always means LAD proximal lesions instead of RCA



Case 3

- Narrow QRS
- Wide QRS: "BBB" in widest definition
  - Always associated with discordant repolarization abnormalities (ST-T changes)
  - Examples:
    - RBBB / LBBB
    - Ventricular Pacing
    - VT
    - WPW

Case 3

- New-onset LBBB → Treat as AMI
- Any "BBB" that obscures ST elevation with clinically high suspicion of MI → Treat as AMI
- Undetermined LBBB/RBBB
  - Discordant ST-T changes → Undetermined
    - Exceptions: ST elevation above 5 mV
  - Concordant ST-T changes → Consider AMI

Case 3