HAEMOPHILUS & THE HACEKGROUP OF ORGANISMS

Suggestions on what to do with tiny gram negative coccobacilli

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Haemophilus

- Clinical presentations----adults
  - Meningitis---Post upper respiratory infection
  - Cellulitis in the buccal and periorbital region
  - Epiglotitis
  - Pneumonia
  - Pericarditis
  - Septic arthritis
  - Occult bacteremia
- Underlying medical conditions
  - Pulmonary disease, HIV, alcoholism, pregnancy & malignancy

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Haemophilus cont

- Clinical presentations---neonatal
  - Usually present within 24 hours after birth
  - Usually NTHi
  - Manifestations maybe nonspecific and may include:
    - Bacteremia
    - Sepsis
    - Meningitis
    - Pneumonia
    - Respiratory distress
  - Underlying conditions
    - Premature birth, premature membrane rupture, low birth weight

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Characteristics of *Haemophilus*

- **Small, pleomorphic gram-negative coccobacilli**
- **Positive for cytochrome oxidase**
- **No growth on MacConkey or Sheep blood agar (BA)**
- **Growth in culture requires exogenous hemin (X factor) and/or nicotinamide adenine dinucleotide (NAD) (V factor)**
- **Media of choice----Chocolate**
  - **Can use BA with hemolytic organism--**Satellitism

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Characteristics of *Haemophilus*

- **Growth of *Haemophilus* on chocolate agar in the presence of 5-10% CO_2 (capnophilia)**
- **Commercial chocolate agar is a synthetic "mix" of NAD, hemoglobin, vitamins (cobalamin, thiamine hydrochloride), minerals (iron, magnesium), cysteine, glutamine, and glucose**

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Common Species of *Haemophilus*

- ***Haemophilus influenzae***
- ***Haemophilus parainfluenzae***
- ***Haemophilus aphrophilus***
- ***Haemophilus ducreyi***

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Haemophilus Biochemicals

	X Factor	V Factor	X+V Factor	Porphyrin
H influenzae	No Growth	No Growth	Growth	Negative
H haemolyticus	No Growth	No Growth	Growth	Negative
H parainfluenzae	No Growth	Growth	Growth	Positive
H parahaemolyticus	No Growth	Growth	Growth	Positive

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Haemophilus Biochemicals

	Catalase	Oxidase	Urease
H influenzae	+	+	(+)
H haemolyticus	+	+	+
H parainfluenzae	d	+	d
H parahaemolyticus	d	+	+
H aegyptius	+	+	+

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HACEK Organisms

- Haemophilus species
- Actinobacillus actinomyetemcomitas
- Cardiobacterium hominis
- Eikenella corrodens
- Kingella species

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Clinical

- Have an enhanced capacity to produce endocardial infections (IE)
  - Approximately 3% of native valve endocarditis
- Most common cause of gram negative endocarditis in non drug users
- Also associated with
  - Periodontal infections, Bacteremia, Abcesses, Peritonitis, Otitis media, Conjunctivitis, Septic arthritis, Osteomye.itis, UTI, Brain abcess
  - Infections frequently associated with dental procedure

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Haemophilus IE

- Cause up to 1 % of IE
- Of these:
  - 40% due to H. aphrophilus, followed by H. parainfluenzae,
  - H. influenzae rarely causes IE despite the frequency of it being associated with bacterimia
- Up to 10% of cases of IE include a second pathogen
  - Either a Streptococcus viridans or Staphylococcus aureus

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Actinobacillus Clinical

- Frequently associated with localized juvenile periodontitis
  - Manifestation of early-onset periodontitis (EOP)
- Also associated with gingivitis
  - Can mimic clinical picture of Actinomycetes
- IE infections
  - 86% have underlying heart disease
  - 25% have infection of prosthetic valve (aortic)
  - Arterial embolism occurs in 43% of cases

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Eikenella Clinical

- Usually associated with mixed bacterial infections
- Cellulitis from human bites or clenched-fist injuries
- Also associated with osteomylitis and various pulmonary infections (empyema , pneumonia)
- Soft tissue infections and endocarditis in drug abusers
  - Most patients have underlying valve lesions

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Kingella Clinical

- Frequently associated with diseases in children
  - Osteomylitis & septic arthritis in young children
  - Bacteremia in infants
  - IE in school aged children and adults
    - Vary rapid progress is characteristic
  - Rarest of the HACEK organisms causing infection

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Haemophilus Hints

- New Name: Haemophilus aphrophilus is Aggregatibacter aphrophilus
  - Also includes H. paraphrophilus
- Short Gram – bacillus that may for filaments
- Require 5-10% CO_2
- Growth maybe enhanced by heamin but X factor not absolute requirement, V variable
- Colonies opaque, granular & yellow
- Catalase & Urease—Neg, Oxidase --variable

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Actinobacillus Hints

- New name: Aggregatibacter actinomycetamcomitans
- Short gram negative coccobacillus, may stain irregularly, cells arranged, singly & in pairs
- Does not require X or V factors
- Microaerophilic, optimal temp 37^0 C
- Colonies firm, star shaped, rough and pitting
- Slime maybe produced, colonies sticky
- Catalase & Oxidase—Pos, Urease—Neg
- Floating colonies in TSB

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Cardiobacterium Hints

- Two species: hominis & valvarum
- Pleomorphic or straight rods with round ends, may give rosette clusters
- May find some of these cells are gram +
- Growth on BA poor, does not require X or V factors. May require X initially
  - Very small colonies, need humidity & 5% CO_2
  - Optimal temp-----30 to 37^0 C
- Colonies smooth, opaque, butyrous
- Oxidase---Pos, Catalase & Urease---Neg

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Eikenella Hints

- Monospecies: corrodens
- Straight, unbranched, non-spore forming
- May take several days to grow, bleach odor
- Flat colonies maybe surrounded by spreading
  - Pitting common, yellow color in older cultures
  - Non hemolytic but slight greening maybe seen
  - Optimal temperature 35-37^0 C,
  - Twitching "motility" maybe seen
- Oxidase---Pos, Catalase & urease--- Neg

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Kingella hints

- Three species--- kingae, denitrificans, oralis
- Straight rods with rounded or square end
  - Tendency to decolorize poorly
- Two colony types: Neither requiring X or V
  - Spreading corroding
  - Smooth convex
  - Zone of beta hemolysis
- Optimal temperature---33-37^0 C
- Oxidase --Pos, Catalase & Urease-- Neg

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HACEK Organisms

	H	A[1]	C[2]	E[3]	K[4]
Mac	+/-[5]	+/-	-	-	-
Oxidase	+/-	-*	+	+	+
Catalase	-	+*	-	-	-
Indole	-	-	+*	-	-
Nitrate	+	+	-*	+	-
Glucose	+	+	+	-	+
Mannitol	-	+/-	+	-	-
Sucrose	+	-	+	-	-

[1]Colonies show central opaque dot that with incubation forms a star-like configuration like "crossed cigars" visible on clear agar medium such as brain heart infusion (supplemented with serum) at 100X magnification; may show light growth on MacConkey agar
[2]Irregularly-staining gram-negative rods with bulbous (swollen) ends; indole detected by xylene extraction
[3]Cultures smell of hypochlorite (bleach)
[4]Colonies show small but distinct zones of β-hemolysis
[5]X-factor requirement lost with passage in culture

Slide taken from Dr. J. Warren lecture, Northwestern University

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References

- Identification of Haemophilus species and HACEK group of organisms. NHS, National Standard Method. BSOP ID 12
- E-medicine.medscape. Com/article/218158-overview
- **Dr. John R. Warren, Department of Pathology**
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