“Where did the mold come from?”

Advanced Training for Infection Control Nurses 2017

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How the story began in March, 2016

- HKEC ICT informed by a PYNEH pathologist:
  - Possible clustering of fungal organisms seen in cytology samples
  - From 1/3-8/3, 5 out of 7 BAL cytology samples +ve for ? *Aspergillus* spp.
  - All samples from RTSKH bronchoscopy samples
  - Highly unusual; ?? outbreak

First step: Verify the diagnosis and confirm existence of outbreak (1)

- Slide review
  - All fungus of similar morphology ? dematiaceous mold
  - Not present in BAL samples from RTSKH in preceding week
- Computer record review
  - No report of “fungal hyphae” from RH cytology samples in Jan - Feb 2016
- Microbiology lab
  - no recent +ve pigmented mold cultures in past 1 year

First step: Verify the diagnosis and confirm existence of outbreak (2)

- Case review
  - 5 patients, M:F = 2:3
  - Age 25-82
  - Unrelated
  - Clinical admissions for bronchoscopy
  - Not immunocompromised
  - No S/S of infection

- Laboratory review
  - Fungus not seen in samples processed in microbiology lab

- Assessment
  - Unusual clustering of possible same fungus seen in cytology, no clinical infection $\Rightarrow$ Outbreak / Pseudo-outbreak??

Definitions of terms

- Outbreaks
  - Alert signal from lab / clinical or surveillance data that is significantly ↑ compared with baseline
  - Can be true infections or patient colonizations without infection

- Pseudo-outbreaks
  - Unrelated cluster of true infections
    - Chance finding
    - Surveillance or testing artefacts (too sensitive / changed methods)
  - Related cluster of false infections
    - Ix for possible testing / diagnosing error (collection, processing errors, etc)

Hospital pseudo-outbreaks: what are they, and when should one suspect them? (1)

- Recognized since 1960-70s
- US CDC experience
  - 6-11% of all hospital outbreaks investigated between 1956-2000
- Types of pseudo-infections
  - Pseudobacteremia
  - Pseudomeningitis
  - Pseudopneumonias
  - Pseudohepatitis
  - Pseudodiarrhea
  - Pseudourinary tract infections

Hospital pseudo-outbreaks: what are they, and when should one suspect them? (2)

- Specimen contamination can occur at any step
  - Collection equipment
  - Lab processing error

- Suspect pseudo-infections when discrepancy between clinical findings and typical manifestations of the isolate at the body site
  - Absence of clinical features of infection (note: can still be colonization)
  - Usual pathogens found at an unusual body sites e.g *Streptococcus pneumoniae* found in urine sample
  - Unusual pathogens

Investigations at cytology lab: was the lab to blame?

- Review of laboratory processes
  - No recent change in lab practice / methodology
  - No deviations from SOPs

- Sampling of lab equipment / accessories: all -ve for the fungus
  - Containers
  - Disposable pipettes
  - Glass slides / cover glass
  - Cytolyt / PreservCyt solutions

- Subsequently fungus also detected in a cytology sample processed independently at microbiology lab
  - Fungus already present in sample upon arrival to lab

Next steps in the investigation: pin-pointing the source (1)

- Further information
  - Positive samples limited to RH patients only who had bronchoscopy from 1/3 – 8/3
  - Fungus not found in BAL or other respiratory cytology samples from PYNEH patients (retrospective review, Jan – early March, 2016)

- Assessment
  - Possible outbreak / pseudo-outbreak involving fungal organisms, associated with bronchoscopy service at RH

Next steps in the investigation: pin-pointing the source (2)

- HOCT (10/3/16)
  - CHP: Quarantine all bronchoscopes
  - Suspension of bronchoscopy service at RH
  - Joint site visit to bronchoscopy suite with Prof KY Yuen's team

- Case definition
  - Any patient with fungal elements seen in bronchoscopic cytology specimens, with morphology suggestive of dematiaceous fungus, collected at RTSKH from 1/3/2016 onwards will be counted as a case

- Line-listing

Bronchoscopy-related infections / pseudo-infections (1)

- Increasingly used procedure worldwide
  - ~500,000 / yr in US alone
- Complications
  - Rare
  - Fever: 0 - 27%
  - Transient bacteremia <5%
  - Pneumonia 0.6 - 6%
- Most infections “endogenous”
  - Patient’s own oral / URT flora “carried” to LRT
  - E.g. Viridans streptococcus, staphylococci, Moraxella spp., anaerobes

Bronchoscopy-related infections / pseudo-infections (2)

- Rare but important: exogenous contamination of bronchoscope with pathogenic organisms
  - Contamination of patient samples or even causing infections
  - “Water bugs” commonly involved
    - Bacteria / mycobacteria / fungus

- Associated with inadequate cleaning and disinfection procedures
  - High level disinfection of scope together with sterilization of selected critical items (e.g. biopsy forceps) required
  - Bronchoscopes inherently difficult to clean due to design / occult damage to channels
  - AER used for scope disinfection can itself be colonized by bacterial biofilm
  - Other sources of contamination

Review on bronchoscopy-related outbreaks and pseudo-outbreaks: 2000-2016

- Total 39 incidents
  - Pseudo-outbreaks: 22 (56.4%)
- Organism types
  - Bacteria: 25 (64.1%)
  - Mycobacteria: 8
  - Fungus: 5
  - Mixed: 1
- No. of patients involved: 2-117
- Duration: 7 days - 23 months
- Bronchoscope as the most common source, followed by AER

Summary of investigations at RH and recommendations (as at 22/3) (1)

- Total >100 samples tested, all -ve
  - Sputum traps, tubings
  - Saline, lubricant gel, local anaesthetic sprays
  - Washings from bronchoscopes
  - Detergents, AER rinse water
  - 50% alcohol for cytology samples
  - Environmental swabs, air samples

- Fungus in patient BAL samples not recovered by culture or identified by PCR; not seen in subsequent sputum samples from patients
  - Patients not colonized

Summary of investigations at RH and recommendations (as at 22/3) (2)

- Impression
  - ? Transient and low-level contamination of AER by "fungal corpses", causing pseudo-outbreak
  - ? Fungal DNA damaged by Cidex-OPA

- Recommendations
  - Single use lubricant gel
  - IV grade saline for BAL
  - Discard opened bottles of 50% alcohol after 24 hrs
  - Initiate program for testing of AER final rinse water
  - Resume service; change to manual disinfection pending maintenance checking of AERs

Outbreak is not over … yet

- 2 further RTSKH cases found after service resumed on 24/3 and 29/3

- Re-examine evidence and formulate new hypothesis for testing
  - Review of data from 1/3 - 29/3 suggested persistent contamination source at RH bronchoscopy
  - 2nd site visit on 30/3 with sampling of >150 old + new items
  - Inventory record review showed that three consumable items were recently introduced in RTSKH for use
    - A: Disposable spray noozles (Feb 2016)
    - B: Disposable suction catheters (Oct 2015)
    - C: Sputum traps (Oct 2015)

Finally, some early answers to the enigma …

- 2/10 of the newly sampled sputum traps found fungus inside on smear using a special concentration method
  - Subsequently confirmed by large scale testing at PYH / RTSKH

- Recommendations made on 2/4/16:
  - The likely source of contamination is the sputum trap
  - Immediate retrieval of this brand and batch of sputum traps from ALL HA / private hospitals
  - Alert Pathologists: avoid reporting of false +ve results; retrieve any cytology +ve for mould and correlate clinical / lab findings
  - Alert Resp physicians: Review cases started on antifungals recently based on cytology results alone

Outbreak investigation: final conclusions and recommendations (1)

- Likely a pseudo-outbreak of non-viable dematiaceous fungi related to contaminated sputum trappers
  - Fungus killed by gamma-irradiation
  - DNA destroyed, non PCR-identifiable
  - Differences in stock at PYH and RH possibly due to intra-lot variation

- Immediate change to alternative product
  - >2000 traps recalled in whole of HA

Outbreak investigation: final conclusions and recommendations (2)

- Look back program for previously reported fungal hyphae +ve cytology cases in HA hospitals
  - 3 other HA hospitals potentially involved
  - No further cases identified

- Resumption of bronchoscopy service at RH with on-going surveillance
  - Total 177 RH bronchoscopic cytology samples received during the 5-month period from 5/4/16 till 5/9/2016, all -ve for the fungus

Summary and lessons learned

- Suspected hospital outbreaks / pseudo-outbreaks should be investigated as far as possible
  - May uncover new pathogens / mode of transmission
  - Avoid unnecessary Ix and Tx for patients
  - Identify potential / hidden problems in system

- During investigation
  - Keep an open mind and do not assume anything
  - Follow the general steps in outbreak investigation
  - Be prepared to explore new hypothesis
  - Laboratory testing should be targeted and guided by epidemiological information