

Laboratory diagnosis of skin infections - *a clinician's perspective*

*Seminar on Infectious Diseases:
Diagnosing common infections in the
general practice organized by PMH,
HKMA, HKSID*

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Classification of skin Infections

1. Bacterial
2. Viral
3. Fungal
4. Parasitic infections & infestation
5. Algae

General principles of laboratory diagnosis (in dermatological conditions)

Interpret the test results in the appropriate clinical context.

- The attending physicians have to familiarize with the concept of sensitivity and specificity
- Mnemonics: "SnOut" that a sensitive test with a negative result rules out the disease
- Mnemonics: "SpPin" that a specific test with a positive result rules in the disease
- Culture is regarded as the gold standard and with specificity ~ 100% but variable sensitivity
- The sensitivity of the test is "vulnerable" to sample collection technique, storage and transport conditions
- The positive and negative predictive values are sensitive to the pre-test probability of disease occurrence: therefore the ordering clinicians should have in mind whether they want to "confirm" (context with high pre-test probability) or to "rule-out" (context with low pre-test probability) the infection
- In the setting of clinical diagnostic, the attending doctor has to judge if a positive (or negative) result explains the concurrent clinical presentation or disease of the index case

Laboratory diagnosis

- What is the purpose of performing the laboratory tests under consideration?
- Which is the most appropriate laboratory test?
- How to interpret the laboratory results in (clinical) context?

Bacterial infection

1. Primary
2. Secondary
3. Special bacterial infection
4. Cutaneous manifestation of systemic infections
5. Cutaneous infection in abnormal host
6. Dermatoses related to bacteria

Bacterial (primary)

1. Pyoderma: impetigo; ecthyma; folliculitis; furunculosis; carbunculosis
2. Soft tissue infections: Erysipelas; cellulitis; gangrenous cellulitis
3. Staphylococcal scalded skin syndrome
4. Erythrasma & pitted keratolysis
5. Others: erysipeloid; lyme disease; actinomycosis and nocardiosis; Bartonellosis; etc.

Laboratory diagnosis - Pyoderma

- Gram smear - presence of host response (WBC); presence of concern pathogen; results available almost immediately
- Standard culture - more sensitive and most specific (gold standard); sensitivity test available (antibiotics resistance monitoring, additional information may be derived from the sensitivity pattern [e.g. nosocomial vs community acquired infection such as CA-MRSA]); details on transport, storage may be important

Laboratory diagnosis - Infected eczema and wound infection

- Textbook teaching - swab for culture and sensitivity
- In real life - treat empirically in those patients with heavy weeping; +ve culture do not differentiate colonization vs genuine infection, most will have +ve growth for staphylococcus
- (same principles applied to wound - +ve culture in those clinically secondary infected wound is useful, but not for diagnostic purpose in those "clean" wound [may be for other purpose], some laboratory will perform microscopy and report if there is any WBC in the sample)

Laboratory diagnosis - Erythrasma and pitted keratolysis

- Causative agent: corynebacteria that are normal commensal on the skin surface, therefore culture is not required to establish the diagnosis; may not indicate in the culture report
- Diagnosis by clinical assessment (may be assisted with Wood's light examination)

Principles of diagnosis (bacterial infection)

- Clinical : infection VS colonization / contamination
- Investigation :
 - direct microscopy : Gram stain
 - culture : special medium
 - histology/cytology : leprosy
 - serology : syphilis
 - molecular technique : TB
 - others : skin test

Fungal

- Superficial fungal : dermatophytes, yeast, mould
- Deep fungal : chromomycosis, sporotrichosis
- Systemic fungal : penicillium, cryptococcus, aspergillosis

Fungal infection (dermatophytes)

- Tinea (pedis, corporis, cruris, manuum, faciei, capitis, unguium)
- Id reaction : allergic dermatophytids
- Dermatoplytosis complex : mixed fungal and bacterial infection of toe web

Laboratory diagnosis - Dermatophyte infection

- Skin scraping - choose the active margin, collect scale with colour paper, (dry up the oily or wet skin with alcohol or ether in the old days before scraping), can send to laboratory by post
- Hair plugging (NOT cutting) - choose the short broken hair (mostly likely found in the margin of bald patch), can be guided by Wood's light; sample with specific brush; sample the pets
- Nail clipping - scrape the subungual hyperkeratosis as proximal as possible, maximum amount of disease nail material, may use a small punch biopsy needle to sample in proximal subungual onychomycosis, scraping of the nail surface in superficial white onychomycosis

Laboratory diagnosis - Dermatophyte infection

- Wet mount - dissolve the keratin material with KOH, direct examination with or without stain (e.g. Parker stain) [Sn 12% & Sp 93%]
- Culture with Sabouraud agar (if mould [non-dermatophyte filamentous fungi] infection is suspected, culture without cycloheximide is required)
- Nail clipping for histology (with special stain) can be performed in those persistent culture negative cases (with clinical features of fungal infection)

Laboratory diagnosis - Dermatophyte infection

- Species identification is particularly important in tinea capitis as: infection caused by zoophilic fungi will prompt an investigation on the pets whereas infection by anthropophilic fungi may prompt an investigation for human to human transmission (such as institutional outbreak).
- Some laboratories have the tendency to report any positive results including non-dermatophyte filamentous fungi and other mould. Most non-dermatophyte filamentous fungi or mould are not pathogenic (innocent bystanders). Not all laboratories inoculate samples to agar with or without cycloheximide and therefore easy to produce positive results (may be reported as positive for fungal elements or nomenclature of "funny" fungal species). Clinical correlation is essential to determine if these fungi are pathogenic and hence explain the clinical presentation of the index case.
- Can be negative in dermatophytosis complex (over grown by concurrent bacterial infection).

Fungal infection (yeast & Pityrosporum/Malassezia)

- Candidiasis : intertriginous area, napkin area, chronic paronychia, chronic mucocutaneous candidiasis, balanitis, oral thrush
- Pityrosporum : pityriasis versicolor, pityrosporum folliculitis (seborrhoeic dermatitis, pityriasis capitis)
- Trichosporosis : piedra

Laboratory diagnosis - Candida

- Skin scraping - choose the active lesions, wet mount examination or Gram stain (regarded pathogenic in the presence of germ tube formation [pseudohyphae])
- Fungal culture may or not useful - can be commensal/bystander; need clinical correlation

Laboratory diagnosis - Pityriasis versicolor

- Wood's light examination - hypopigmentation (not depigmentation), yellowish fluorescence indicates active disease)
- Skin scraping - choose the active lesions, wet mount examination (typically the "spaghetti and meat" pattern is seen)
- Fungal culture not applicable - can be commensal; need specific (lipid) supplement to grow the fungus

Principles of diagnosis (fungal infection)

- **Clinical : infection VS colonization / contamination**
- **Investigation :**
 - **direct microscopy : candida & pityriasis versicolor**
 - **culture : SDA \pm cycloheximide**
 - **histology : deep fungal infections**
 - **serology : penicillium**
 - **others : Wood's light for PV and tinea capitis.**

Viral

- HSV : cold sore, genital herpes
- VZV : Chicken pox, zoster
- HPV : wart
- Pox virus : molluscum contagiosum
- Viral exanthemata : measles, rubella, roseola infantum, erythema infectiosum,
- Others : Hand foot mouth disease; (EBV, HIV)

Laboratory diagnosis - Herpes virus

- In HK, the traditionally taught axiom that herpes labialis is caused by HSV-1 and genital herpes is caused by HSV-2 is still appropriate (up to 50% of genital herpes is caused by HSV-1 in some other countries)
- Viral culture is still the gold standard - specific transport medium is required
- Other techniques include - Tzanck' s smear (can be performed in office), direct IMF

Laboratory diagnosis - Herpes virus

- Pitfalls of using serology to confirm the diagnosis of HSV infection - ?FDA approved commercial kit, ?confirmation test performed, active disease vs past infection
- Viral culture for HZV more difficult compared to HSV
- Skin biopsy can only tell that it is herpetic infection but not exactly the type involved

Principles of diagnosis (viral infection)

- **Clinical vs laboratory**
- **Investigation :**
 - direct microscopy: Tzanck smear
 - culture : HSV
 - histology: wart
 - serology: viral exanthemata
 - others : DFA for HSV

Warts is basically a clinical diagnosis occasional supported by histopathology. Demonstration of HPV by molecular diagnostics is not required and can be confusing.

Parasitic infestation

- Mite: *Sarcoptes scabiei*
- Lice: head lice, body lice, pubic lice
- Others: cutaneous larva migrans, amoeba, myiasis, etc

Principles of diagnosis (scabies and pediculosis)

- Clinical vs laboratory
- Investigation: -direct microscopy
 - histology : scabetic mite
 - others : therapeutic trial

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