**Mucoraceous moulds & mucormycosis**

### **1. Taxonomy & Key Species**

* Two medically important orders: **Mucorales** and **Entomophthorales**; formerly grouped in polyphyletic *Zygomycota*.
* Common human-pathogenic genera (Box 18.1):
  + *Rhizopus* (esp. **R. arrhizus**—most frequent),
  + *Lichtheimia* (formerly *Absidia*),
  + *Mucor*,
  + *Rhizomucor*,
  + *Cunninghamella*,
  + *Saksenaea*, *Apophysomyces*; entomophthoromycosis agents *Basidiobolus ranarum* and *Conidiobolus coronatus* .

### **2. Biology & Pathogenesis**

Broad, **pauci-septate “ribbon-like” hyphae** that branch at ~90° .

Rapid growth at 37 °C; sporangiospores produced in sporangia; some genera form rhizoids for anchoring .

**Virulence mechanisms:** fast angio-invasive growth causing vessel thrombosis/necrosis; high iron affinity (disease worse in iron overload or deferoxamine therapy) .

Larger spore size favours entrapment in nasal turbinates ⇒ rhinocerebral disease more common than pulmonary .

Many Mucorales form thick-walled **zygospores** (sexual stage) that survive extreme conditions — possible environmental reservoir

### **3. Epidemiology & Risk Factors**

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| **Major host factors** | **Illustrative notes** |
| **Diabetes mellitus (DKA)** | Commonest risk |
| **Haematological / other malignancies & neutropenia** | Second most frequent; post-allo-SCT incidence ≈0.3 %, 1-yr survival < 25 % |
| **Trauma & burns** | Includes natural disasters, tornadoes, floods, combat wounds |
| **Solid-organ transplant & prolonged steroids (GVHD)** | Lung / heart-lung recipients particularly vulnerable |
| **Iron overload / deferoxamine** | Siderophore-mediated infection |
| **Nosocomial sources** | Contaminated linens, wooden tongue-depressors |

Overall European incidence ≈ 1 case / 10^6 population; likely rising.

### **4. Clinical Syndromes**

* **Rhinocerebral**: sinus pain, facial swelling, cranial nerve palsies, black palatal/nasal eschar .
* **Pulmonary**: nodular/segmental infiltrates mimicking invasive aspergillosis; “reversed halo” CT sign .
* **Cutaneous / wound**: necrotic eschar, rapidly extending cellulitis or fasciitis.
* **Disseminated**: any organ, often skin lesions secondary to pulmonary focus .
* **Entomophthoromycosis**:

*Basidiobolus*: chronic subcutaneous masses (trunk/limb) or GI pseudotumour .

*Conidiobolus*: painless mid-facial swelling (“woody” rhinofacial lesion) .

### **5. Diagnosis**

**Immediate**

Direct microscopy of tissue (KOH/Calcofluor): broad, ribbon-like hyphae with right-angle branching .

Histology (Grocott): angio-invasion, necrosis.

**Culture**

Grow rapidly in ≤ 24 h on glucose-peptone agar at 30–37 °C; **do not homogenise tissue** (destroys hyphae) .

Identify by sporangial morphology, rhizoids, thermotolerance; confirm with ITS/28S sequencing if sporulation poor .

In histology: **Splendore-Hoeppli phenomenon** (eosinophilic cuffs around hyphae) can appear in entomophthoromycosis and is a useful histological clue.

**Adjunct tests**

Serum (1→3)-β-D-glucan **negative** (low cell-wall content) .

Imaging: CT “reversed halo” in lungs .

Experimental pan-fungal PCR on tissue / blood; useful when cultures negative .

### **6. Management**

**Urgent combined therapy**

1. **Surgical debridement** of necrotic tissue (often extensive) .
2. **First-line antifungal**: lipid complex or liposomal **Amphotericin B 5–10 mg kg⁻¹ d⁻¹** (formulation-specific) .
3. **Azole step-down / salvage**

**Posaconazole** (delayed-release tablet or IV) OR

**Isavuconazole**—licensed for primary or salvage therapy (open-label VITAL trial) .

**Adjuncts (case-by-case)**

* Reversal of immunosuppression / DKA.
* Hyperbaric oxygen, iron chelation with deferasirox (not deferoxamine),
* G-CSF or GM-CSF, interferon-γ; **evidence limited** .
* Topical 0.1–0.25 % acetic acid for superficial disease (experimental) .

**Entomophthoromycosis**: prolonged **itraconazole** ± saturated potassium iodide or cotrimoxazole; surgery rarely needed .

**Monitoring**

Therapeutic drug monitoring for posaconazole/isavuconazole.

Serial imaging & histology to guide further resection.

### **7. Prognosis & Prevention**

Mortality remains high (40–80 %) and correlates with delay to therapy, uncontrolled underlying disease, and disseminated spread .

**Infection-control**: single-use dressings, HEPA filtration, proper linen laundering; avoid wooden devices in NICU .

Hospital Outbreaks: Rising incidence noted since mid-2000s; contaminated **hospital linen** and **wooden tongue-depressors** caused recent outbreaks.

**Risk factors: Alcohol/IV-drug use, natural disasters (floods/tornadoes)** and **near-drowning injuries** crop up in case literature

**Prophylaxis**: posaconazole in selected high-risk haematology/SCT patients (institutional policy driven).

### **8. High-Yield Exam Pearls**

*Rhizopus arrhizus* = commonest agent; think of **DKA patient with black nasal eschar**.

Negative β-D-glucan differentiates mucormycosis from Aspergillus/Candida.

**Reversed halo sign** is characteristic but not pathognomonic.

**Do not homogenise** surgical tissue—culture yield plummets.

Liposomal AmB first; switch to isavuconazole/posaconazole only when clinically improving or nephrotoxicity limits therapy.