



UNIVERSITÀ  
DEGLI STUDI DI BARI  
ALDO MORO

MYCOLOGY

SHORT MASTER



DIPARTIMENTO  
MEDICINA  
VETERINARIA



# LE MUCORMICOSI E LE ENTOMOFTOROMICOSI NEGLI ANIMALI

*Roberta Galuppi,*

*Dipartimento di Scienze Mediche Veterinarie,  
Alma Mater Studiorum - Università di Bologna.*

# Mucormicosi

---

Causate da miceti dell'ordine MUCORALES

Generi

*Rhizopus*

*Mucor*

*Rhizomucor*

*Lichtheimia / Absidia*

*Cunninghamella*

*Apophysomyces*

*Saksenaea*

+

*Mortierella* (ordine MORTIERELLALES)

Solitamente forme acute e rapidamente progressive

Analogamente a quanto accade nell'uomo, granulocitopenia, immunosoppressione, diabete e traumi penetranti sono i principali fattori predisponenti



(prove sperimentali su animali)

In modelli animali:

In conigli diabetici, l'inoculazione sottocutanea di *Rhizopus arrhizus* porta a malattia disseminata e a morte, mentre in conigli metabolicamente normali l'infezione è contenuta nel sito di inoculazione e si osserva guarigione spontanea

Sembrano esserci due meccanismi difensivi:

- soppressione del meccanismo di germinazione delle spore (i macrofagi le distruggono prima per fagocitosi e ossidazione)
  - uccisione degli elementi ifali proliferanti, da parte di fenomeni di ossidazione e citotossicità mediati da neutrofili
- in diabetici i monociti/macrofagi sono disfunzionali e non bloccano la germinazione e le attività dei neutrofili sono alterate, inoltre in topi diabetici si è visto che il siero permette la germinazione delle spore mentre in topi normali è leggermente inibitorio

La somministrazione di corticosteroidi diminuisce o sopprime la normale risposta infiammatoria cellulare e predispone al diabete, aumentando il rischio di sviluppare Mucormicosi

L'uso di antibiotici a largo spettro è associata a un maggiore rischio di sviluppare Mucormicosi presumibilmente per eliminazione della normale flora batterica

In umana rischio associato a dialisi:

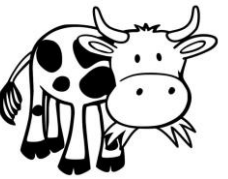
in modelli su porcellini d'india, la somministrazione di deferoxamine (chelanti il ferro) e ferro in soggetti sperimentalmente infetti, diminuisce la sopravvivenza e anche la risposta alla anfotericina B.

Spiegazione: Il ferro è un fattore di crescita, ma non se legato alla transferrina. L'acidosi metabolica (spesso collegata a insufficienza renale) inibisce il legame fra ferro e transferrina, lasciando ferro libero nel plasma, e utilizzabile dal fungo. La somministrazione di chelanti il ferro durante la dialisi non migliora la situazione in quanto questi funghi sono in grado di utilizzare il ferro legato ai chelanti.

Anche le ferite da ustione sono un rischio soprattutto se trattate con sulfamidici per impedire infezione batterica, e possono essere anche associate anche al «burn stress pseudodiabetes,» cioè marcata iperglicemia e glicosuria associata a stress, in questo caso legata all'ustione

Nell'uomo i fattori di rischio associati a mucormicosi gastrointestinali includono inoltre malnutrizione proteica, diarrea, febbre tifoide, ulcere gastrointestinali, colite amebica

Tuttavia negli animali molti fattori predisponenti non sono ancora conosciuti



Nei bovini le mucormicosi, (pur nella loro rarità) sono fra le più frequenti micosi del tratto gastroenterico

Come agenti eziologici sono stati segnalati *Mucor pusillus*, *Rhizopus spp.*, *Absidia spp.* /*Lichtheimia*

L'ingestione di fieno ammuffito è considerato uno dei principali fattori predisponenti, in quanto fonte di spore.

Le localizzazioni a prestomaci e abomaso, possono essere favorite da acidosi ruminale per eccesso di carboidrati o concentrati, sovra alimentazione, o stasi ruminale come stress post partum. Anche somministrazione di antibiotici per la diarrea, mastiti, endometriti e setticemia sono considerate fattori predisponenti

Lesioni iniziali dei prestomaci nello stadio acuto sono rappresentate da degenerazione e desquamazione dell'epitelio, con proliferazione irregolare di ife e infiltrazione di neutrofili; necrosi coagulativa oppure necrosi emorragica con molti trombi, di mucosa, sottomucosa e strato muscolare; proliferazione ifale, di neutrofili e linfociti nella lamina propria e nella sottomucosa estese anche agli strati muscolari. Le ife sono non settate, aberranti e bulbose con diametri variabili da 4 a 10 micron anche nello stesso segmento, sparpagliate o accumulate in foci necrotici. Tendono a invadere i vasi formando trombi e emboli. Ci sono anche lesioni granulomatose, caratterizzate da cellule epitelioidi e giganti, a volte purulente. Anche intestino e lingua possono essere coinvolti (Chihaia et al., J. Comp. Path. 1992 Vol. 107, 195-206)



## Lesioni più frequenti nei prestomaci e abomaso, ma segnalato anche in altri tratti dell'intestino

Slaviero et al., 2020, *Rhizopus microsporus* segmental enteritis in a cow Medical Mycology Case Reports Volume 28, 20-22

Bovino di 10 con diarrea intermittente e perdita di peso, trattato con antibiotici. Progressivo peggioramento fino a morte. All'autopsia inspessimento della parte distale del digiuno e prossimale dell'ileo con petecchie multiple e ecchimosi della sierosa. All'interno del lume massa polipoide di circa 3cm, irregolare gialla-verdastra che ostruiva parzialmente il lume. Nessuna lesione in rumine e altri segmenti intestinali

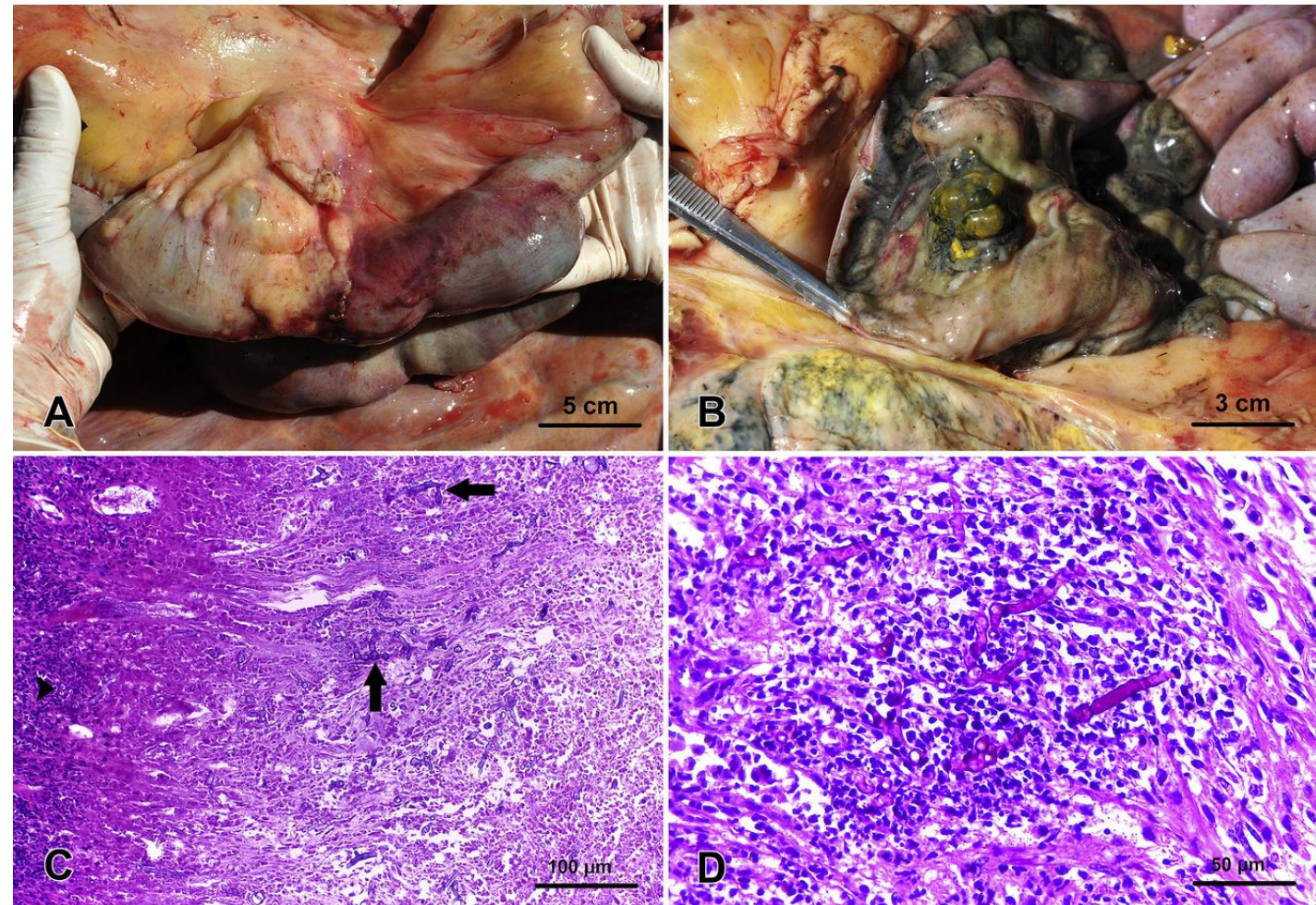
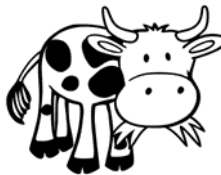
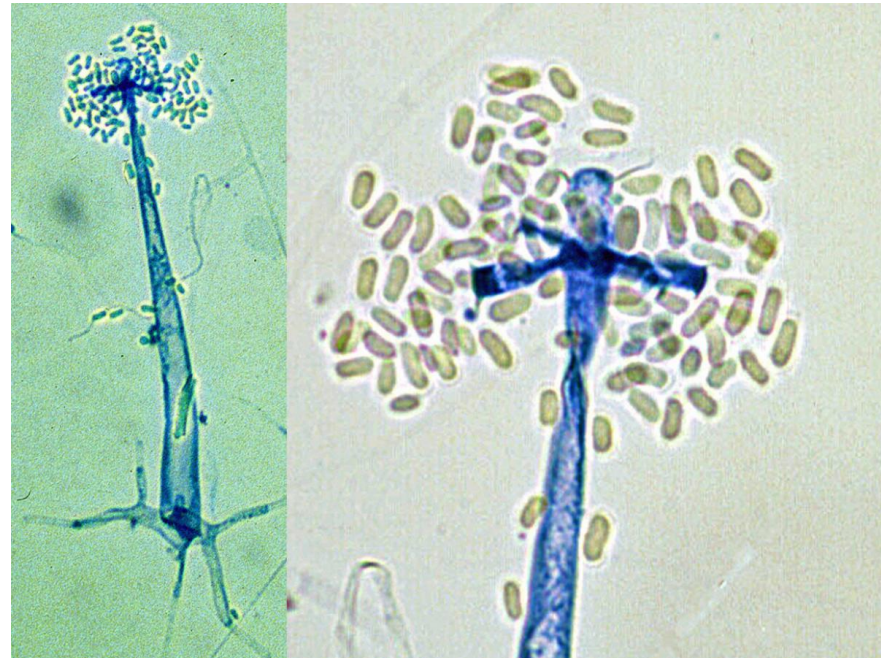


Fig. 1. Gross and microscopic features of *Rhizopus microsporus* segmental enteritis in a cow. (A) Segmental mural thickening at the distal jejunum and proximal ileum with multifocal petechiae and ecchymosis involving the serosa. (B) The small intestine had a partially obstructive polypoid to multinodular, greenish to yellowish mass within the lumen. (C) Small intestine: the polypoid mass within the small intestine was characterized by marked fibrovascular tissue proliferation and a diffusely necrotic surface, which was covered by large amounts of fibrin intermixed by granular basophilic debris and marked inflammatory infiltrate (arrowheads). Within this area and extending into the submucosa there were multiple transverse and longitudinal sections of partially stained amphophilic hyphae (arrows), 200x, HE. (D) Small intestine: multiple broad thick-walled, non-septate, and branched hyphae with focal bulbous dilations were located within blood vessels, which also presented marked fibrinoid degeneration, 400x, Periodic acid-Schiff stain (PAS).

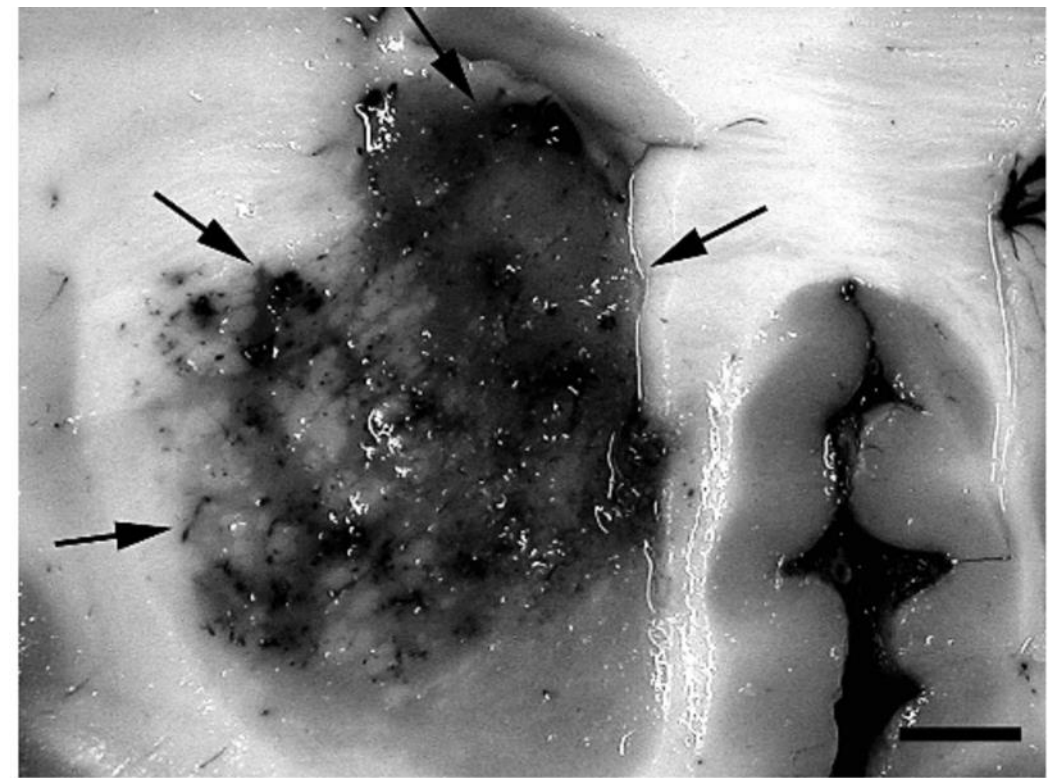
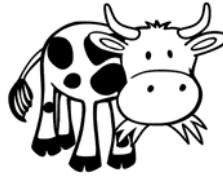
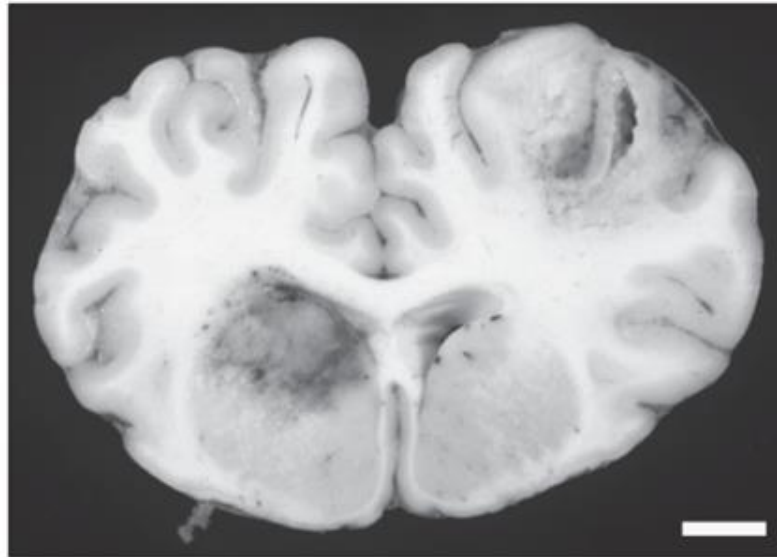
Placentite micotica è descritta in tutto il mondo come causa di aborto nel bovino, e si presenta in maniera sporadica e solitamente l'aborto avviene nel terzo trimestre di gravidanza.

In nord America i generi *Absidia*, *Mucor*, *Rhizomucor*, and *Rhizopus*, sono responsabili del circa 21% di aborto micotico nel bovino.

•Viceversa in Nuova Zelanda *Mortierella wolfii* (ordine Mortierellales) viene largamente segnalato in questi casi, e costituisce l'agente eziologico in circa il 46% dei casi di placentite micotica. Inoltre, mentre in altri casi di aborto micotico non vi sono associate forme cliniche nella bovina, circa il 20% dei bovini con aborto da *M. wolfii* sviluppano una polmonite acuta fatale come conseguenza alla placentite, che viene definita "*mycotic abortion-pneumonia syndrome*". Non è chiaro il motivo per cui le bovine gravide siano particolarmente sensibili, ma probabilmente le proprietà fisico-chimiche dei placentomi possono favorire la germinazione delle spore di questo micete.



Non è chiaro nemmeno perchè solo alcuni dei bovini che sviluppano placentite e endometrite sviluppano poi polmonite. In alcuni casi anche forme sistemiche con coinvolgimento encefalico e sintomi nervosi (Munday et al ., 2006 Nov;18(6):619-22. doi: 10.1177/104063870601800620 ).

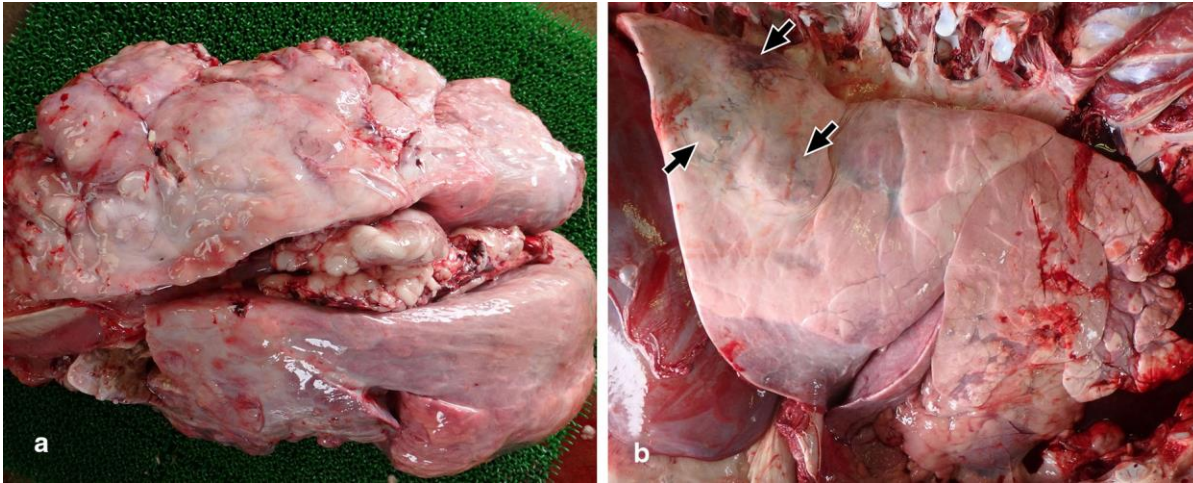


**Figure 1.** *Mortierella wolfii* meningoencephalitis. A focus of hemorrhage and malacia is visible within the cerebrum (arrows). Bar = 3 mm.

Un caso simile dovuto a *M. wolfii*, con coinvolgimento sistemico per possibile disseminazione ematogena dopo l'aborto, è stato descritto comunque anche in Canada (Davies et al 2010 Can. Vet. J. 51(12):1391-1393) in una bovina con letargia, anoressia, atassia e cecità che di recente aveva avuto aborto al 5 mese di gravidanza. Dopo eutanasia osservate lesioni necrotiche, vasculite, trombi contenenti ife che erano presenti anche nelle zone necrotiche riscontrate in cervello, utero polmoni e reni. Le ife erano raramente settate con dilatazioni bulbose e l'agente eziologico è stato isolato e identificato in coltura

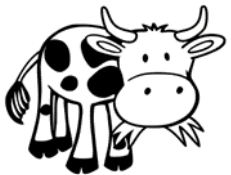
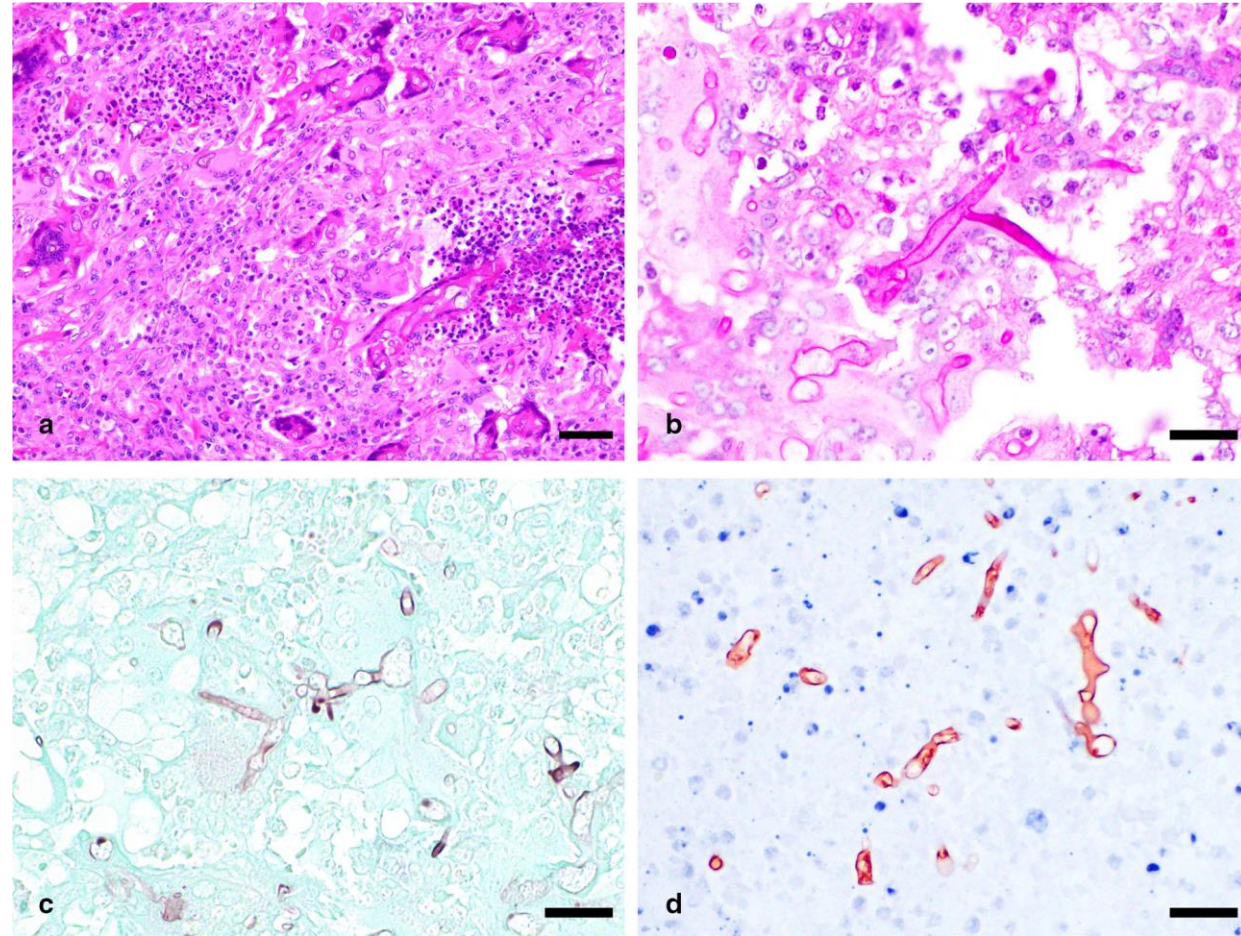


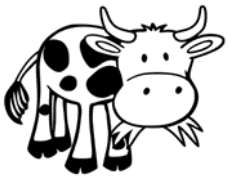
In generale, in riferimento alle mucorales, casi insoliti (o sottodiagnosticati) sono invece le forme broncopolmonari. In alcuni casi il contemporaneo isolamento di *Pasteurella multocida* suggeriva una preesistente infezione che aveva favorito la colonizzazione fungina (Akashi et al., Mycopathologia (2022) 187:317–320)



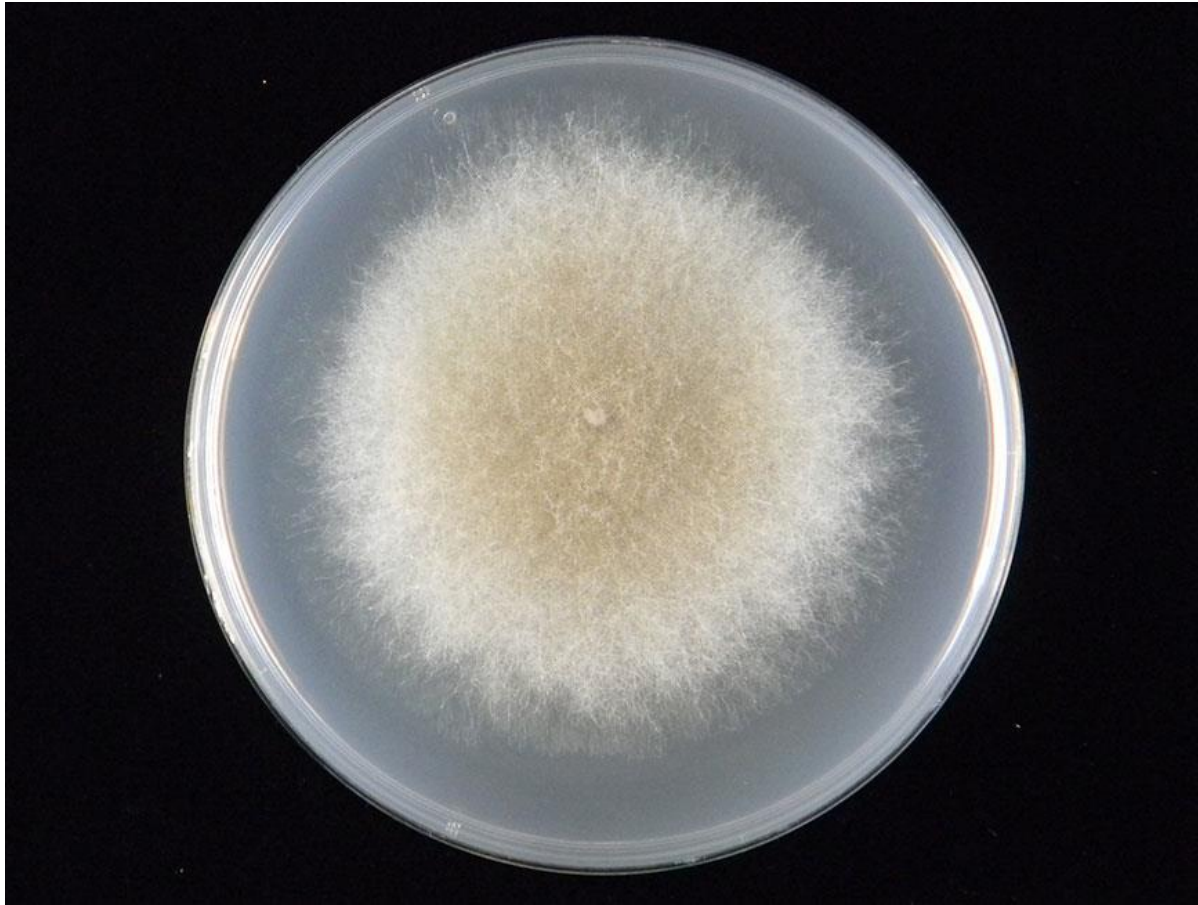
a Densely replaced by multiple, white-colored nodules at the right lung of case 1. b Three distinct nodular lesions (arrows) in the posterior lobe at the right lung of case 2

Fungal granuloma in the right lung of case 2 (H&E, bar = 50 µm). b A poorly septated, 6–13 µm in width, with irregular, non-dichotomous, and acute to right angle branching fungal hypha (PAS, bar = 20 µm). c Dilated or ballooned out hyphae up to 20 µm in diameter (Grocott's methenamine silver, bar = 20 µm). d Positive reaction of anti-Rhizomucor antibody on the hyphae (Immunohistochemistry [AEC], bar = 20 µm)

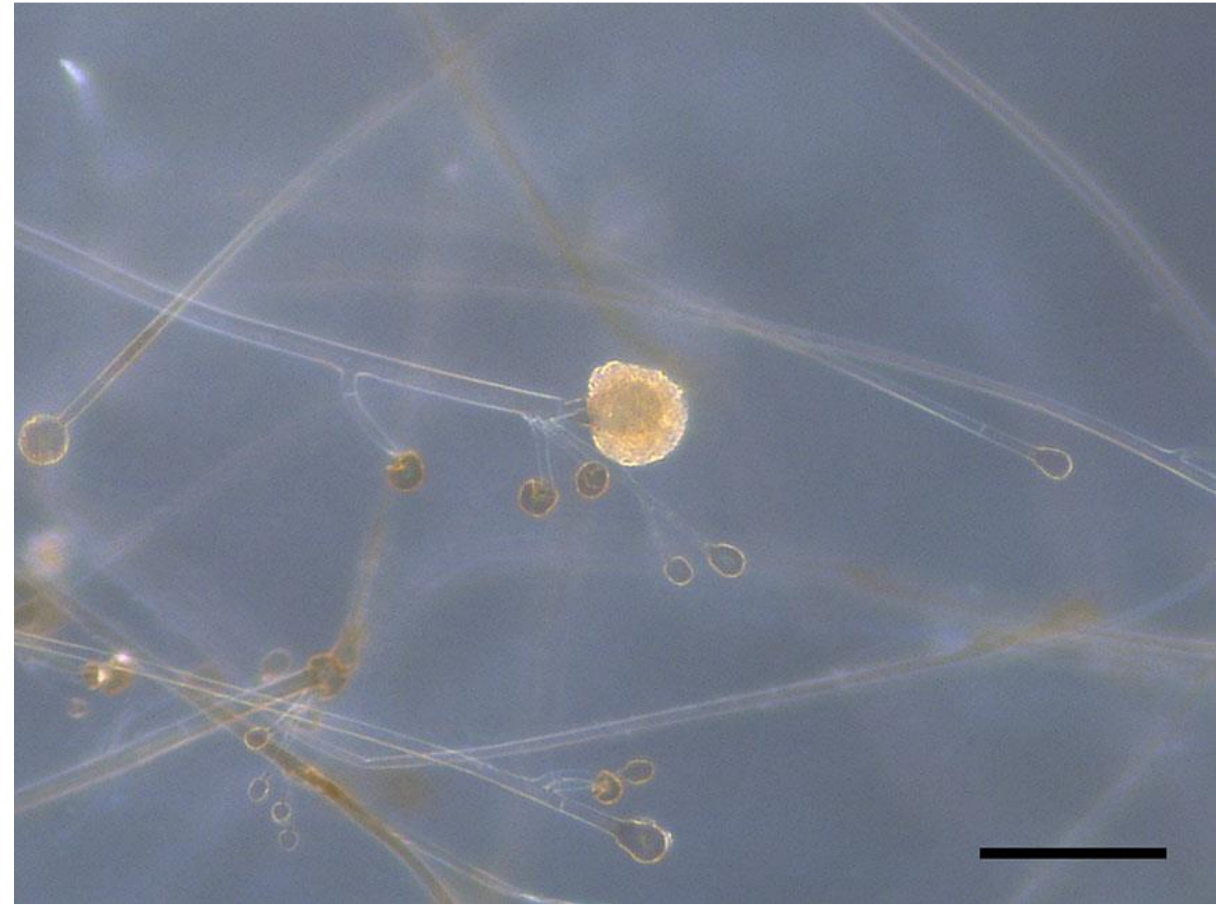




(Akashi et al., Mycopathologia (2022) 187:317–320)



Brown–white fluffy colonies of *Rhizomucor pusillus* isolated from the right lung of case 1 in potato dextrose agar cultured at 37 C for 36 h



Morphological observation under a stereo microscope of *Rhizomucor pusillus* isolated from the right lung of case 1 cultured at 37 C for 36 h, immersed in and fixed with lactic acid



Linfonodo mediastinic

### Mucormycosis in a calf

In a male, Friesian, eleven-month-old calf, two nodular lesions were observed, with a granulomatous appearance in the lung and caudal mediastinal lymph node.

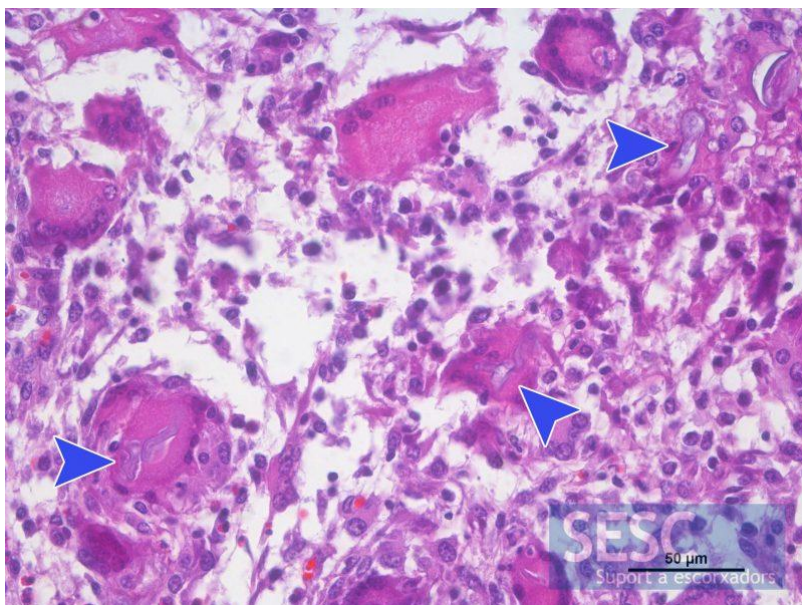
Immediately, inspectors submitted samples to SESC to rule out Tuberculosis because the lesions are compatible with a Tuberculosis primary complex.

Histology confirmed that it was granulomatous lesions but showed the presence of non-septate, irregular fungal hyphae within the lesions, some of them inside multinucleated giant cells. Grocott staining confirmed this finding.

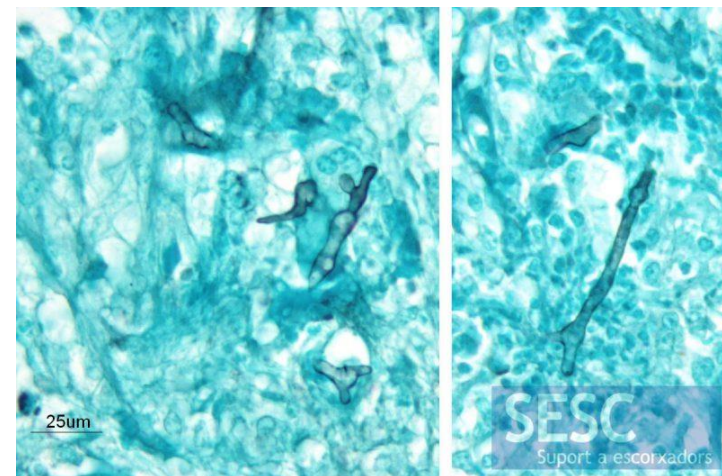
It was not possible to isolate any fungus in microbiological culture, but a subsequent DNA extraction was performed and amplification and sequencing with universal 28S rRNA gene primers. The analysis of the sequence obtained compared with the GenBank database (BLAST) gave a 100% match with *Rhizomucor pusillus* (formerly known as *Mucor pusillus*), a mucoral (a fungus of the Order Mucorales).



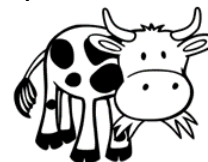
Polmone

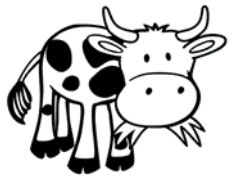


Histopathology shows granulomatous inflammatory infiltrate with structures compatible with fungal hyphae (arrowheads) some of them within multinucleated giant cells.



Grocott's stain confirmed the presence of irregular non-septate hyphae (stained in black).





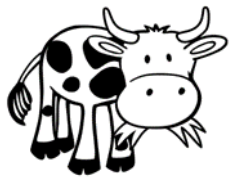
Nel bovino forme diffuse e mortali sono riportate raramente .

Un caso fatale di mucormicosi sistemica è stato descritto in una bovina gravida di 31 mesi di età, causata da *Lichtheimia ramosa* con diffusione dal tratto alimentare. La bovina presentava scolo nasale, anoressia e depressione. Trattata con antibiotici è morta in breve tempo:

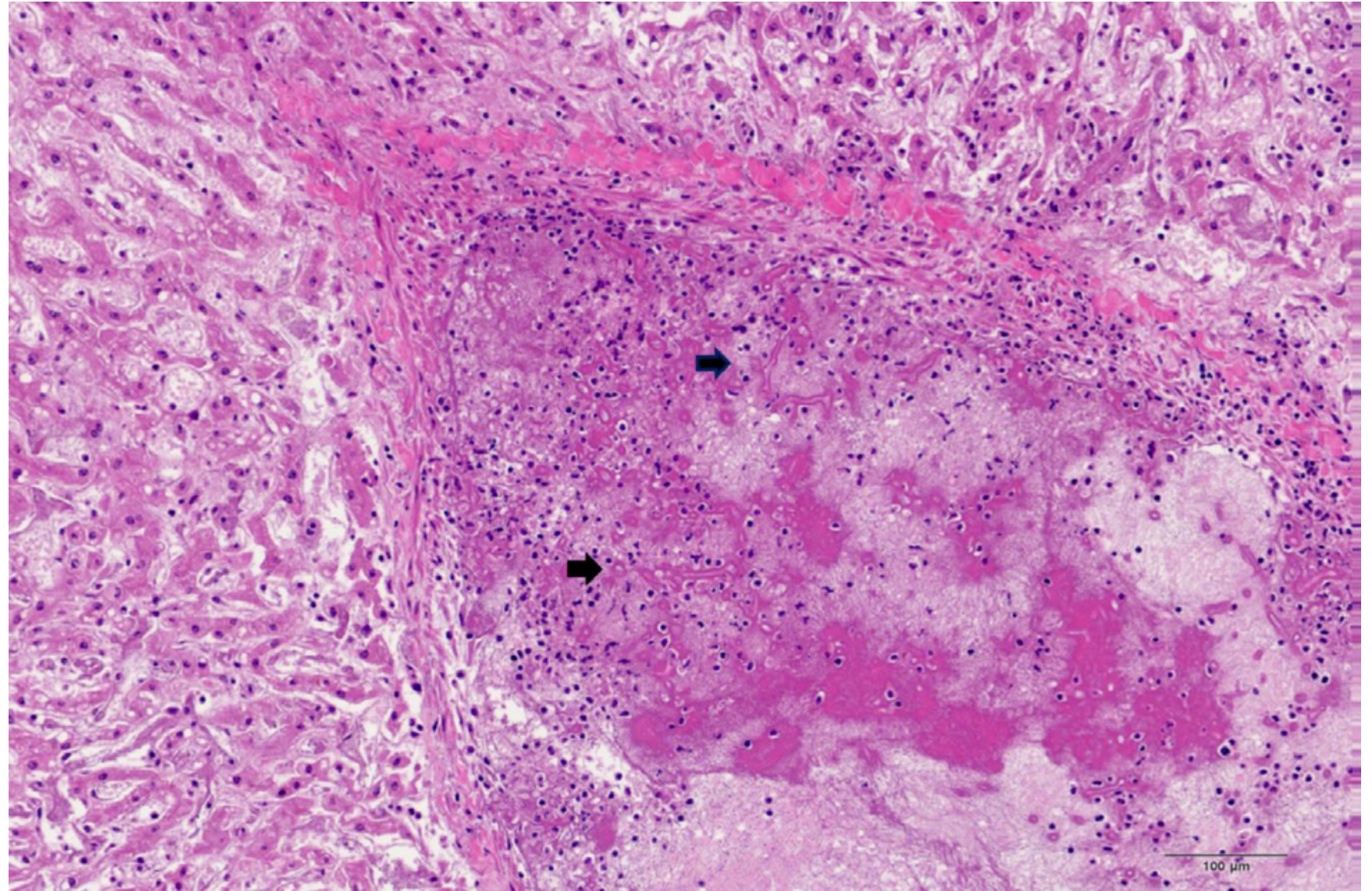
All'autopsia polmoni erano scuri e gonfi, la milza tre volte più grande del normale e sul fegato erano presenti diversi foci emorragici, giallastri, con diametro 0.5–2.0 cm, con il bordo rosso scuro. Lesioni simili erano presenti anche nei prestomaci e in minor misura nell'abomaso.

Ipotizzata diffusione al fegato a partire dai prestomaci

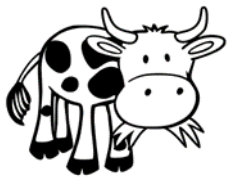




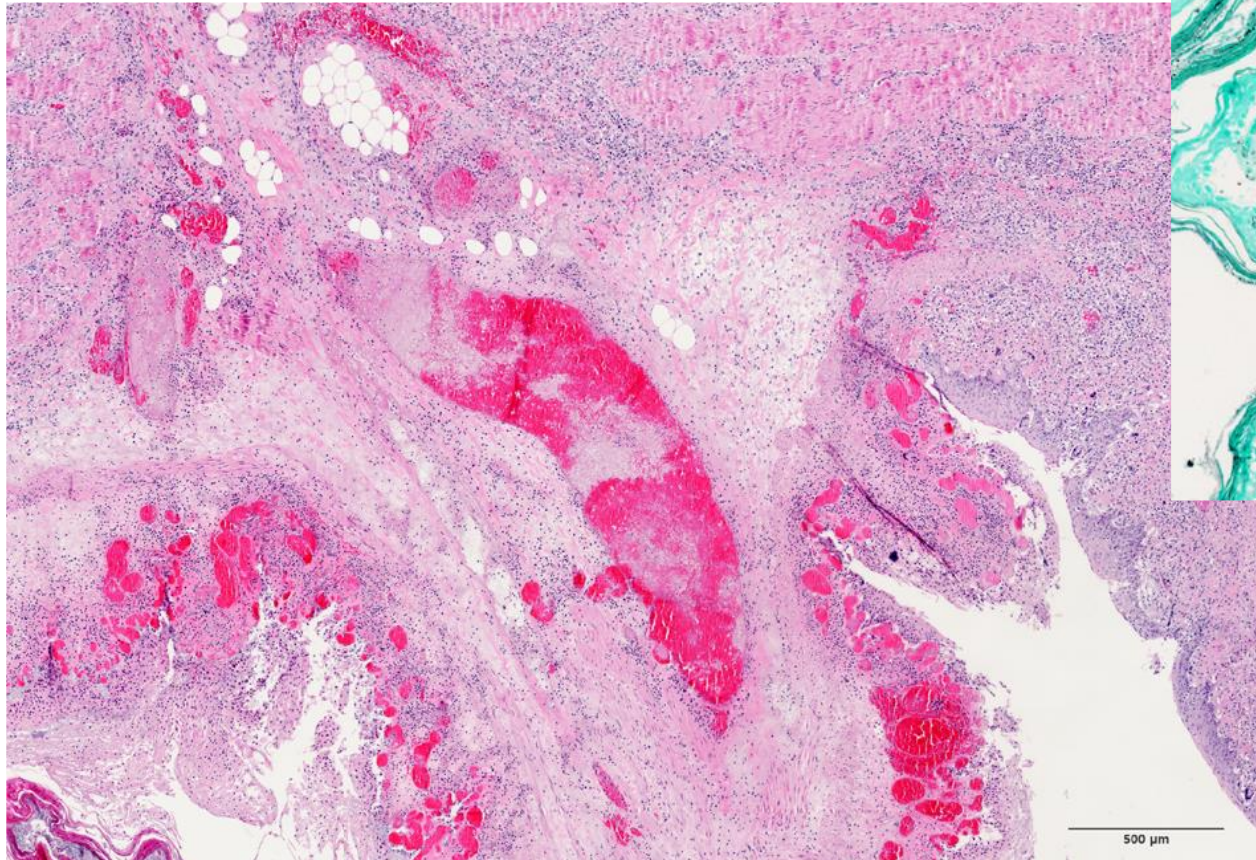
All'esame istopatologico di questi organi, lesioni necrotico infiammatorie con predominante infiltrazione di macrofagi, linfociti e neutrofili. Erano presenti anche lesioni multifocali emorragiche e trombi. Presenza di ife sottili e irregolari, apparentemente vuote che si coloravano bene con Gomori's methenamine



The histopathological appearance of the liver with diffuse haemorrhage, necrosis, severe cellular infiltrates, and thrombi and hyphae (inset) in the blood vessel.



The histopathological appearance of the omasum with diffuse, erosive to ulcerative epithelium, severe cellular infiltrates, and thrombi. H&E stain.



The histopathological appearance of the omasum with numerous fungal hyphae (black).  
Gomori's methenamine silver (GMS) stain



Le mucormicosi nel cavallo sembrano essere molto rare:

Alcuni casi segnalati in letteratura:

Austin, R.J. (1976) Disseminated phycomycosis in a horse. *Can. vet. J.* 250, 84.

Carrasco, et al. (1997) Equine pulmonary mycosis due to *Aspergillus niger* and *Rhizopus stolonifer*. *J. Comp. Path.* 11 7, 191-199.

Muttini, A. (1982) Radiological features in a case of systemic mycosis in the horse. *Acta med. Vet.* 28, 297-304.

Più recentemente segnalate:

Una forma disseminata associata a aspergillosi gastrica e una forma cutanea: nella forma disseminata presenza di letargia, febbre e segni neurologici (circling e convulsioni) nella forma cutanea estese lesioni granulomatose ulcerate e pruriginose (Guillot et al., (2000) Two cases of equine mucormycosis caused by *Absidiacorymbifera* *Equine vet. J.* 32 (5) 453-456).

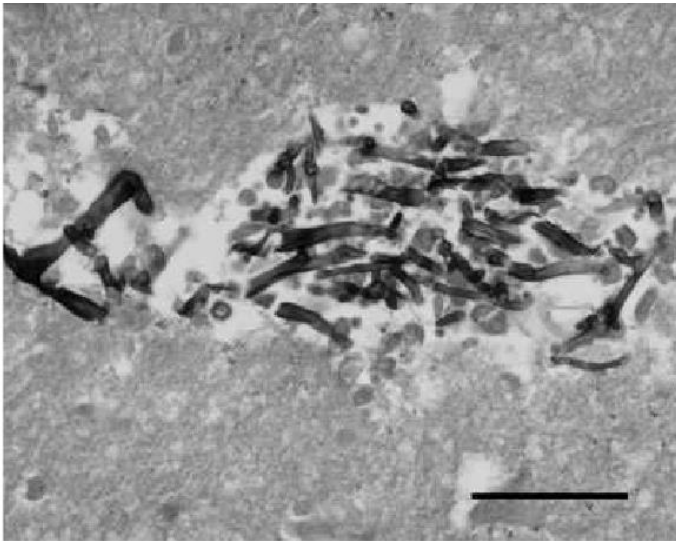


Fig. 2. Brain, caudate nucleus: disruption of the vessel wall and haemorrhage caused by irregular distorted hyphae (suggestive of mucormycosis) (GMS, bar = 50  $\mu$ m).

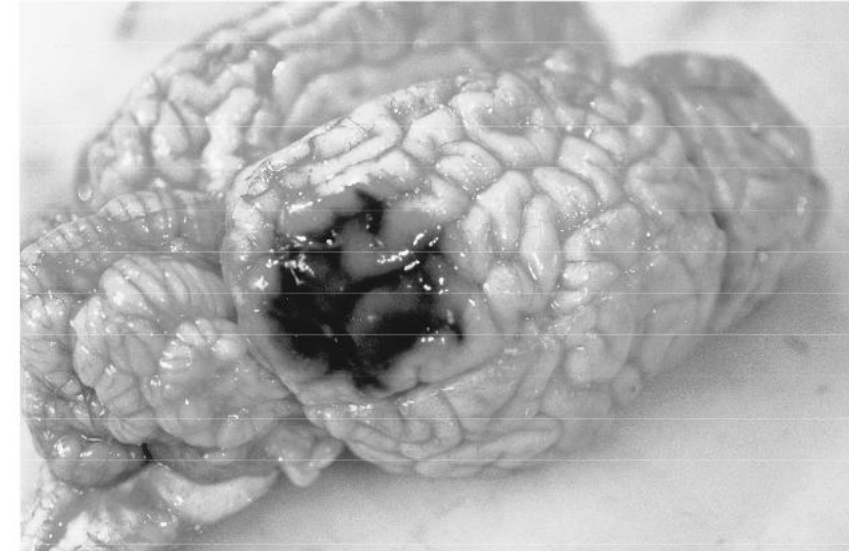


Fig 2: A large infarct (25 mm in diameter) in the right hemisphere of the brain of the pony with systemic mucormycosis.



Una forma polmonare con concomitante presenza di Aspergillosi e mucormicosi associata a disseminazione con febbre, apatia, lacrimazione e dispnea (Thirion-Delalande et al., (2005) Disseminated Acute Concomitant Aspergillosis and Mucormycosis in a Pony *J. Vet. Med. A* 52, 121-124)



J Vítovec, P Vladík, P Fragner  
 [Disseminated mucormycosis--Absidia corymbifera--of lymph nodes in swine]  
 [Article in German] Mykosen. 1976 Apr;19(4):117-23.

#### Case Reports

.S E Sanford, 1985 Gastric zygomycosis (mucormycosis) in 4 suckling pigs  
 J Am Vet Med Assoc Feb 15;186(4):393-4. PMID: 3972702

#### Abstract

Acute gastric zygomycosis (mucormycosis) was diagnosed in four 6- to 7-day-old pigs with large venous infarcts in the gastric fundus. Two pigs were from one farm where several dams had developed fever at parturition and most of their litters had died. The other 2 pigs, from separate farms, had diarrhea that was unresponsive to broad-spectrum antibiotic therapy. Histologically there was severe hemorrhagic, ulcerative gastritis associated with numerous transmurally invading, mucoraceous fungi. The discussion includes speculation on the pathogenesis of this lesion in neonatal pigs.

#### Case Reports

S E Sanford, G K Josephson, E H Waters,1985. Submandibular and disseminated zygomycosis (mucormycosis) in feeder pigs J Am Vet Med Assoc. Jan 15;186(2):171-4. PMID: 3972676

#### Abstract

Submandibular and/or disseminated zygomycosis (mucormycosis) was diagnosed in 3 feeder pigs from 2 farrow-to-finish farms. Affected pigs were stunted and unthrifty. Each pig had a large unilateral submandibular granuloma replacing the mandibular lymph node on the affected side. Two pigs had disseminated lesions. One had an abscess on the serosa of the stomach; another had abscesses scattered throughout the liver and mesenteric lymph nodes. Impression smears were made of several masses and stained with blue-black ink. Examination of smears by light microscopy revealed coarse, infrequently septate, irregularly branching, mucoraceous fungi typical of a Zygomycete. Histologic examination of the submandibular masses revealed granulomas containing large numbers of mixed inflammatory cells, including giant cells. Mesenteric lymph nodes and liver abscesses had necrotic cores surrounded by fibrous capsules infiltrated by mixed inflammatory cells. Hyphae of a mucoraceous fungus were scattered throughout all masses. The 2 pigs submitted alive had marked serum hypoproteinemia, including hypoglobulinemia.

W M Reed 1 , C Hanika, N A Mehdi, C Shackelford. 1987 Gastrointestinal zygomycosis in suckling pigs  
 J Am Vet Med Assoc Sep 1;191(5):549-50.

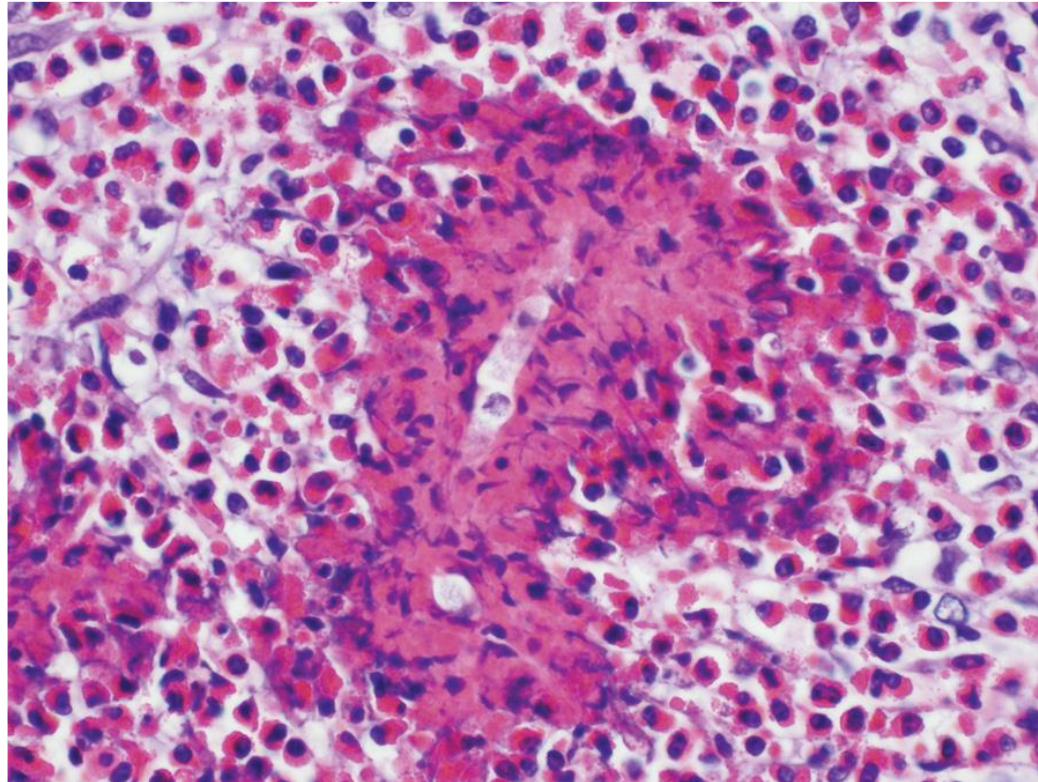
#### Abstract

Gastrointestinal zygomycosis was diagnosed in 3 suckling pigs (10, 14, and 28 days old) with diarrhea that was unresponsive to treatment with broad-spectrum antibiotics. The 3 pigs were from separate farms, and littermates of the 3 pigs with similar clinical signs had died. At necropsy, 2 of the 3 pigs had catarrhal to fibrinonecrotic gastroenteritis, and the third pig had hemorrhagic gastritis without intestinal lesions. Microscopically, transmural necrosis of the stomach and intestines was associated with marked inflammatory cell infiltration and thrombosis and vasculitis of vessels of the lamina propria and submucosa. Numerous broad, irregularly branching, nonseptate, mucoraceous fungi were seen in the lumens of blood vessels and in the necrotic mucosa and submucosa.





Abstract. Two Vietnamese potbellied pigs (*Sus scrofa*) had respiratory disease and, on autopsy, both pigs had large masses in the lungs and thoracic cavity. Microscopically, pulmonary and pleural masses contained large areas with hyphae surrounded by hypereosinophilic cellular debris rimmed by abundant eosinophils, lymphocytes, plasma cells, and histiocytes with occasional multinucleate giant cells. The hypereosinophilic debris usually formed tight cuffs, or “sleeves” around the hyphae, compatible with Splendore-Hoeppli–like material. The fungal organisms were determined by PCR to be *Conidiobolus incongruus* in one pig and *Mucor circinelloides* in the other. Entomophthoromycosis and mucormycosis should be included in the differential diagnoses for swine pneumonia, particularly when there is evidence of granulomatous pulmonary masses and pleural effusion with eosinophilic inflammation.



Microscopic evaluation of the granulomatous mass has numerous *Mucor circinelloides* hyphae surrounded by Splendore-Hoeppli–like reaction.



A large granulomatous mass in the lung is attached to the ribs of a 20-mo-old Vietnamese potbellied pig, case 2.



Infezione da funghi dell'ordine Mucorales è considerata rara anche nel cane

Casi sporadici descrivono **forme:**

**Cutanee o sottocutanee** (Awadin et al., 2015; A case of subcutaneous destructive facial swelling in a dog caused by *Mucor* species Journal of Veterinary Science and Medical Diagnosis, 4 (2015), pp. 1-3; Reynaldi et al., 2017 Mucormycosis due to *Saksenaea vasiformis* in a dog; Medical Mycology Case Reports, 16 (2017), pp. 4-7)

**Nasali** (Shirani et al., 2008; An unusual case of nasal mucormycosis caused by *Rhizopus oryzae* in a German shepherd dog (scientific report) Journal of Veterinary Research, 9 (2008), pp. 378-380

**Polmonari e gastrointestinali** (Galiza et al., 2014 Ocorrência de micoses e pitiose em animais domésticos: 230 casos Pesquisa Veterinária Brasileira, 34 (2014), pp. 224-232)

**Cerebrali** (Frade et al., 2018 Central nervous system disorders diagnosed in dogs Pesquisa Veterinária Brasileira, 38 (2018), pp. 935-948)



## UN CASO DI MUCORMICOSI CANINA

S. Corradini<sup>1</sup>, M. Giunti<sup>1</sup>, O. Capitani<sup>1</sup>, M. Morini<sup>1</sup>, E. Dannaoui<sup>2</sup>, J. Guillot<sup>2</sup>, M.P. Tampieri<sup>1</sup>; R. Galuppi<sup>1</sup>  
<sup>1</sup>Dipartimento di Scienze Mediche Veterinarie - Alma Mater Studiorum- Università di Bologna ; <sup>2</sup>Dynamyc research group, Ecole nationale vétérinaire d'Alfort, Université Paris Est Créteil, France

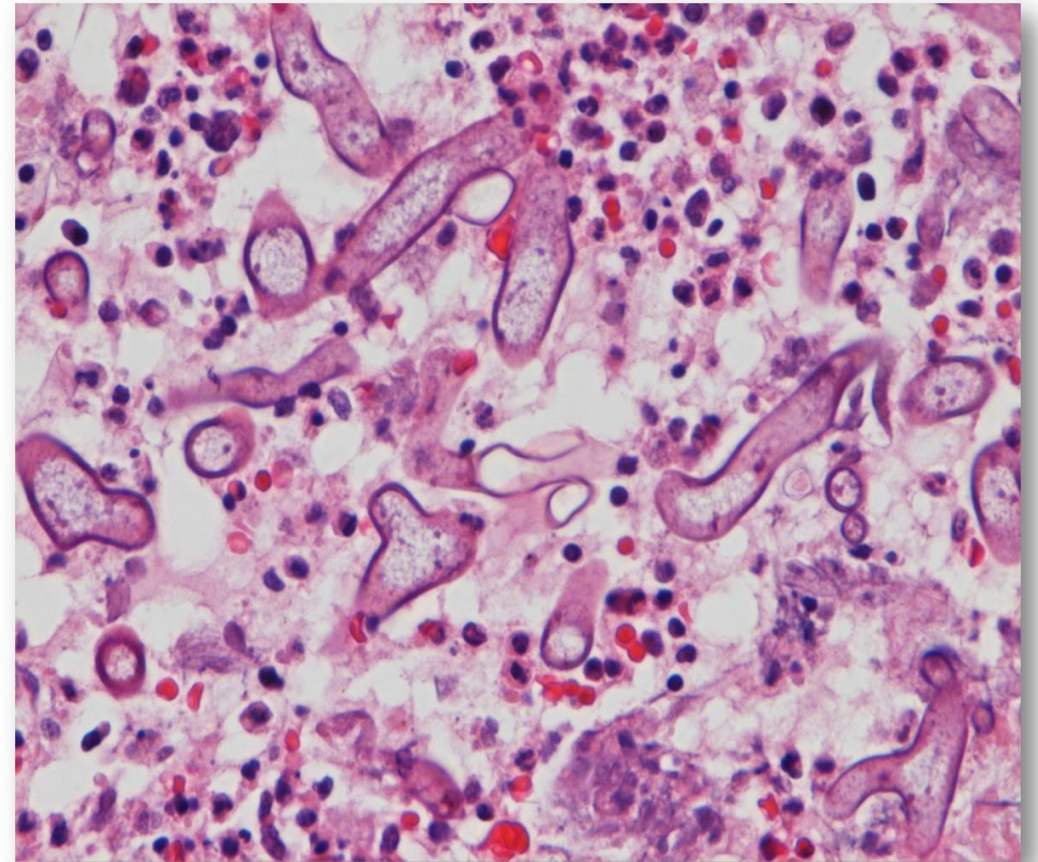
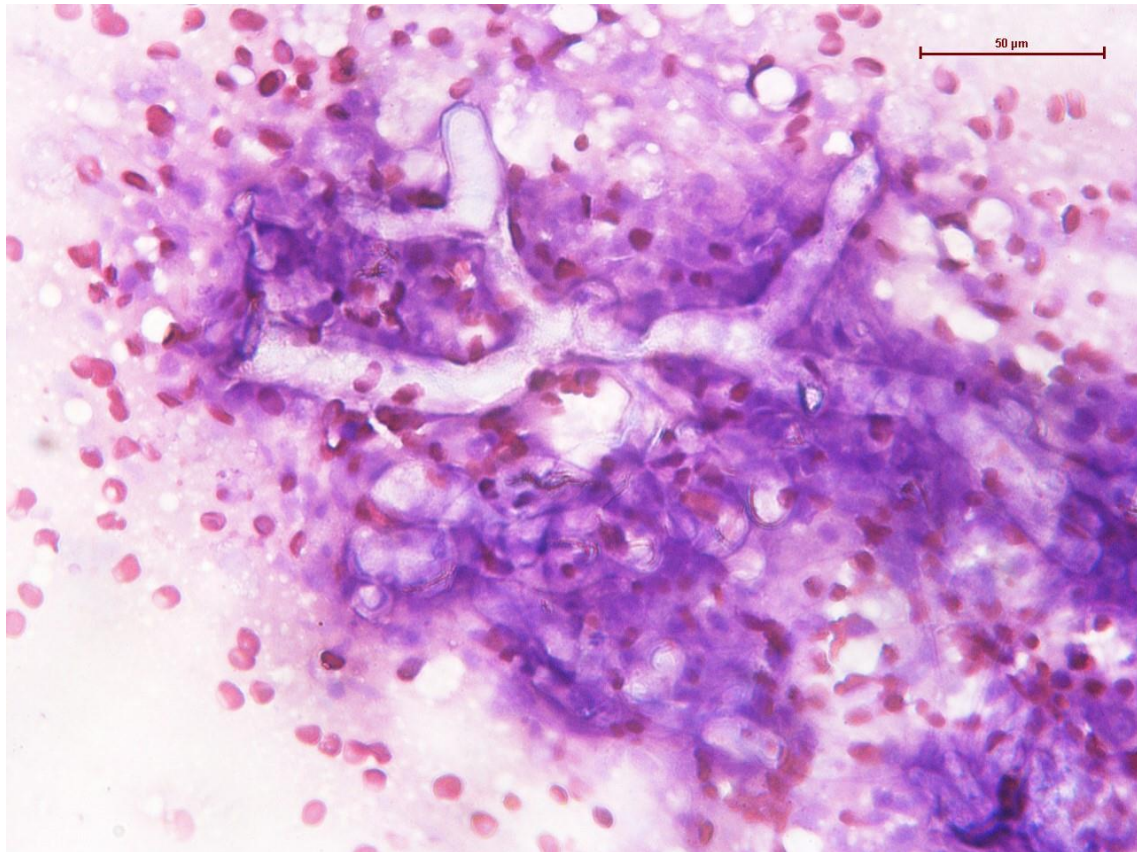


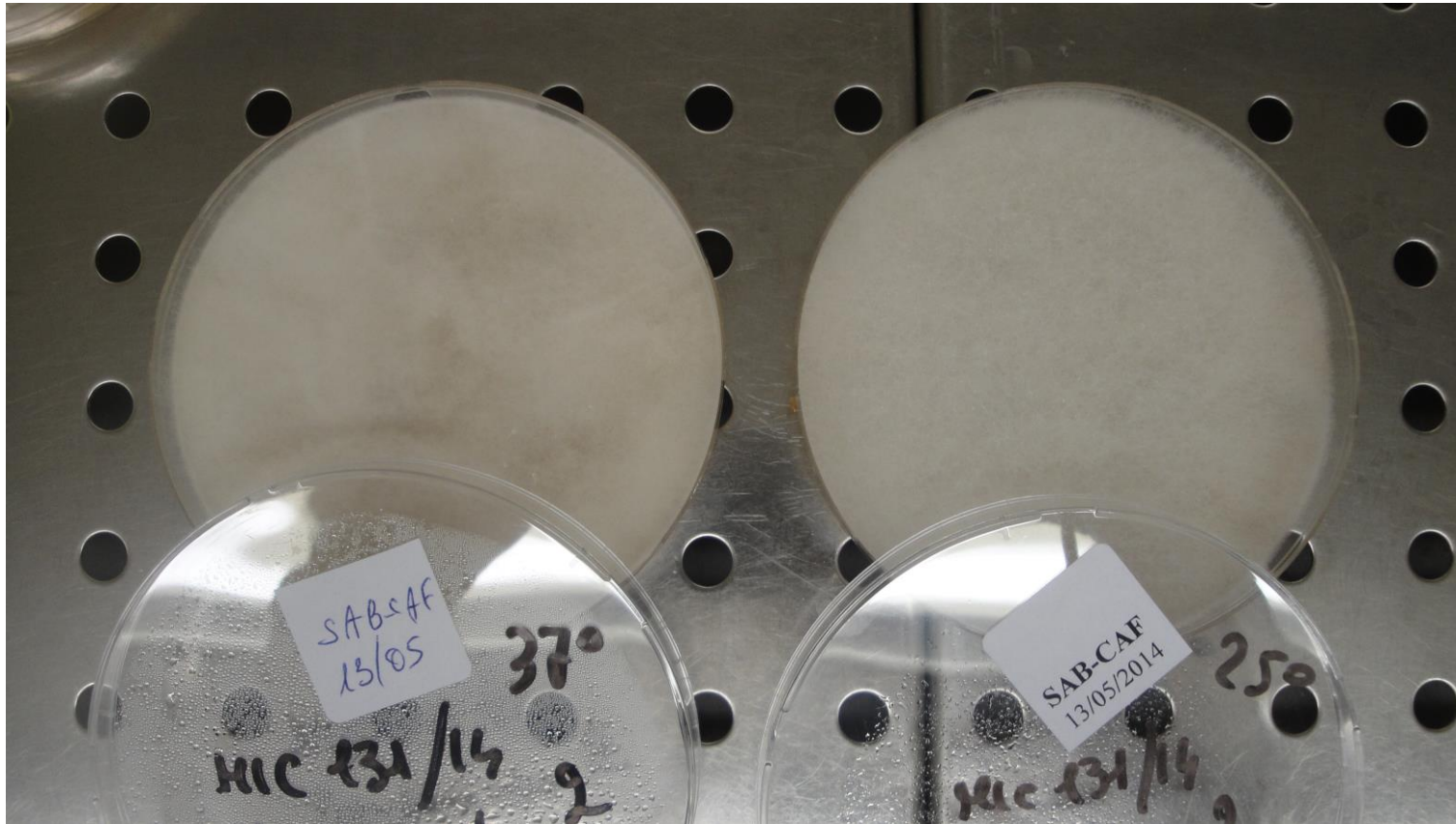
cane maschio meticcio di 9 anni affetto da ipercortisolismo e diabete mellito

Esami emato-biochimici: alterazioni compatibili con ipercortisolismo e diabete mellito non controllati.

Esame batteriologico: *Staphylococcus pseudintermedius*, *E.coli* e *Acinetobacter baumannii/calcoaceticus* sensibili unicamente ad amikacina ed imipenem.

Esame citologico: infiammazione cronica piogranulomatosa e presenza di ife non settate. Il dato è stato confermato da un esame istologico su biopsie cutanee della lesione periorbitale.





L'esame colturale ha condotto all'isolamento di un micete a rapida crescita riconducibile a Mucorales.



L'analisi molecolare ha permesso di identificare l'isolato come *Rhizopus oryzae*.



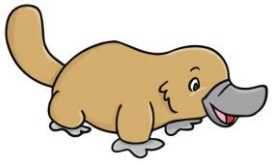
TABLE 1: Cases of opportunistic systemic mycosis reported in cats

Cat	Age (years or months)	Sex	Pan-leucopenia	Antimicrobial and, or, corticosteroid therapy	Duration of clinical signs (days)	Location of mycelia	Fungus involved	Reference
1	3	...	...	...	14	Lung	<i>Aspergillus</i> species	Sautter and others (1955)
2	1½	...	+	...	...	Jejunum	<i>Candida albicans</i> *	Schiefer (1965)
3	1½	M	+	+	...	Jejunum, colon	<i>Aspergillus</i> species	"
4	6	M	+	+	...	Intestine	Mucorales	"
5	2	M	+	+	...	Colon	Mucorales	"
6	9 months	...	...	+	14	Colon	Mucorales	König and others (1967)
7	9 months	...	...	+	15	Ileum	Mucorales	"
8	1½	M	+	+	5	Ileum	Mucorales	"
9	Adult	F	...	+	3	Lung	<i>Aspergillus</i> species	Pakes and others (1967)
10	1	M	+	+	Weeks	Jejunum	<i>Aspergillus</i> species	Weiland (1970)
11	4	M	+	...	...	Intestine	<i>Candida</i> species	Langheinrich and Nielsen (1971)
12	7 months	M	+	+	12	Colon	<i>Aspergillus</i> species	Bolton and Brown (1972)
13	2	...	+	+	6	Lung	<i>Aspergillus</i> species	McCausland (1972)
14	4 months	M	+	+	6	Ileum	<i>Candida</i> species	"
15	4 months	M	+	+	7	Duodenum	<i>Aspergillus</i> species	Stokes (1973)
16	Juvenile	F	+	+	10	Lung, colon	<i>Aspergillus fumigatus</i> *	Vogler and Wagner (1975)
17	Adult	F	+	+	12	Lung, jejunum	<i>Aspergillus</i> species	Fox and others (1978)
18	Adult	F	+	+	5	Lung	<i>Aspergillus</i> species	"
19	Adult	M	+	+	12	Colon	Mucorales	"
20	...	...	...	...	...	Lung	Mucorales and <i>Aspergillus</i> species	Köhler and others (1978)
21	...	...	...	...	...	Generalised	Mucorales and <i>Aspergillus</i> species	"
22	7 months	F	...	...	10	Intestine	Mucorales	Adar (1979)
23	9 months	F	...	...	4 months	Generalised	Mucorales	"
24	6½	F	...	...	2 months	Lung, sinuses, orbits	<i>Penicillium</i> species	Pfeiffer and others (1980)
25	Adult	M	...	+	40	Urinary bladder	<i>Aspergillus fumigatus</i> *	Kirkpatrick (1982)
26	2½	F	...	+	10	Lung	Mucorales	Loupal (1982)
27	4	M	...	Topical	2½ months	Orbits, sinuses	<i>Aspergillus</i> species	Wilkinson and others (1982)
28	4	...	+	...	5	Intestine	<i>Candida albicans</i>	Van Kruiningen and others (1983)
29	2	F	+	+	14	Intestine	<i>Candida albicans</i>	"

Ossant (1987): Systemic aspergillosis and mucormycosis in 23 cats  
Veterinary record, 120: 330-333

(osservati in 30 anni)

\* Confirmed by mycology



## Ornitorinco

Nick Gust and Joshua Griffiths 2009, *Platypus mucormycosis and its conservation implications* Australasian Mycologist (2009) 28, 1–8

### Abstract

Since 1982 some Tasmanian platypuses have been affected by a fungal disease called mucormycosis. This disease causes skin lesions, morbidity and mortality in these iconic Australian animals. Here we review the contemporary understanding of the epidemiology of mucormycosis and its potential impacts on the conservation status of platypuses.

*Mucor amphibiorum*, the fungal pathogen responsible for mucormycosis, may have been transported to Tasmania with infected frogs from mainland Australia. Although there are no confirmed cases of mucormycosis from platypuses in mainland Australia, mucormycosis appears to have spread widely in Tasmania since 1982. In the 25 years to 2007, ulcerated platypuses were captured across 11 river catchments that cover 24% of the land area of Tasmania. The potential disease spread is much larger, with unconfirmed public observations over the same period reporting ulcerated platypuses in 11 additional catchments spanning another 31% of the state. Though a number of mechanisms are suggested, it is currently unclear what the route of individual infection is, or how mucormycosis is spread within or between catchments in Tasmania. There is currently insufficient fundamental information on the distribution and impacts of the disease to rigorously assess the threat. For instance, it is unclear whether mucormycosis has persisted in platypus populations that were historically affected, whether the proportion of infected animals has changed within these areas, or whether platypuses still persist and reproduce successfully in formerly infected areas. Difficulties in reliably quantifying platypus abundance compromise researchers' ability to determine impacts on populations.

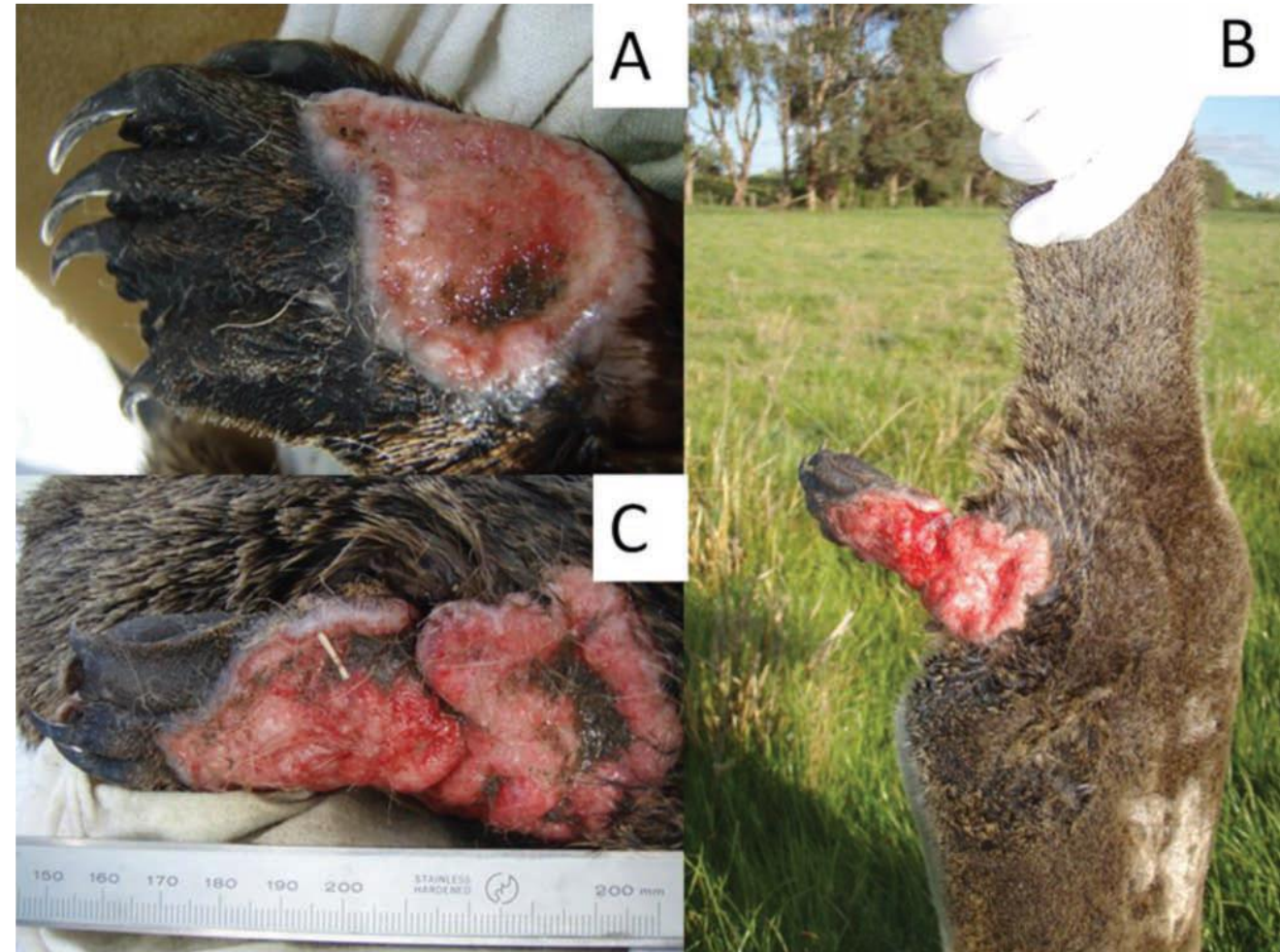
Vie di ingresso ?

Lesioni cutanee

Inalazione

Ectoparassiti

ingestione

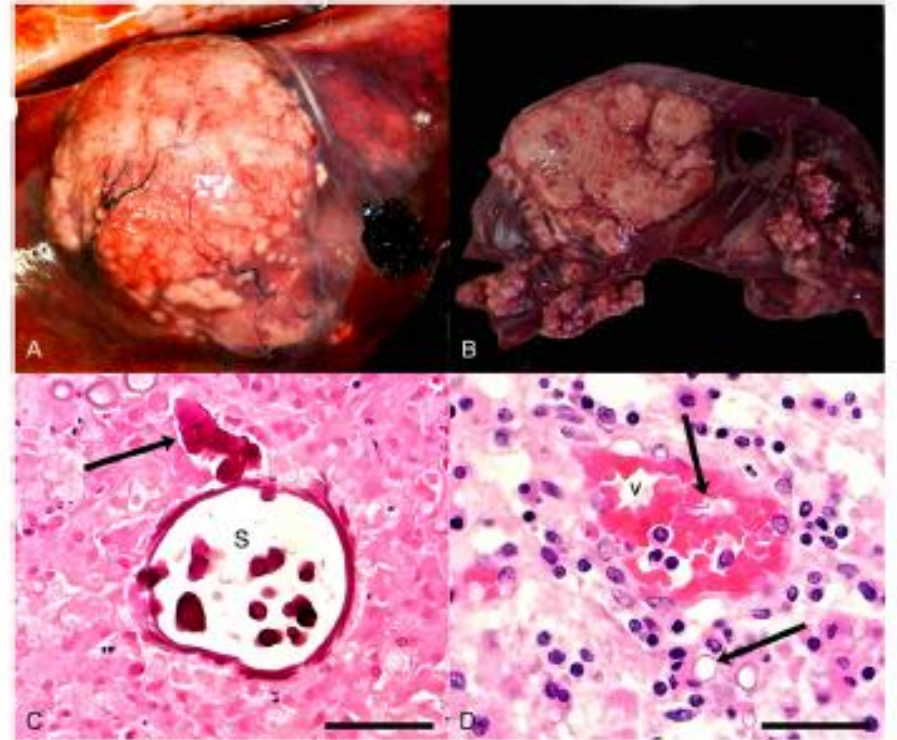




Huggins et al., 2020 The Emergence of Mucormycosis in Free-Ranging Marine Mammals of the Pacific Northwest Front. Mar. Sci. 7:555.  
doi: 10.3389/fmars.2020.00555

Primary fungal diseases in marine mammals are rare. Mucormycosis, a disease caused by fungi of the order Mucorales, has been documented in few cetaceans and pinnipeds. In 2012, the first case of mucormycosis in the Pacific Northwest was documented in a dead stranded harbor porpoise (*Phocoena phocoena*) in Washington state. Since then, mucormycosis has been detected in a total of 21 marine mammals; fifteen harbor porpoises, five harbor seals (*Phoca vitulina*), and one southern resident killer whale (*Orcinus orca*). Infected animals were predominately found in the inland waters of Washington and British Columbia, and one harbor seal was recovered in northern Oregon. Fungal hyphae were detected histologically in a variety of tissues, including brain, lung, spleen, pancreas, kidneys, muscle, lymph nodes, and skin. Three fungal species were identified from seven cases by PCR screening or fungal culture; *Rhizomucor pusillus* (four cases), *Lichtheimia corymbifera* (two cases), and *Cunninghamella bertholletiae*. Underlying conditions such as emaciation, current or recent pregnancy, multisystemic parasitism, protozoal infection, and herpesvirus were found in several affected animals. Reasons for the appearance and subsequent increase of these fungal infections in marine mammals are unknown. The emergence of this disease as a source of marine mammal mortality in the Pacific Northwest is of particular concern for endangered southern resident killer whales that spend time in this region. Current population-level stressors such as insufficient prey, high levels of contaminants, and noise pollution, could predispose them to these fatal infections.

Focene, foche e orche

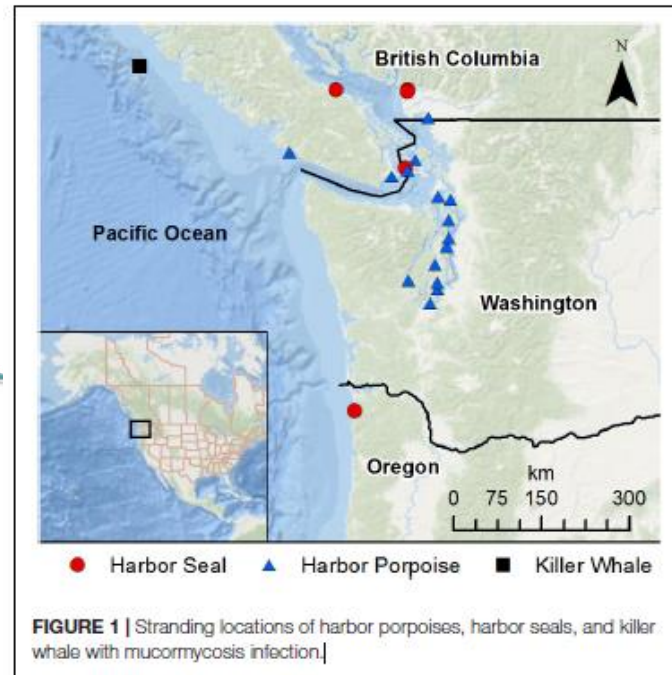


**FIGURE 2 | (A)** Harbor porpoise, pulmonary abscess. Note large bulging white nodular mass in lung. **(B)** Harbor seal, Pulmonary abscesses. Note variably sized irregular nodular white masses. **(C)** Harbor porpoise, lung. Note undulating, broad, septate intensely eosinophilic fungal element (arrow), terminating in a large spherical sporangium (s). Pulmonary tissue around the fungi is necrotic. HE, bar = 75  $\mu$ . **(D)** Harbor porpoise, brain. Note small blood vessel (v) with luminal and perivascular fungal elements (arrows). The neuropil around the vessel is infiltrated by low numbers of plasma cells, lymphocytes and histiocytes. HE, bar = 75  $\mu$ .

E anche delfini...



Chang et al., Systemic mucormycosis caused by *Rhizopus microsporus* in a captive bottlenose dolphin  
Vet Med Sci. 2021 Nov; 7(6): 2404–2409



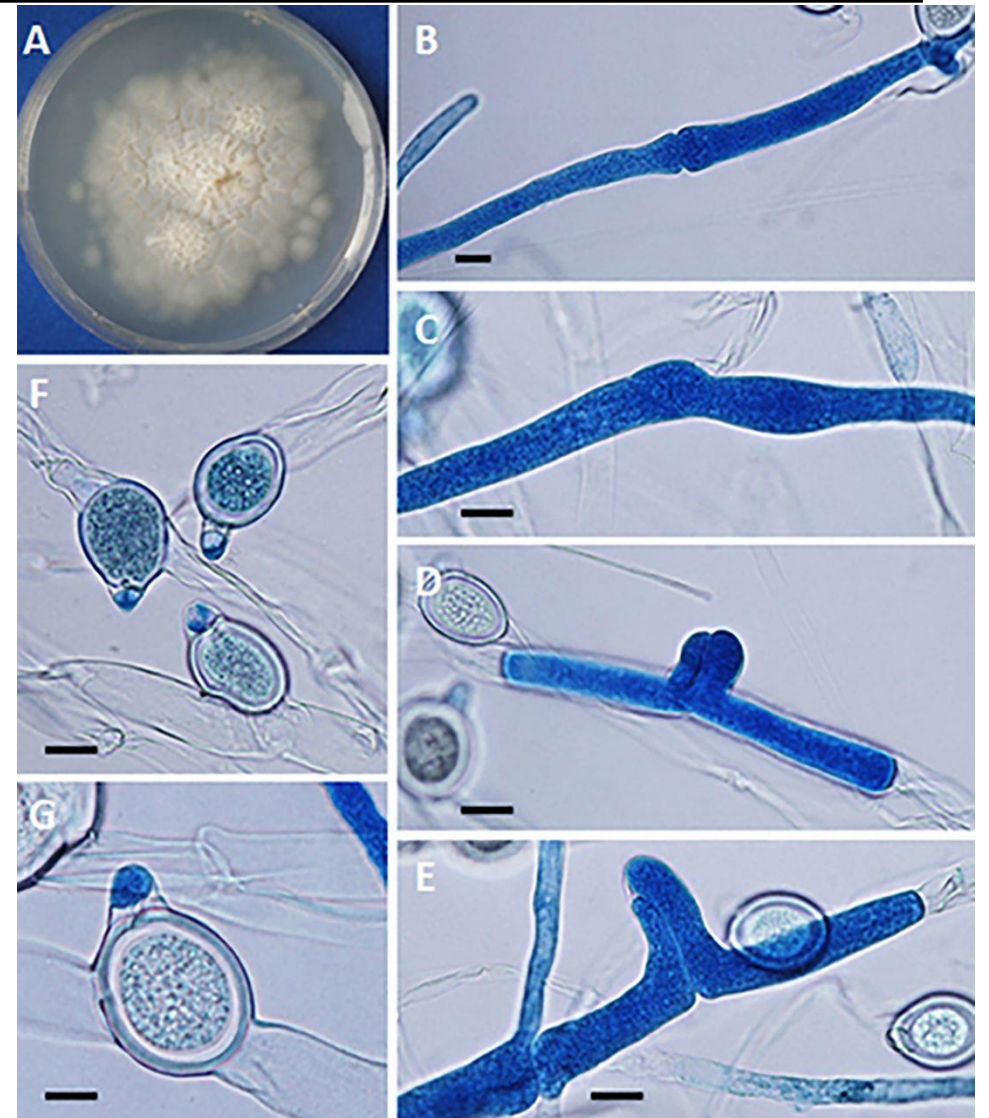
# Entomoftoromicosi

Causate da miceti del subphylum Entomophthoromycotina

Di interesse in ambito veterinario:

1) *Basidiobolus ranarum* (differenziazione di specie confusa)

(A) Creamy rugose colony of *Basidiobolus ranarum* on 2% Sabouraud dextrose agar. (B to E) Encounter of opposite-sex hyphae before the formation of lateral beaks. Bars, 12  $\mu\text{m}$  (B to D) and 10  $\mu\text{m}$  (E). (F and G) After the exchange of genetic material, zygospores develop with their characteristic beak. Bars, 25  $\mu\text{m}$  (F) and 15  $\mu\text{m}$  (G).



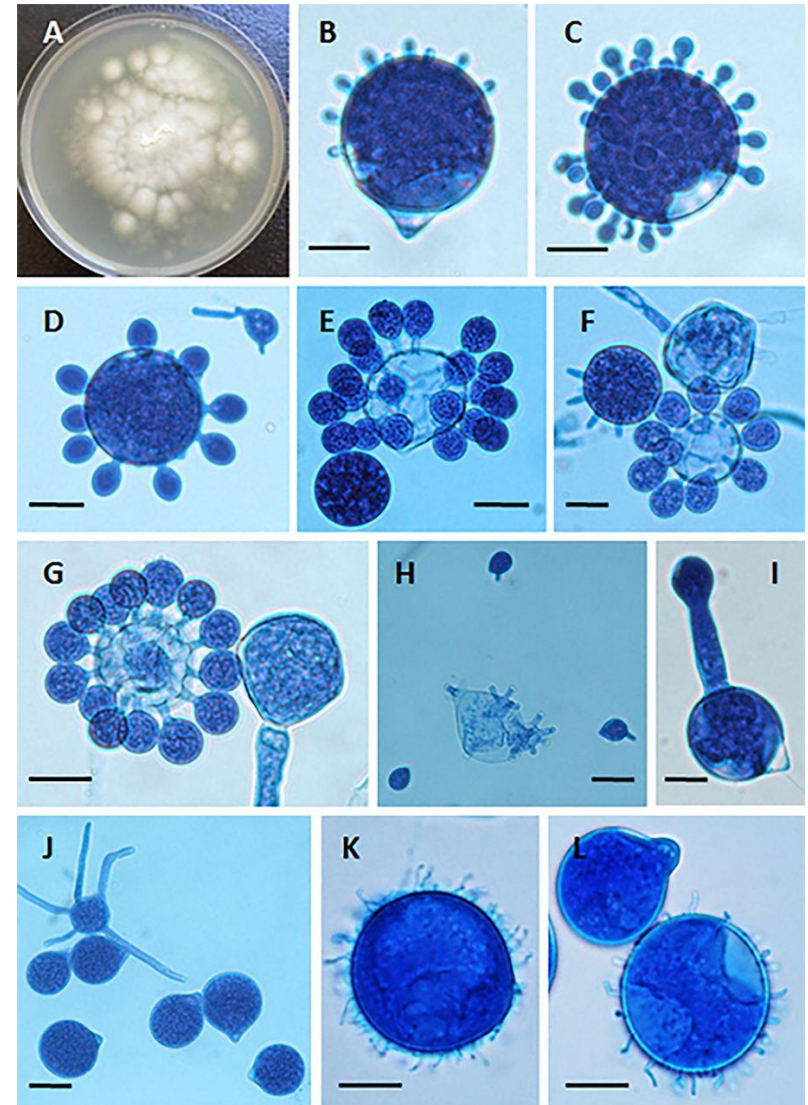
# Entomoftoromicosi

Causate da miceti del subphylum Entomophthoromycotina

Di interesse in ambito veterinario:

2) *Conidiobolus* spp. (*C. coronatus*, *C. lamprauges*, *C. incongruus*)

(A) Yellow-white colony of *Conidiobolus coronatus* on 2% Sabouraud dextrose agar (SDA) from a primary culture after 48 h. The presence of a few aerial hyphae and satellite colonies due to the ejection of conidia from sporangiophores, detected on the lid of the SDA plate (data not shown), is also observed. (B to G) Formation of secondary conidia from a primary multinucleate conidium of *C. coronatus* in lactophenol blue. Bars, 20  $\mu\text{m}$  (B, D, and G), 22  $\mu\text{m}$  (C and E), and 21  $\mu\text{m}$  (F). Note the different steps of development into fully formed corona secondary conidia in panels F and G. (H) Ejected secondary conidia and also several empty sporangiophores and three small ejected secondary conidia, some of which are developing germ tubes. Bar, 22  $\mu\text{m}$ . (I and J) Single conidiophore with a secondary sporangiophore and conidium (I) and several primary *C. coronatus* conidia, one with several coenocytic hyphae (J). Bars, 20.0  $\mu\text{m}$  (I) and 22  $\mu\text{m}$  (J). (K and L) Presence of *C. coronatus* villose conidia in water agar cultures. Bars, 18  $\mu\text{m}$  (K) and 19  $\mu\text{m}$  (L).



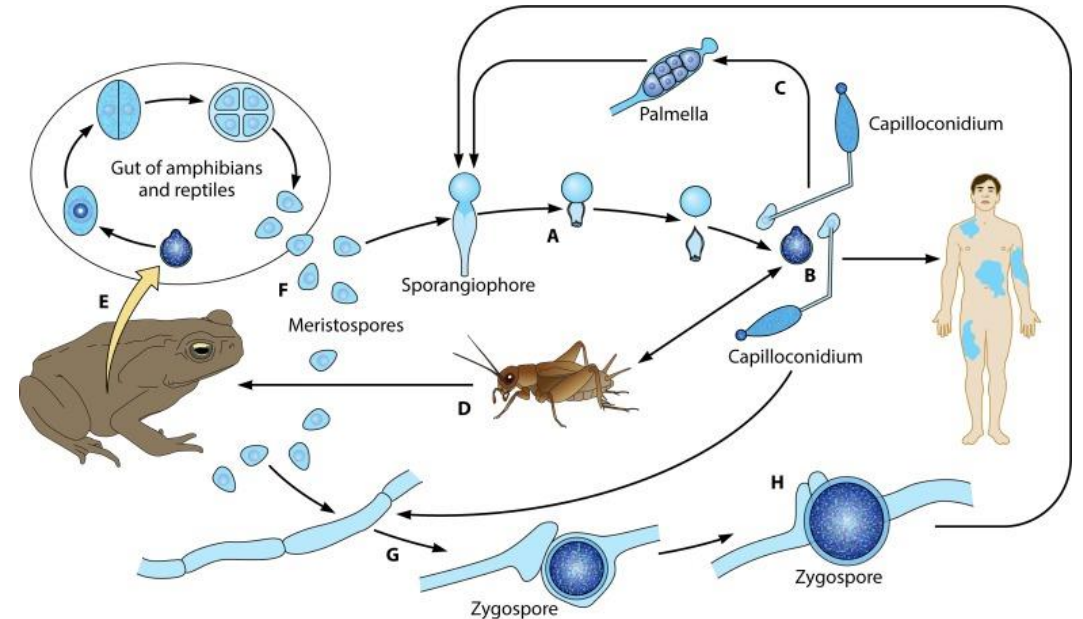
# Basidiobolomicosi

Vilela & Mendoza, Human Pathogenic Entomophthorales Clinical Microbiology Reviews, 29 Aug 2018, 31(4):e00014-18 DOI: [10.1128/cmr.00014-18](https://doi.org/10.1128/cmr.00014-18)

Rare negli animali.

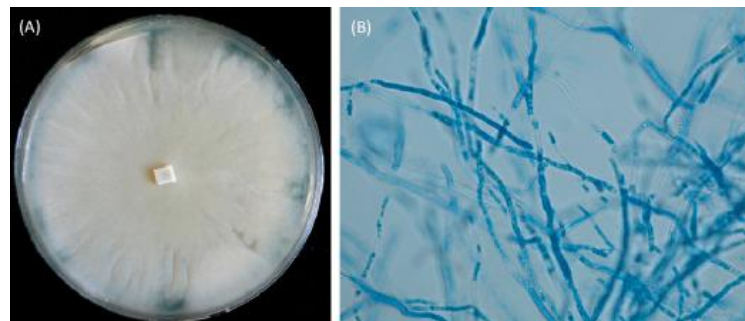
L'infezione nei mammiferi è ipotizzato avvenire dopo inoculazione delle spore per via percutanea a seguito di traumi, punture di insetti, oppure per ingestione

Habitat naturale in vegetazione in decomposizione e associato a insetti, che sono mangiati da rettili e anfibi, nei quali il fungo si può trovare nel tratto intestinale e nelle feci



The life cycle of *Basidiobolus ranarum*. (A) The life cycle starts when sticky conidia are forcibly ejected from sporangiophores. (B) The sticky primary conidium could attach to a passing host (humans or insects) or develop an elongated adhesive conidium (capilloconidium), which also can attach to passing hosts. (C) The latter secondary elongated structure could develop to contain a sticky beak haptor that divides to form numerous "Palmella" endospores, some of which are released outside the broken capilloconidium cell wall, giving rise to new hyphae and single sporangiophores (A). (D and E) The target insects (D) can be ingested by reptiles or amphibians (E), initiating a new cycle inside the intestinal tract of these animals. (F) In this new environment, hundreds of resistant meristospores are produced and then secreted in feces. When environmental conditions are right, coenocytic hyphae are developed (G). (H) If two opposite-sex hyphae contact each other, their exchange of genetic material leads to the formation of sexual zygospores (see also Fig. 7). Zygospores can develop into sporangiophores (long arrow).

Nel cavallo essenzialmente sottocutanee; considerare diagnosi differenziale con lesioni dovute a *Pythium*, più frequenti



Gastra et al., *Pythium insidiosum*: An overview. *Veterinary Microbiology*, Volume 146, Issues 1–2, 2010, Pages 1-16, <https://doi.org/10.1016/j.vetmic.2010.07.019>.



- Miller RI, Campbell RS. The comparative pathology of equine cutaneous phycomycosis. *Vet Pathol* 1984;21:325–332. By combining two studies, 204 horses with pythiosis, 48 horses with basidiobolomycosis, and 14 horses with conidiobolomycosis were diagnosed by histology and location of lesion.

**Secondo questi autori istologicamente può essere possibile distinguere le emntomoftoromycosi da infezioni sostenute da *Phytium* per vari caratteri in particolare:**

“*Pythium* sp hyphae were 2.6 to 6.4 pm in diameter, had thick walls, and occasionally were septate. *Basidiobolus haptosporus* hyphae were 5.1 to 20.5 pm in diameter, had thin walls, and commonly were septate. *Conidiobolus coronatus* hyphae were 5.1 to 12.8 pm in diameter, had thin walls, and commonly were septate. A perihyphal eosinophilic cuff (Splendore-Hoepli phenomenon) with a radius of up to 20 pm was associated with the latter two fungi” **Ma altri autori dicono che il fenomeno Splendore-Hoepli è presente anche nelle infezioni causate da *Phytium*.**

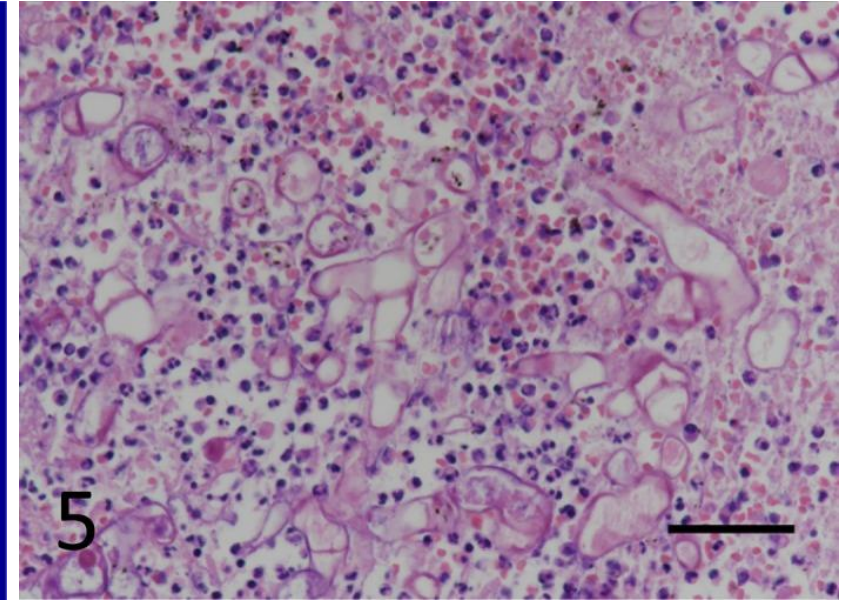
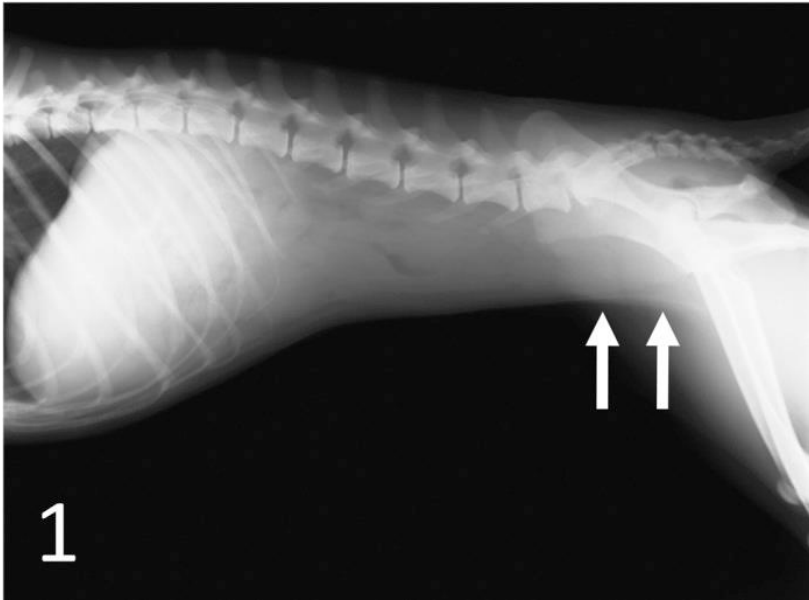
- Owens et al. Phycomycosis caused by *Basidiobolus haptosporus* in two horses. *J Am Vet Med Assoc* 1985;186:703–705. *Basidiobolus haptosporus* was isolated from a horse with a rapidly progressive ulcerative lesion of the ventral midline. The pathologic findings of an irregular line of yellow material composed of hyphae, eosinophils, and granulomatous inflammation between the superficial edematous tissue and the underlying muscle, and hyphae in tissue sections intimately surrounded by granular eosinophilic cuffs were considered diagnostic for this and one other case diagnosed retrospectively. Both horses were successfully treated by surgery and potassium iodide

## Nel cane più segnalate forme gastrointestinali



Okada K et al. Gastrointestinal basidiobolomycosis in a dog. J Vet Med Sci. 2015;77:1311-1313

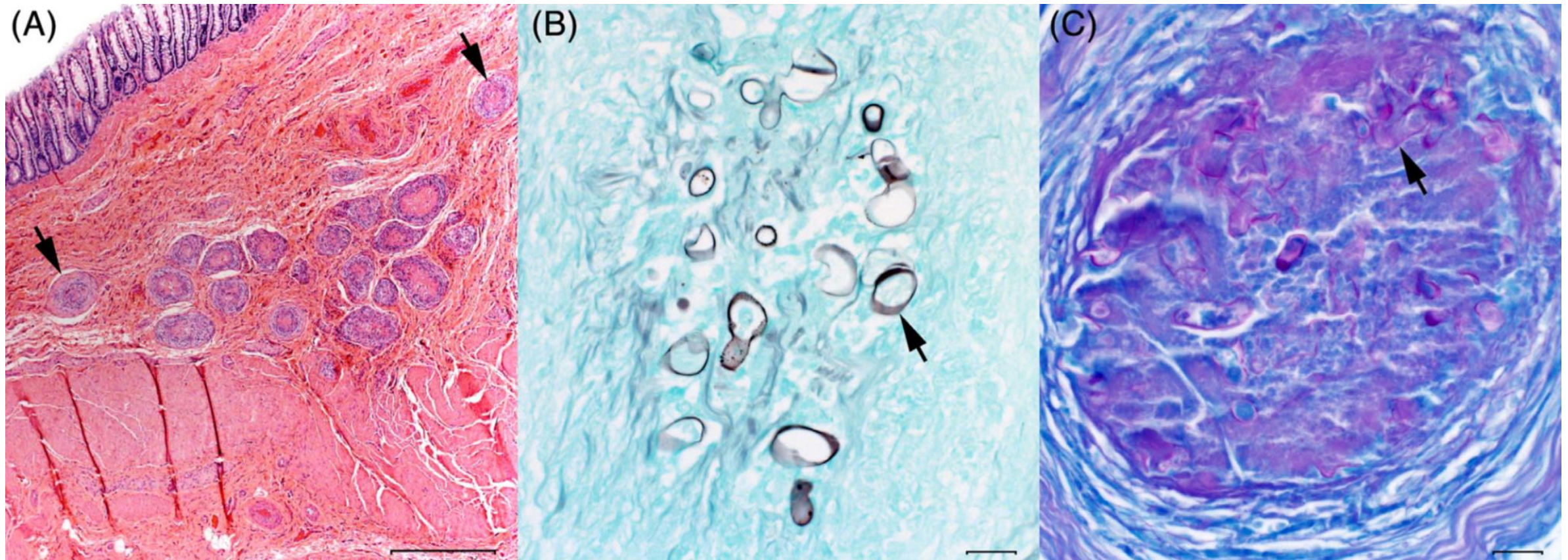
8-year-old, spayed, female Shiba dog was presented to a referring veterinarian with a complaint of chronic diarrhea and anorexia. Ultrasound and radiographs revealed an irregular mass in the pelvic cavity. The mass and the affected section of colon were surgically removed. Histopathological examination revealed multifocal coalescing granulomas and effaced intestinal structures. Central necrotic debris surrounded by multinucleated giant cells, lymphocytes, plasma cells and neutrophils was observed. Numerous, irregularly branched hyphae with pale basophilic, thin walls and occasional bulbous enlargements at the tips were present. **Polymerase chain reaction identified *Basidiobolus ranarum***, successfully confirming a definitive diagnosis of basidiobolomycosis. The dog died immediately after resection of the colon and ileum



Miller RI, Turnwald G. Disseminated basidiobolomycosis in a dog. Vet Pathol 1984;21:117–119.

A 4-year-old intact Golden Labrador was presented with a one-month history of vomiting following ingestion of food or water and anorexia of one-week's duration and died during hospitalization. At necropsy, granulomatous lesions in the gastrointestinal mucosa that spread to the mesentery, mediastinum, and involving the stomach, small intestine, pleura, mediastinum, diaphragm, mesenteric root, liver, and spleen). ***B. haptosporus* was isolated from all tissue cultured.**

A caudal abdominal mass and circumferential thickening of the rectum with mucosal irregularity circumferential thickening of the colonic wall with loss of wall layering extending from the mid-descending colon to the pelvic inlet. Colonoscopy identified hyperemic and irregular colonic and rectal mucosa, with multifocal ulcerative mucosal lesions in the rectum. Hystology: eosinophilic proctitis with intralesional hyphae that measured 5 to 20  $\mu\text{m}$  in diameter. Based on a presumptive diagnosis of colonic pythiosis, medical treatment with prednisone, itraconazole and terbinafine was initiated. **Amplification and sequencing of ribosomal DNA extracted from paraffin-embedded tissues yielded a sequence with 97% identity to GenBank sequences for *Basidiobolus ranarum*.**



Photomicrograph of rectal tissue taken at necropsy showing multifocal to coalescing granulomas (arrows) in the submucosa (A); hematoxylin and eosin stain; scale bar = 500  $\mu\text{m}$ . Large, thin-walled, irregularly shaped hyphae (arrows) within granulomas were GMS (B) and PAS (C) positive; scale bar = 20  $\mu\text{m}$

Lesioni regredite dopo 15 settimane di terapia poi sospesa per ragion finanziaria. Morto tre settimane dopo (carcinoma pancreatico osservato in necropsia). In istologia ancora granulomi intestinali





Greene et al., Infection with *Basidiobolus ranarum* in two dogs. JAVMA, Vol 221, No. 4, August 15, 2002: 528-532

Infection in the 2 dogs reported here involved subcutaneous (one order collie) or respiratory (one chow chow) infections with *B ranarum*; this localization of infection has not been previously described. In both instances, the dogs had prolonged and repeated direct contact with water or soil in their environment. Diagnosis with **culture on Sabouraud dextrose agar**

In questi due casi i trattamenti con Itrazonazolo e ioduro di potassio si sono rivelati inefficaci nel primo caso (le lesioni cutanee si sono diffuse, fino a eutanasia) o solo parzialmente efficaci (i sintomi respiratori sono regrediti ma il cane è morto due anni dopo senza causa apparente).



Photograph of draining ulcerative lesions on the distal portion of the forelimb of a dog with *Basidiobolus ranarum* infection.

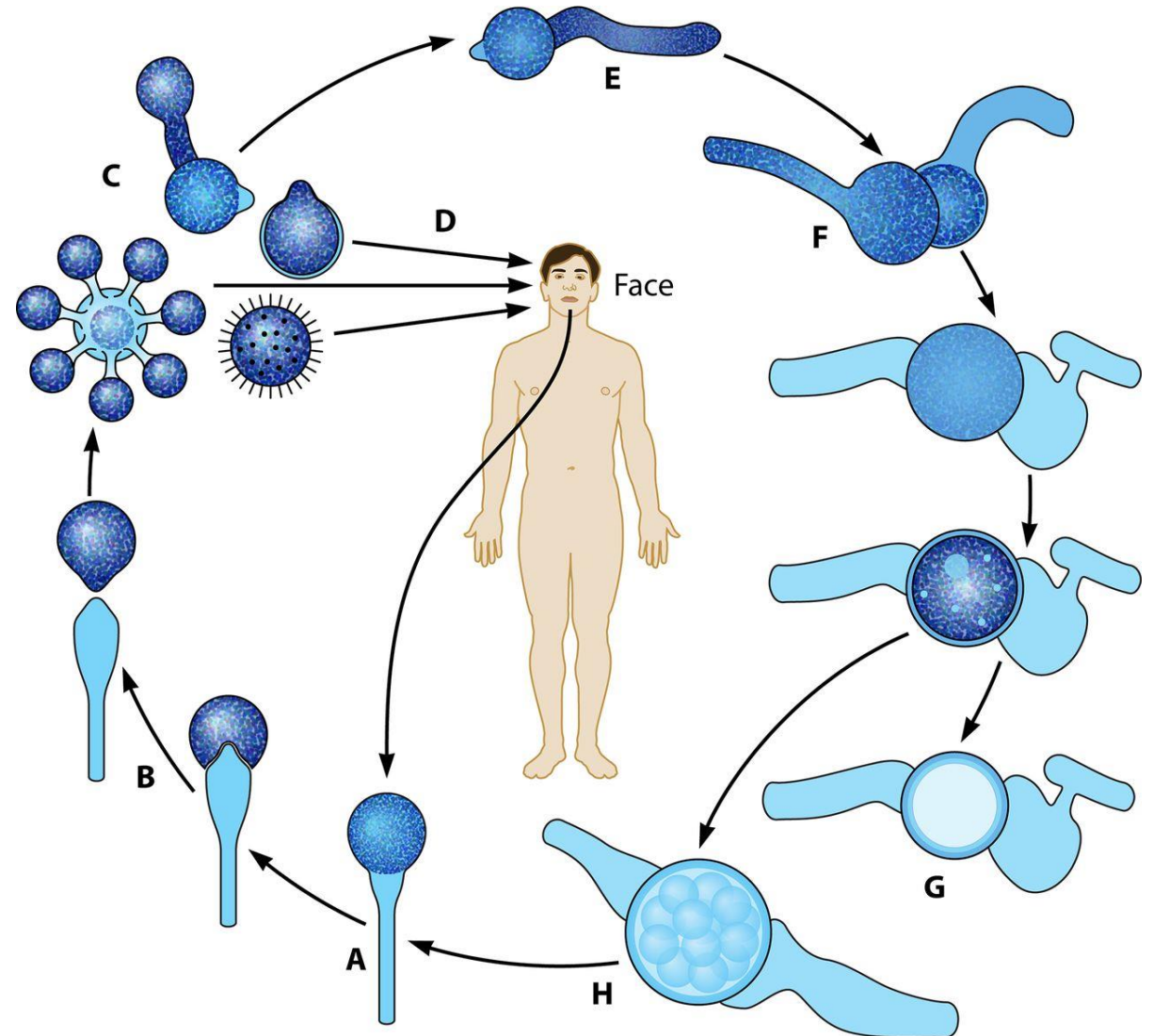


# Conidiobolomicosi

Vilela & Mendoza, Human Pathogenic Entomophthorales Clinical Microbiology Reviews, 29 Aug 2018, 31(4):e00014-18 DOI: [10.1128/cmr.00014-18](https://doi.org/10.1128/cmr.00014-18)

Più frequenti negli animali, rispetto alle precedenti, in particolare nelle pecore

FIG 5 (A and B) The life cycle of *Conidiobolus* species starting with the development of a sporangiophore from hyphae (A) and the ejection of multireplicative primary conidia at the top of sporangiophores (B) (Fig. 2). (C and D) The primary conidia could replicate into secondary conidia that could also attach to passing hosts (C) or directly attach to the skin of humans (including the villose conidia of *C. coronatus*) (D). Clinical samples can be cultured, leading to the development of hyphae and sporangiophores (long arrow). (E to H) In nature and in culture, the primary conidia could form coenocytic filaments, which, after the interchange of genetic material, could lead to the formation of sexual zygospores, and the cycle starts all over again.





Nelle pecore è stata descritta per la prima volta in Australia nel 1992 , con una mortalità, nel giro di tre mesi, di circa 700 capi distribuiti in 52 allevamenti, con un decorso clinico di 7-10 gg. Successivamente a Trinidad e Tobago. In Brasile fu sottodiagnosticata fino al 2007 e considerate un tumoreetmoidale

Successivamente fu riportata in diverse aree del Brasile con morbilità fino al 6% e letalità fino al 100%. Più colpite le zone umide ma casi anche in zone aride, dove fattore di rischio sono le zone attorno agli stagni di abbeverata.

Nelle zone più a rischio riscontrata una incidenza annuale del 2,8%, e la maggior parte dei casi si riscontrano durante la stagione calda delle piogge





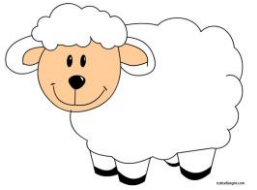
Table 2- Epidemiological and clinical aspects of ovine conidiobolomycosis outbreaks reported in Brazil, 1979-2014.

State/year of disease occurrence	Clinical form	Affected sheep (n)	Total of sheep (n)	Lethality %	Breed	Climatic condition of the region (month of the year)*	<i>Conidiobolus</i> species	Reference
MG/1979	NI	3	NI	NI	SI/MN	NI	<i>Conidiobolus</i> spp.	1
PB/2001	Rhinofacial	5	80	100	SI	Feb-May	<i>Conidiobolus</i> spp.	2
PI/2002/2003/2004	Nasopharyngeal	157 (2002)	6380 (2002)	100	SI/MN	Apr-Jun	<i>C. coronatus</i>	3
		152 (2003)	6115 (2003)					
		212 (2004)	6086 (2004)					
		173.66 (average of number of cases)	6194 (mean of exposed animals)					
PB/2004	Nasopharyngeal	8	140	100	SI/Ca	Jan-May	<i>Conidiobolus</i> spp.	2
SC/2006	Nasopharyngeal	6	75	100	SI	Dec-May**	<i>C. lamprauges</i>	4
MT/2006-2012	Rhinofacial	2	NI	100	SI	Jan-Jan	<i>C. lamprauges</i>	5
MT/2007	Nasopharyngeal	12	40	100	SI	Jan-Jun**	<i>Conidiobolus</i> spp.	6
RS /2007	Nasopharyngeal	1	30	100	Tx	Jan-Apr	<i>Conidiobolus</i> spp.	7
PE/2009	Nasopharyngeal	5	29	100	NI	Apr-May**	<i>Conidiobolus</i> spp.	8
PB/RN/2009-2012	Rhinofacial	299 17 <sup>#</sup>	1333	100	SI/CB	Mar/2009 – Dez/2012**	<i>Conidiobolus</i> spp.	9
MT/NI	Nasopharyngeal	9	NI	NI	SI	NI	<i>C. lamprauges</i>	10

Brazilian States: MG=Minas Gerais; MT=Mato Grosso; PB=Paraíba; PE=Pernambuco; PI=Piauí; RN=Rio Grande do Norte; RS=Rio Grande do Sul; SC=Santa Catarina. NI=no informed. SI=Santa Inês. MN=Morada Nova. Ca=Cariri. Tx=Texel. CB=Cross breed. \*All of those regions reported high pluviometric precipitation and high humidity periods; including the presence of considerable amounts of decaying vegetation. \*\*In those reports the sheep were in *Brachiaria* spp. pastures. #Concomitant conidiobolomycosis and pythiosis. <sup>1</sup>SILVA et al. (2010), <sup>2</sup>RIET-CORREA et al. (2008), <sup>3</sup>SILVA et al. (2007<sup>a,b</sup>), <sup>4</sup>FURLAN et al., (2010), <sup>5</sup>UBIALI et al. (2013), <sup>6</sup>BOABAID et al. (2008), <sup>7</sup>PEDROSO et al. (2009), <sup>8</sup>MENDONÇA et al. (2012), <sup>9</sup>AGUIAR et al. (2014), <sup>10</sup>DE PAULA et al. (2010).

Weiblen et al., Epidemiological, clinical and diagnostic aspects of sheep conidiobolomycosis in Brazil *Ciência Rural*, v.46, n.5, mai, 2016. 839.

<http://dx.doi.org/10.1590/0103-8478cr20150935>



Clinicamente si presenta in due forme nella pecora: (1) *rinofarinosa*, più comune, che colpisce tipicamente la regione etmoidale, (2) *rinofacciale*, meno comune, che colpisce il vestibolo nasale e la cute del naso

In entrambe le forme i segni clinici includono grave scolo nasale, febbre, apatia, anoressia, perdita di peso, e difficoltà respiratorie marcate.

Nella forma rinofaringea, la diffusione dell'infiammazione a una delle orbite può determinare esoftalmo unilaterale, spesso associato ad asimmetria facciale e cheratite ulcerative

Quando l'infiammazione invade il lobo frontale del cervello si sviluppano segni neurologici con ottundimento, movimenti di circolo, postura anormale della testa

Le lesioni principali sono localizzate nella regione etmoidale, faringe e/o turbinata nasali e sono caratterizzate da masse irregolari giallastre con alcuni foci nerastri e friabili le lesioni di solito si estendono all'orbita, alla lamina cribrosa e ai seni nasali

La diffusione ematogena avviene occasionalmente. Colpiti primariamente i polmoni e i linfonodi retrofaringei, ma possono estendersi anche ad altri linfonodi, fegato, intestino, reni e cistifelle

Istologicamente piogranulomi con area centrale eosinofila di necrosi, con neutrofili, eosinofili, cellule giganti, linfociti e plasma cellule. Conematossilina eosina le ife non si colorano e sono circondate spesso dalla reazione Splendore-Hoeppli le ife sono di 5–30  $\mu\text{m}$  di diametro a forma irregolare parete spessa, con dilatazioni apicali bulbose. Le ife colorano con impregnazione argentea ma non con PAS.

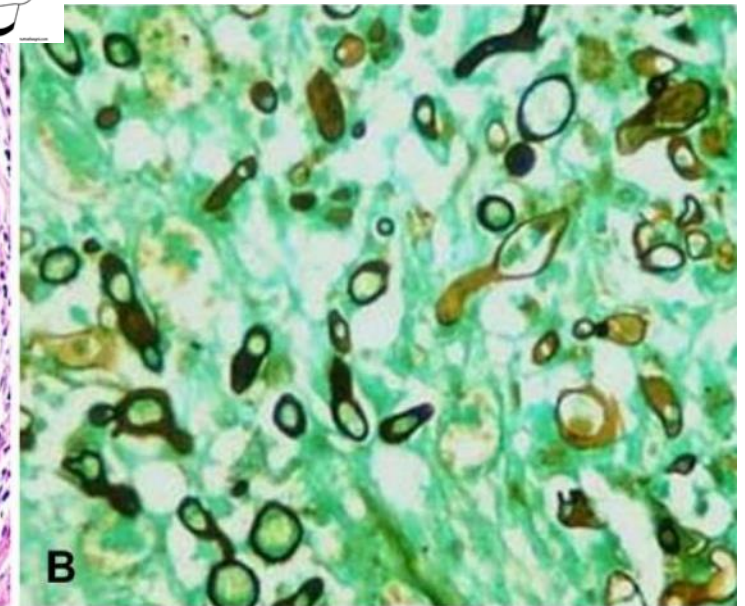
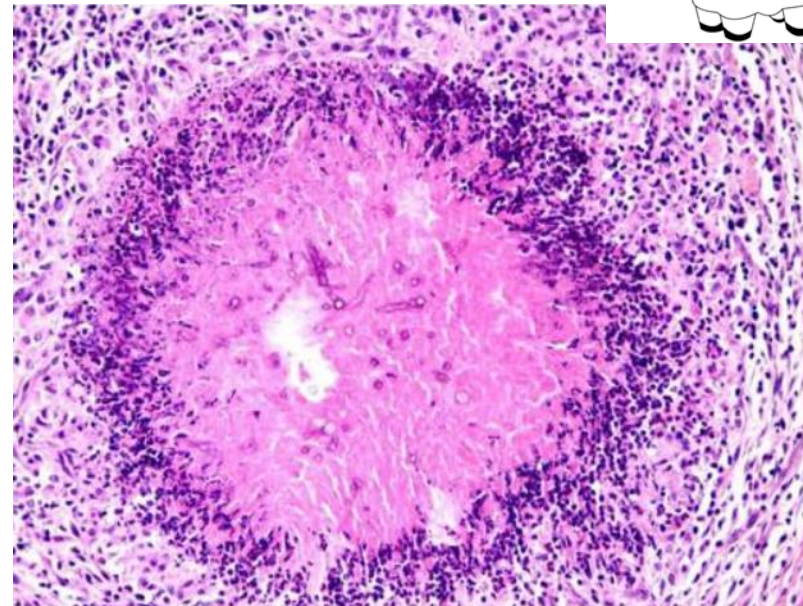
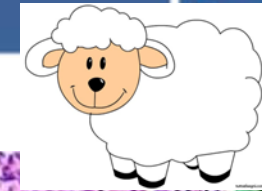
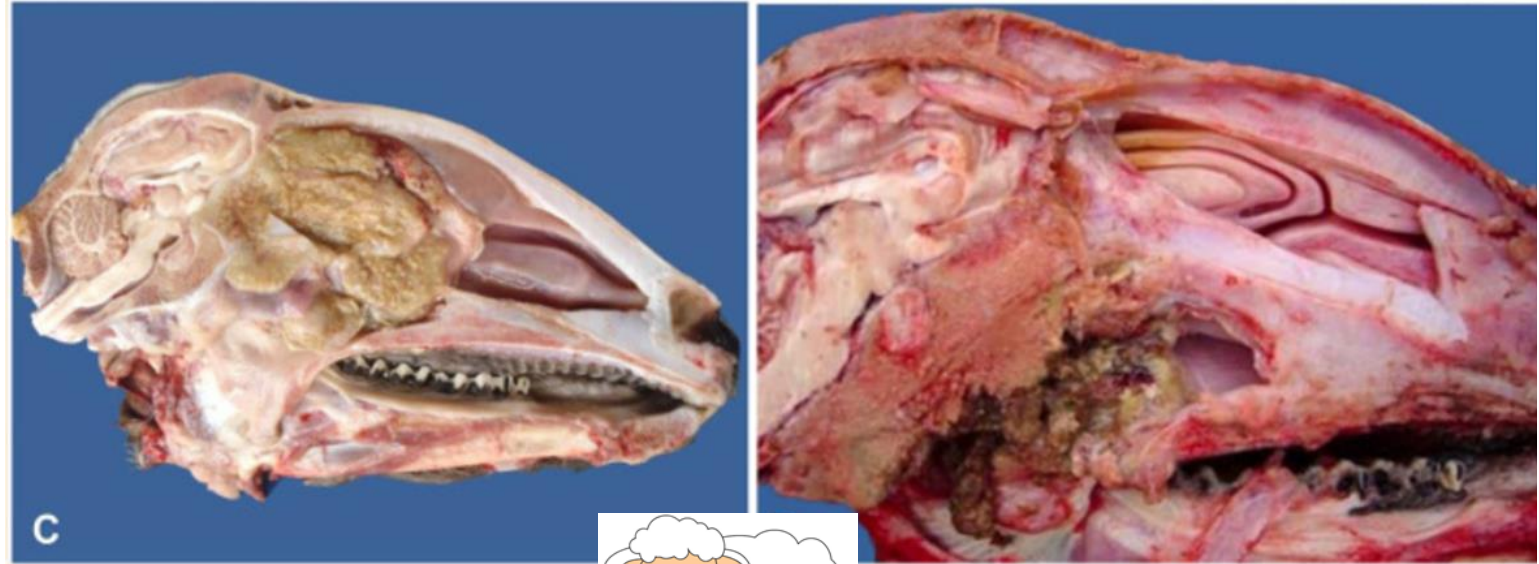


Table 1- Reported cases of conidiobolomycosis in animal species from outside Brazil.

Altri animali

Species	Number of affected hosts	Country/Year of disease occurrence or reported	Organism	Site of infection	Outcome	Reference
Dog	1	United States/1994	<i>Conidiobolus</i> spp.	Skin	D	1
	1	United States/1996	<i>Conidiobolus</i> spp.	Oral	R	2
	1	United States/2006	<i>Conidiobolus</i> spp.	Pulmonary	R	3
	1	United States/2014	<i>C. incongruus</i>	Pulmonary	D	4
Deer	1	Australia/1997	<i>C. incongruus</i>	Disseminated	D	5
	1	United States/2009	<i>C. incongruus</i>	Disseminated	D	6
Horse	1	United States/1989	<i>C. lamprauges</i>	Nasopharyngeal	D	7
	1	United States/1996	<i>C. coronatus</i> <sup>*</sup>	Nasopharyngeal	D	8
	1	United States/2001	<i>C. coronatus</i>	Granulomatous tracheitis	R	9
	1	United States/2001	<i>C. coronatus</i>	Nasopharyngeal	R	10
	2	United States/2003	<i>C. coronatus</i>	Nasopharyngeal	R	11
Llama	1	United States/1992	<i>C. coronatus</i>	Nodular dermatosis in external nares/Respiratory	RI	12
	1	United States/1994	<i>C. coronatus</i>	Granulomatous dermatitis and nasal commitment	D	13
Non human primates	1	United States/1982	<i>Conidiobolus</i> spp. <sup>*</sup>	Disseminated	D	14
Sheep	700	Australia/1992	<i>C. incongruus</i>	Rhinofacial	D	15
	5/200	Australia/1992	<i>C. incongruus</i>	Rhinofacial (n=1) and Rhinocerebral (n=4)	D	16
	1/60	Trinidad/2001	<i>Conidiobolus</i> spp.	Rhinocerebral	D	17

Weiblen et al., Epidemiological, clinical and diagnostic aspects of sheep conidiobolomycosis in Brazil *Ciência Rural*, v.46, n.5, mai, 2016. 839.

<http://dx.doi.org/10.1590/0103-8478cr20150935>

<sup>1</sup>HILLIER et al. (1994), <sup>2</sup>BAUER et al. (1997), <sup>3</sup>HAWKINS et al. (2006), <sup>4</sup>MACKEY et al. (2015), <sup>5</sup>STEPHENS & GIBSON (1997), <sup>6</sup>MADSON et al. (2009), <sup>7</sup>HUMBER et al. (1989), <sup>8</sup>ZAMOS et al. (1996), <sup>9</sup>STEIGER & WILLIAMS (2000), <sup>10</sup>ROBINSON et al. (2007), <sup>11</sup>TAINTOR et al. (2004), <sup>12</sup>MOLL et al. (1992), <sup>13</sup>FRENCH & ASHWORTH (1994), <sup>14</sup>MIGAKI & TOFT (1982), <sup>15</sup>CARRIGAN et al. (1992), <sup>16</sup>KETTERER et al. (1992), <sup>17</sup>MORRIS et al. (2001). D=Died. R=Recovered. RI=Remaining infection. \*Case was not confirmed with culture.

Stewart. *Conidiobolus coronatus* fungal upper respiratory infections in horses Equine Veterinary Education.(2019). 31(6): 301-302doi: 10.1111/eve.12852

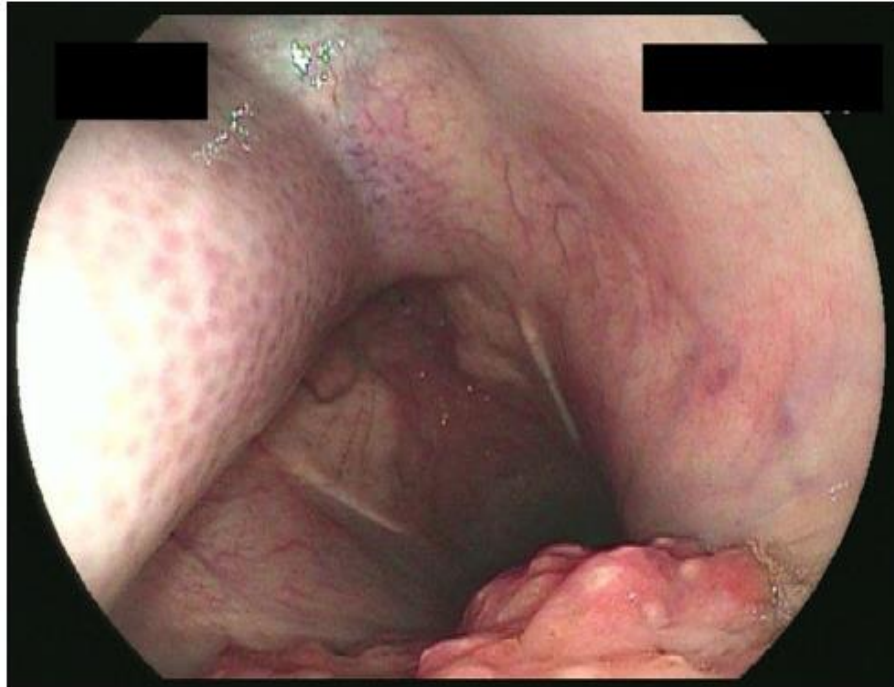


Fig 1: Endoscopic image of raised masses caused by *Conidiobolus coronatus* in the nasopharynx of a horse.

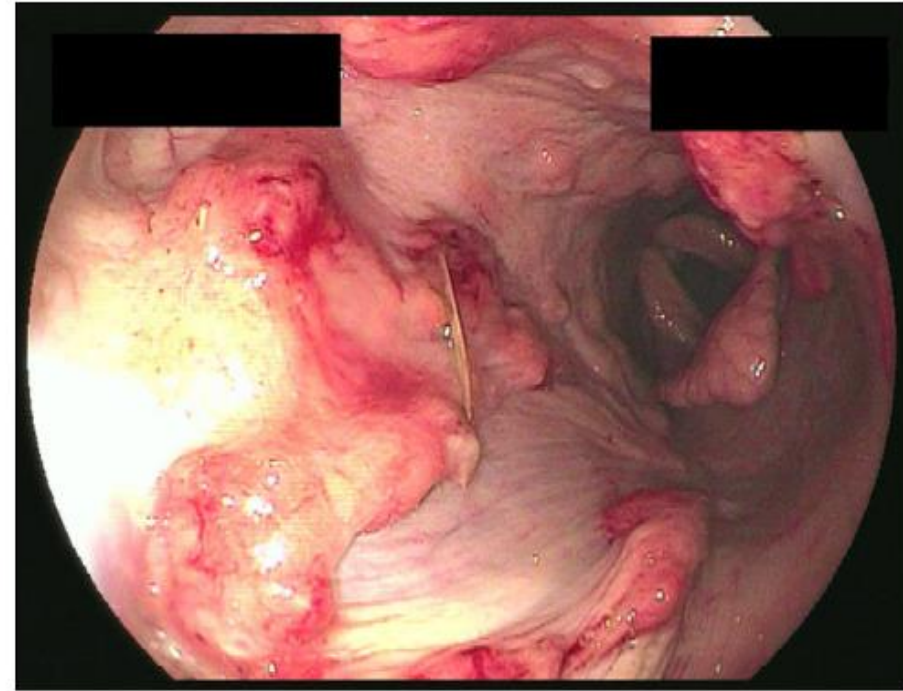


Fig 2: Endoscopic image of multifocal ulcerated raised masses caused by *Conidiobolus coronatus* in the nasopharynx of a horse.

Terapia con fluconazolo per 2-4 settimane dopo la scomparsa dei segni clinici e risoluzione lesioni in endoscopia (solitamente 2-4 mesi). Descritto anche uso di ioduro di potassio da altri autori



Canine Subcutaneous Zygomycosis Caused by *Conidiobolus* sp.: A Case Report and Review of *Conidiobolus* Infections in other Species Vet Dermatol. 1994 Dec;5(4):205-213. doi: 10.1111/j.1365-3164.1994.tb00032.x.

A young adult dog was presented with a 1-month history of a subcutaneous mass on the right thoracic wall and an ulcerative, subcutaneous mass of the proximal right hindlimb. Pyogranulomatous inflammation of the dermis and subcutis with broad fungal hyphae were found on histopathologic examination. Despite some waxing and waning of the skin disease, new lesions continued to appear. A 2-week course of itraconazole did not alter the course of the disease. Euthanasia was performed 10 weeks after initial presentation. **Conidiobolus sp. was isolated in culture** from surgical specimens.

Bauer et al., Oral conidiobolomycosis in a dog Vet Dermatol . 1997 Jun;8(2):115-120. doi: 10.1046/j.1365-3164.1997.d01-9.x

Conidiobolomycosis was diagnosed via culture from an oral lesion in a 1.5-year-old German Shepherd dog. Clinically, the lesion consisted of a large, irregularly shaped, ulcerative focus on the caudal hard palate. Microscopically, the lesion was characterized by an eosinophilic granulomatous stomatitis with hyphal organisms surrounded by eosinophilic sleeves (Splendore-Hoeppli material) suggestive of an entomophthoramycosis. **The fungus was cultured** and identified with features consistent with *Conidiobolus* sp. Treatment with itraconazole at 10 mg kg<sup>-1</sup> twice daily for 61 days resulted in clinical and radiographic resolution of the lesion.





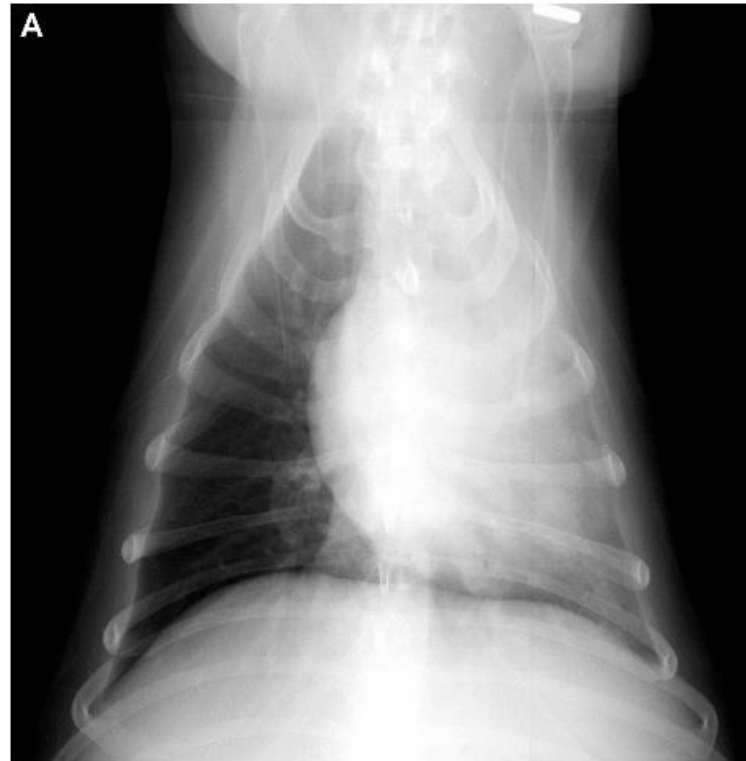


Hawkins et al. Treatment of *Conidiobolus* sp. Pneumonia with itraconazole in a dog receiving immunosuppressive therapy, *J Vet Intern Med* 2006; 20: 1479–1482 The dog in this case report had fungal pneumonia, an unusual presentation for conidiobolomycosis. Although recurrence of infection after treatment is commonly reported, this dog had complete resolution of *Conidiobolus* pneumonia after treatment with itraconazole despite receiving immunosuppressive therapy, and sub-sequently chemotherapy.

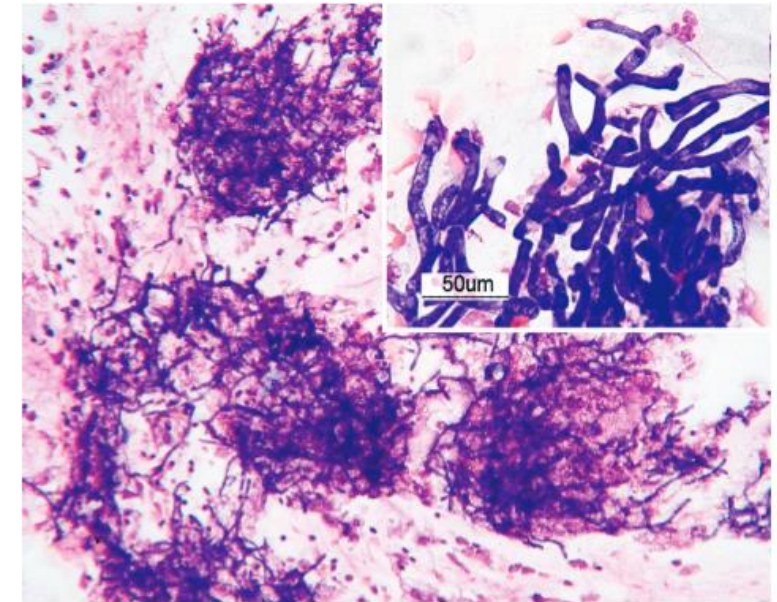
Cane meticcio di 4 anni sotto trattamento immunosoppressivo e antibiotici per trombocitopenia.

Identificazione morfologica da coltura come *Conidiobolus* sp..

Trattato con itraconazolo e chemioterapici per contemporanea presenza di neoplasia epatica (sarcoma istiocitario) il cane è migliorato fino a guarigione e stava bene a un follow up di tre anni



The ventral-dorsal view of thoracic radiographs obtained at the time of presentation reveals an alveolar pattern in the left cranial lung lobe with a leftward shift of the mediastinum (A)



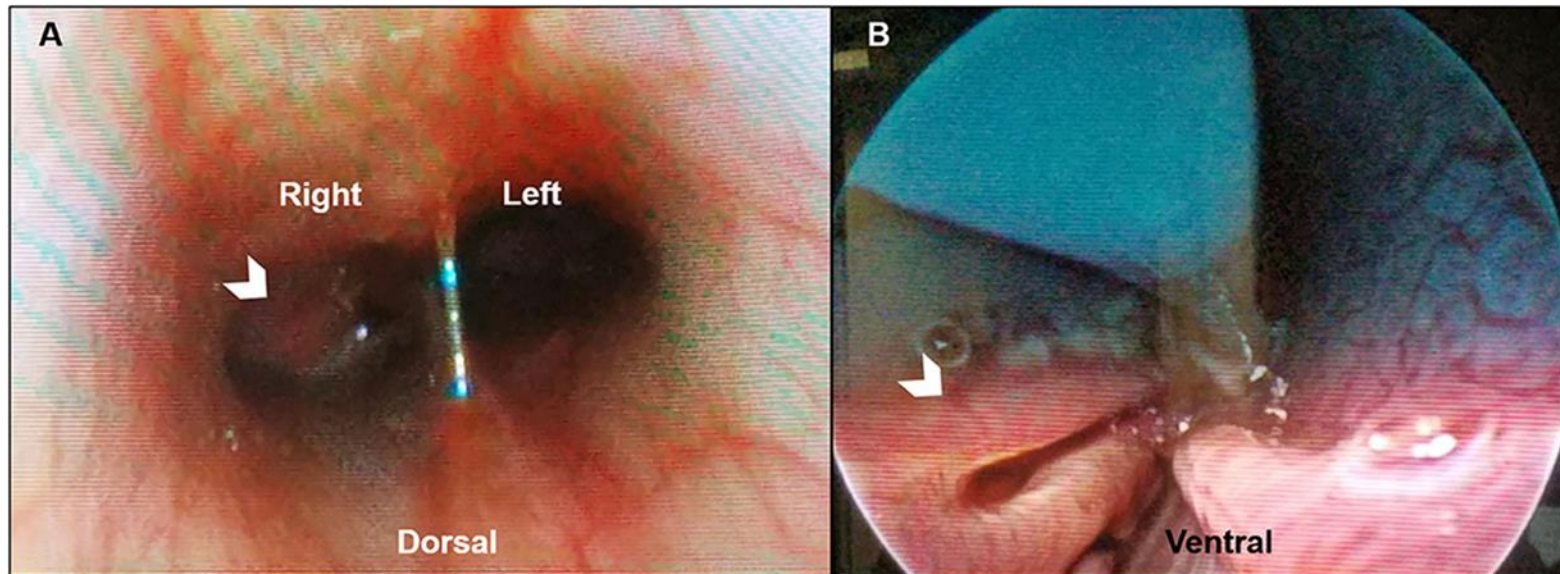
**Fig 2.** Tracheal wash fluid revealing suppurative inflammation with numerous fungal organisms. The majority of cells were degenerative neutrophils, with occasional large and small mononuclear cells. Moderate amounts of mucus were present. Deeply basophilic fungal hyphae were plentiful. Hyphae were 5–9  $\mu\text{m}$  in width with nonparallel walls, occasional branching, frequent bulbous ends, and virtually no septation. Cytocentrifuge preparation; Wright-Giemsa stain. High magnification inset, 50  $\mu\text{m}$ .

Jeffrey et al.: Case Report: Successful Management of *Conidiobolus lamprauges* Rhinitis in a Dog Front. Vet. Sci., 05 February 2021  
 Sec. Comparative and Clinical Medicine Volume 8 - 2021  
 | <https://doi.org/10.3389/fvets.2021.633695>

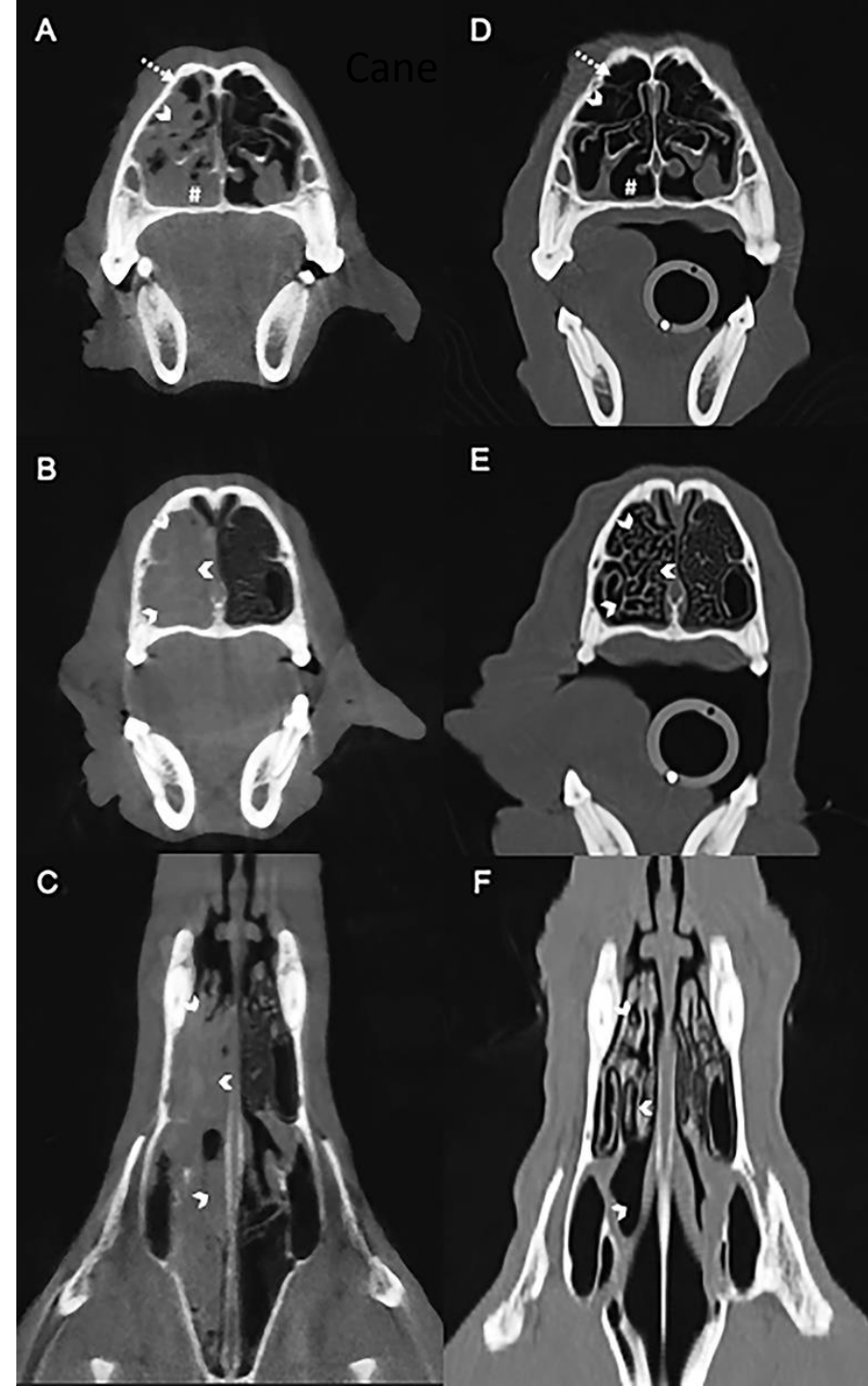
Cane



A Goldendoodle, was presented for evaluation of sneezing, coughing, lethargy, as well as right-sided epistaxis and clear ocular discharge. Computed tomography revealed a large amount of soft tissue within the right nasal passage that obscured the osseous turbinates from the right maxillary canine tooth to the right side of the choanae.



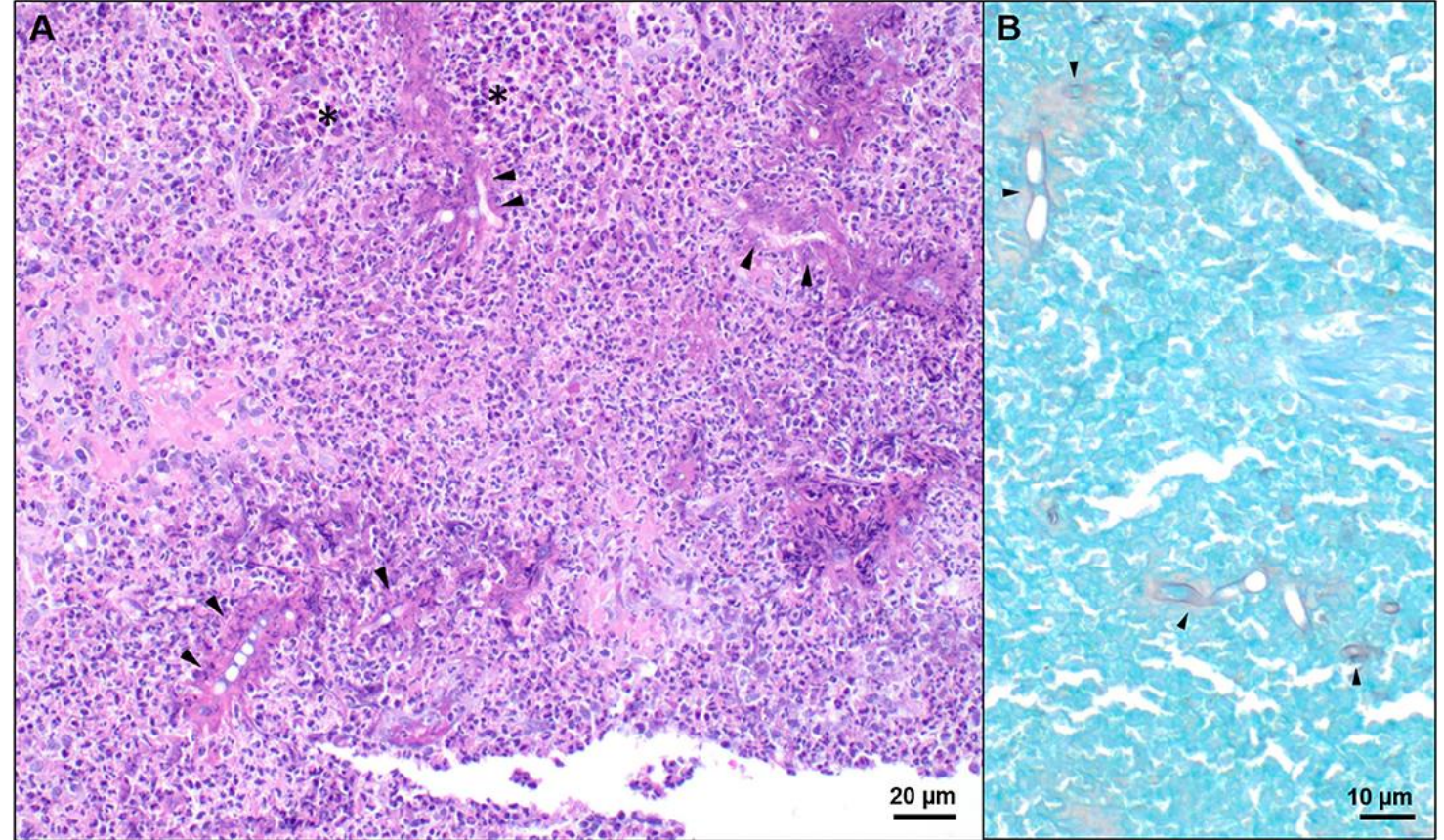
At endoscopy, there was proliferative tissue that extended caudally from the right side of the choanae and the mucosa of the nasopharynx appeared edematous and erythematous the right nasal turbinates showed generalized marked erythematous and edematous mucosa with hemorrhage and mucopurulent material





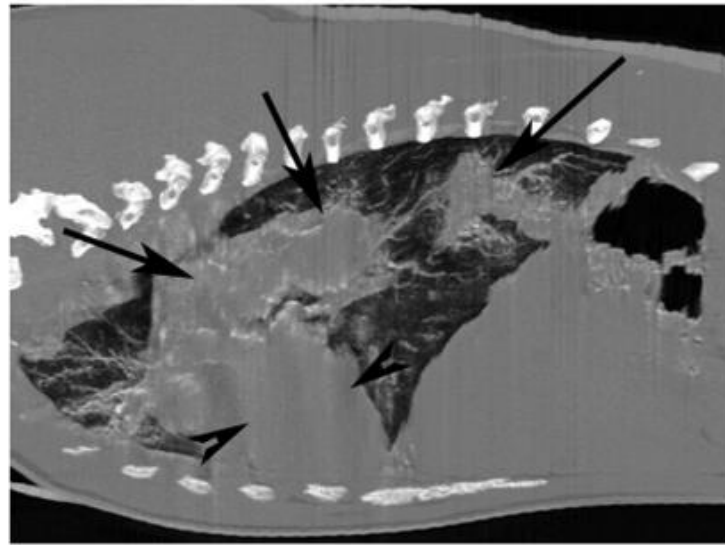
Biopsies revealed eosinophilic granulomas with variable number of basophilic to negatively staining, septate, fungal hyphae with non-parallel walls and irregular branching that were subsequently determined to be *Conidiobolus lamprauges* via panfungal PCR and sequencing.

Trattamento effettuato con Itraconazolo, Terbinafina e Prednisone (quest'ultimo sospeso gradualmente dopo un mese)



Complete e duratura risoluzione del caso ottenuta dopo 75 gg di terapia antimicotica.

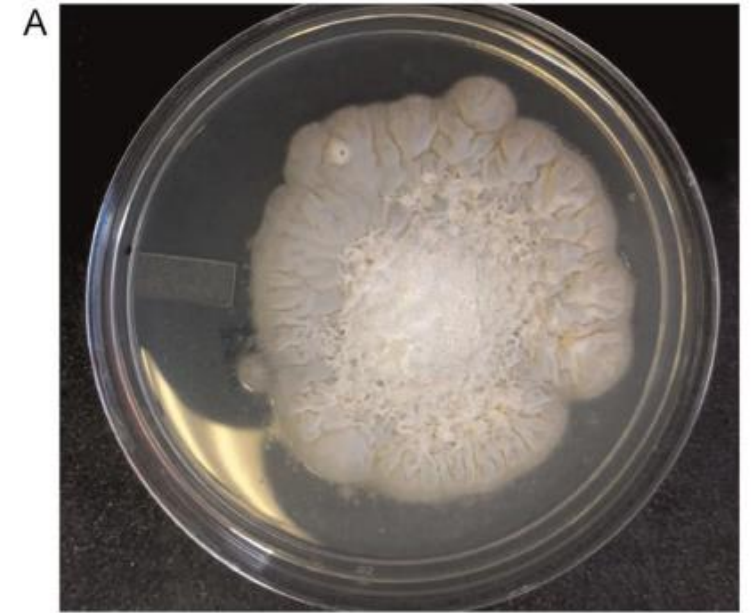
Mackey et al., Disseminated  
*Conidiobolus incongruus* in a dog: A  
case report and literature review  
Medical Mycology Case Reports  
Volume 8, June 2015, Pages 24-28



**Fig. 1.** Sagittal reconstructed CT image of the less severe alveolar pulmonary infiltrates in the left cranial and caudal lung lobes (black arrows). The linear streaking through the caudal thorax is beam hardening artifact secondary to incidental subcutaneous shot pellets. The black arrow heads are at the cranial and caudal margins of the heart.

Disseminated fungal infection in a young, apparently immunocompetent English Mastiff dog who initially presented for antibiotic resistant pneumonia cough, (dyspnea, weight loss, fever, and lethargy).

Bronchoscopic abnormalities include a raised, pink, irregular, proliferative lesion in the distal trachea and the right cranial bronchus was obstructed with proliferative tissue and mucus. At ultrasound small mass was present in the jejunal wall causing a complete loss of bowel wall layering within the central region of the mass. Owners elected euthanasia. Histopathology and mycology culture identified a *Conidiobolus* sp., further confirmed as *Conidiobolus incongruus* through DNA sequencing of D1/D2 regions. This is the first report of this species causing disease in dogs and the fifth reported infection in animals.



**Fig. 2.** (A) Two day culture of *Conidiobolus incongruus* on SDA at 37 °C (colony surface). (B) Multireplicative conidia, papillate conidia and hyaline coenocytic hyphae of *Conidiobolus incongruus*, in lactophenol cotton blue. Bar, 20 µm.

## Conclusioni

- Difficoltà a risalire a report in letteratura: termine zigomicosi usato sia per Mucormicosi che Enteromoftomicosi, oppure Phycomycosi sia per infezioni da oomyceti che zigomiceti.
- Diagnostica spesso solo istologica, e a volte tardiva o post mortem, specialmente in passato.
- Terapia solo aneddótica, non facile, e il più delle volte fallimentare.



UNIVERSITÀ  
DEGLI STUDI DI BARI  
ALDO MORO

MYCOLOGY

SHORT MASTER



DIPARTIMENTO  
MEDICINA  
VETERINARIA



**Grazie per l'attenzione**

[roberta.galuppi@unibo.it](mailto:roberta.galuppi@unibo.it)