Otogenic meningoencephalomyelitis due to Cryptococcus gattii (VGII) infection in a cat from Western Australia

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Abstract

Case summary A 7-year-old spayed domestic longhair cat from Perth, Western Australia, presented with left-sided head tilt, dysphonia, head shaking, anappetence and weight loss. A polypoid lesion had previously been removed from the external ear canal. Otitis media with extension into the external ear canal was suspected and investigated using video-otoscopy and computed tomography examination. Invasive disease with extension from the middle ear to the base of the skull, and intracranial extension into the caudal fossa and cranial cervical vertebral canal was detected. Cytology of external ear canal exudate showed capsulated budding yeasts and Cryptococcus gattii VGII was cultured. Treatment with amphotericin B infusions and oral fluconazole was prescribed, with nutritional support via oesophagostomy tube. The cat clinically recovered 12 months after treatment commenced.

Relevance and novel information This case report describes the successful medical treatment of otogenic meningoencephalomyelitis due to C gattii (VGII) infection in a cat.

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Introduction

Cryptococcosis is a common systemic mycosis affecting cats worldwide and can affect cats of any age and sex.1 The two most common species causing disease in animals are Cryptococcus neoformans and Cryptococcus gattii. Historically, Cryptococcus was classified into five serotypes (A, B, C, D and AD) on the basis of antigenic differences in capsular polysaccharides.2 Using a modern molecular typing scheme, cryptococcal strains are now divided into eight multilocus sequence types (VNI, VNII, VNIII, VNIV, VGI, VGII, VGIII, VGIV), which are likely to be cryptic species.3

C gattii has been associated with tropical and subtropical climates, with an outbreak of disease affecting both humans and animals in the Pacific Northwest of the USA, emanating from an initial focus of infection on Vancouver Island, British Columbia, Canada.4,5 C gattii has unique features, which distinguish it from C neoformans.4-6 C gattii primarily infects immunocompetent hosts and the organism can cause disease in unusual host species (eg, horses, ferrets, goats, dolphins).7,8 VGII has a high environmental presence in Perth, Western Australia, and areas of the Northern Territory, in contrast to eastern Australia where VGI

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isolates predominate. The genetic diversity of VGII environmental and clinical isolates obtained from the Perth environs suggests there is a sexually recombining population structure in this geographical niche.9,10

While C gattii VGI is strongly associated with detritus in mature eucalyptus tree hollows, the ecological niche of VGII is largely unknown.11 In Vancouver Island, where an outbreak of VGIIa was diagnosed in humans and animals, C gattii VGII colonises coniferous, evergreen and deciduous trees in the Douglas fir tree bioclimatic zone, with transient isolation from soil, saltwater, freshwater and air.12

Infection most likely occurs subsequent to inhalation of airborne infectious propagules such as basidiospores or desiccated yeast cells with clinical signs of sneezing, stertor, nasal deformity and discharge reflecting nasal cavity infection.11 It is common for the infection to spread, both locally to contiguous adjacent structures and haematogenously to other sites.

We present an unusual case of otogenic infection with intracranial extension attributable to C gattii VGIIb in a cat for which signs resolved with aggressive medical therapy.

Case description
A 7-year-old spayed domestic longhair cat was presented to Murdoch University Veterinary Hospital for evaluation of left ear tilt, dysphonia, head shaking, inappetence and weight loss of 2 weeks’ duration.

Initial investigations by the referring veterinarian identified an aural mass in the left horizontal ear canal, which had been removed. Sabouraud’s dextrose agar culture of an ear swab had resulted in heavy growth of C gattii. Serum latex cryptococcal antigen agglutination test (LCAT) was positive, with a titre of 1:256. ELISA testing for feline immunodeficiency virus antibodies and feline leukaemia virus antigen were negative.

The cat was treated with enrofloxacin (5 mg/kg PO q24h [Baytril; Bayer Animal Health]), itraconazole (10 mg/kg PO q24h [Sporanox; Janssen Pharmaceutica]), meloxicam (0.05 mg/kg PO q24h [Meloxicam; Troy Laboratories Australia]) and a topical compounded enrofloxacin/dexamethasone otic preparation. No improvement in the clinical signs was seen.

The cat was thin (body condition score [BCS] 3/9; weight 4.9 kg) and had a left-sided head tilt. The remainder of the clinical examination, including full ophthalmic and neurological examinations, was unremarkable. The presence of a head tilt without ipsilateral postural reaction deficits was consistent with left peripheral vestibular disease. Hand-held otoscopic examination demonstrated a mass occluding the lumen of the left horizontal ear canal, and ceruminous discharge.

Preanaesthetic blood tests were clinically insignificant. The cat was premedicated with buprenorphine (0.018 mg/kg IM [Temgesic; Symbion Pharmacy Services]) and acepromazine (0.04 mg/kg IM [ACP; Westralian Holdings]), anaesthetised with propofol and maintained with isoflurane in 100% oxygen. A CT (Siemens Emotion Duo 2 slice CT scanner; GE Healthcare Australia) examination of the head was performed using soft tissue and bone spatial reconstruction algorithm and 1 mm slice thickness pre- and postintravenous contrast (iohexol; 10 ml [300 mmol/l] IV) (Figure 1), followed by video-otoscopic examination.

CT showed moderate contrast enhancement of the left ear canal lining. The medial portion of the left external ear canal and left tympanic bulla were filled with homogenous, contrast-enhancing soft tissue attenuating material (Figure 1a). Ventromedial and rostral to the tympanic bulla, a region (1.6 cm width × 1.3 cm height × 2.5 cm length) of poorly contrast-enhancing tissue, outlined by a rim of strong contrast enhancement (Figure 1b) causing a mass effect, was seen, which compressed the nasopharyngeal lumen by >50% and displaced the hyoid bones laterally (Figure 1b). Ventromedial and caudal to the bulla, a similarly enhancing region was seen (0.6 cm height × 0.3 cm width × 0.6 cm length). In the caudal left bulla, there was bony lysis of the temporal bone (Figure 1c). Lateral to the oval foramen and dorsal to the larger parapharyngeal lesion, an intracranial rim of contrast enhancement was seen in the ventral aspect of the left temporal lobe. Adjacent to the lytic region of the temporal bone, contrast enhancement outlining a hypoattenuating area with broad dural base was seen (Figure 1c). Poorly enhancing material extended caudally along the left ventral portion of the brainstem to mid first cervical vertebra, displacing and compressing the brainstem and cranial spinal cord, accompanied by strong meningeal contrast enhancement (Figure 1d).

Video otoscopy (MedRx Video Otoscope) identified a large pink fleshy mass obscuring the lumen of the horizontal ear canal. The mass traversed the tympanic membrane, and was contiguous the tympanic bulla (Figure 2), in agreement with CT findings. Pinch biopsies and material near the mass was collected for fungal culture. The mass was debulked using curettes and biopsy forceps passed through the video otoscope. An oesophageal feeding tube was placed for nutritional support.

Impression smears of the mass revealed large numbers of round yeast, surrounded by a prominent clear halo and narrow-necked budding consistent with cryptococcal infection. A heavy pure growth of a Cryptococcus species resulted, which was identified as C gattii by conventional phenotypic mycology testing. Further analysis by sequencing of the ribosomal internal transcribed spacer region identified C gattii VGII by comparing the sequence with published signature sequences;13 however, the isolate was not available for further molecular typing. The isolate was susceptible to
fluconazole, itraconazole, posaconazole, flucytosine and amphotericin B, but resistant to caspofungin. The minimum inhibitory concentration (MIC) for fluconazole was 8 mg/l (Table 1).

Antifungal therapy was commenced with fluconazole (10 mg/kg PO q12h [Symbion Pharmacy Services]) and amphotericin deoxycholate (0.5 mg/kg; subcutaneous infusion in 350 ml 0.45% NaCl and 2.5% dextrose three times weekly).14 Monitoring for potential nephrotoxicity included weekly serum urea and creatinine determinations and urinalyses.

Four weeks after treatment commenced, the cat was brighter, with complete resolution of the head tilt, although inappetence persisted. Combination therapy continued. At 8 weeks, the cat had received a cumulative amphotericin B dose of 12.5 mg/kg, and was starting to eat and gain weight. Owing to finances, the frequency of amphotericin B infusion was reduced to twice weekly (dose 0.7 mg/kg/infusion). Fluconazole was continued (50 mg PO q12h). No azotaemia developed during therapy.
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cat had a nasopharyngeal cryptococcal granuloma
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emphasised the need for surgical intervention and/or
therapy and initial de-bulking within the ear canal. While recent papers concerning C gattii VGI infections of
the nasal cavity and contiguous tissues in koalas have
emphasised the need for surgical intervention and/or
tralesional therapy because antifungal agents may not
penetrate well into poorly perfused tissues, the require-
ment for this probably should be made on a case-by-case
basis.20,21 Surgical excision is not always possible, as in
this cat.

C gattii VGGI can be divided into VGGIa, VGGIb and
VGGIc strains, with VGGIa being the major genotype in
the Vancouver Island outbreak. Determining the specific
biotype is critical because C gattii VGGI and VGGIII isolates
tend to demonstrate heteroresistance to fluconazole.22–25
The epidemiological cut-off values for fluconazole in
VGGI and VGGIII infections are therefore higher than for
VGI and C neoformans var grubii isolates.22–25 In this
instance the causal VGGI isolate was susceptible to
fluconazole in vitro, with a MIC of 8 mg/l. Given the

Table 1 Antifungal susceptibility data for the
Cryptococcus gattii VGGII isolate cultured from the cat

| Antifungal agent  | MIC (mg/l) | Interpretation |
|------------------|------------|----------------|
| Amphotericin B   | 0.25       | S              |
| Fluconazole      | 8.00       | S              |
| Itraconazole     | 0.06       | S              |
| Ketoconazole     | 0.03       | S              |
| Posaconazole     | 0.12       | S              |
| 5-Flucytosine    | 0.50       | S              |
| Voriconazole     | 0.06       | S              |
| Caspofungin      | 16.00      | R              |

S = susceptible; R = resistant; MIC = minimum inhibitory concentration

Discussion
Peripheral vestibular disease associated with cryptococ-
cosis has been previously reported in three cats.15 One
cat had a nasopharyngeal cryptococcal granuloma
caused by C gattii VGI. Treatment involved removal of the
granuloma followed by oral itraconazole. In another
cat, otitis media due to C neoformans var grubii infection
was managed by a total ear canal ablation and lateral
bulla osteotomy, followed by oral itraconazole. In the
third cat ventral bulla osteotomy and twice weekly
amphotericin B subcutaneous infusions, with oral flucy-
tosine and fluconazole, were used. In these latter two
cats, diagnosis was made on cytological and histological
evaluation of material removed via bulla osteotomy, cul-
ture and serum antigen testing.
The cat presented initially with unilateral peripheral
vestibular disease. As a mass in the left external ear canal
was detected during preliminary examination, an aural
cyst arising from the middle ear was initially suspected.
Presence of additional signs, including dysphonia, inapp-
etence and weight loss, may have suggested a more
sinister underlying aetiology. Cytology from the external ear
canal resulted in a prompt diagnosis of cryptococcosis;
however, failure to improve clinically to azole monothera-

Three months after diagnosis, the cat was appetant
and BCS was 5/9. The frequency of amphotericin B infu-
sion was reduced to once weekly (0.7 mg/kg/infusion). Four months after diagnosis, LCAT was 1:256 and the
plasma concentration of fluconazole was 45 mg/l. Seven
months after diagnosis, the LCAT was 1:64 and was 1:32
a further 3 months later, with a corresponding plasma
concentration of fluconazole of 47 mg/l. After 12 months,
the weekly amphotericin B infusions (0.7 mg/kg) were
discontinued and the cat continued to be clinically well,
receiving only fluconazole (50 mg q12h). At the time of
writing, 21 months after starting therapy, the LCAT was
1:8 and the cat continued to be clinically well.

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The primary site of infection and the chronology of
disease progression are speculative. Inhalation of air-
borne basidiospores or desiccated yeast cells into the
nasal cavity is considered the primary route of infection
in cats.14 Colonisation of the caudal nasal cavity, with
subsequent epithelial invasion, possibly in the vicinity of
the nasopharynx, may have been the primary route of
infection, with extension via the auditory tube to the
middle ear. Possible pathways from the inner ear into
the brainstem include erosion through the medial aspect
of the petrous temporal bone (although this was not
apparent in the CT scans), along the nerves and vessels
of the internal acoustic meatus, or via haematogenous
spread.16,17 Inoculation of cryptococcal organisms
directly into the external ear canal, with subsequent
spread to the middle ear by penetration of the tympanic
membrane is considered unlikely and usually results in
only superficial lesions.18 A grass seed heavily contami-
nated with cryptococcal cells may provide an explana-
tion for how this might have occurred, although these
are less commonly found in the ear canal of cats than
dogs. This case is quite distinct from a recent feline case
of bilateral cryptococcal otitis interna, which was
thought to have arisen haematogenously as there was no
evidence of rhinosinusitis disease or otitis media, and a
small cryptococcal lesion was also present in the thala-
mus; this patient was infected with C neoformans var
grubii.19

The pathogenesis of cryptococcus in this cat is unus-
usual and supports the contention by Sykes and Malik
that VGI and VGIII infections are more invasive than
C gattii VGI and C neoformans var grubii infections.14
All clinical signs resolved after aggressive medical
therapy and initial de-bulking within the ear canal. While recent papers concerning C gattii VGI infections of
the nasal cavity and contiguous tissues in koalas have
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instance the causal VGGI isolate was susceptible to
fluconazole in vitro, with a MIC of 8 mg/l. Given the
pharmacokinetics of fluconazole in the cat, a dose of 10 mg/kg PO q12h should produce peak blood concentrations of fluconazole at steady state in the order of 20–80 mg/l.20

In eastern Australia, about 20% of cryptococcosis in cats and dogs is caused by C gattii (predominantly VG1).1 In Western Australia, VGIIb (mating type α) is the predominant species of C gattii, although VG1 and VGII (mating type α) also occur. Studies on the C gattii VGIIa isolates from the Vancouver Island outbreak and VGIIb isolates from Australia have demonstrated that such strains are highly virulent in experimental infections of mice and rats.26,27

Although central nervous system (CNS) involvement is an important negative prognostic indicator in feline cryptococcosis, this cat improved markedly with combination therapy using amphotericin B and fluconazole.28,29 Cross-sectional imaging was not often undertaken when cases of cryptococcosis were first recorded in the veterinary literature. In this case, clinical findings and plain radiographs would not have provided indication of the extensiveness of the disease, and the success of medical therapy in this cat testifies that good outcomes may occur despite extensive invasive disease.

Treatment for CNS cryptococcosis is prolonged and should be continued until the LCAT titre reaches zero, which may take 1–2 years.14 In recovered cats, the titre can be monitored every 3–6 months to allow early detection of recurrences, which is more common than re-infection with a new strain or antifungal resistance.29,30

Conclusions
This case report describes the successful medical treatment of otogenic meningoencephalomyelitis due to C gattii (VGII) infection in a cat.

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Conflict of interest
The authors do not have any potential conflicts of interest to declare.

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