Presentation and outcome of rhino-orbital-cerebral mucormycosis in patients with diabetes

A Bhansali, S Bhadada, A Sharma, V Suresh, A Gupta, P Singh, A Chakarbarti, R J Dash

Aim: To report presentation and outcome of rhino-orbital-cerebral mucormycosis (ROCM) exclusively in patients with diabetes mellitus.

Methods: Retrospective, non-comparative, intervention analysis of the medical records of 35 patients with ROCM among 22,316 patients with diabetes seen over the last 12 years.

Results: A cohort of 23 men and 12 women with a mean (SD) age of 47.3 (14.4) years (range 18–70 years) was studied. Five patients had type 1 diabetes mellitus, 29 had type 2 diabetes mellitus, and one had secondary diabetes. Nine patients had ROCM as the first clinical manifestation of diabetes. The mean (SD) blood glucose at presentation was 20.6 (8.3) mmol/l (range 10.0 to 53.3 mmol/l) and 17 patients had ketosis/ketoacidosis. Ophthalmic symptoms and signs were pronounced: external ophthalmoplegia (89%), proptosis (83%), visual loss (80%), chemosis (74%), and eye lid gangrene (14%). Non-ophthalmic manifestations included sinusitis (100%), nasal discharge/ulceration (74%), intracranial VI nerve palsy (46%), palatal necrosis (29%), cerebral lobe involvement (20%), and hemiparesis (17%). Computed tomography/magnetic resonance imaging showed involvement of paranasal sinuses in all patients with ethmoid (86%) and maxillary (80%) sinuses being most frequently involved. Orbital involvement was observed in 80% of patients with cavernous sinus thrombosis in 11%, and internal carotid occlusion and hydrocephalus in 3% each. All were treated with amphotericin B (3–3.5 g) and 26 (74%) patients underwent appropriate surgery. Twenty one patients (68%) survived with a mean (SD) follow up of 39.6 (34.1) months (range 10 months to 11 years). Factors related to poor survival included delay in diagnosis and treatment (p<0.05), facial and/or eye lid gangrene (p<0.05), hemiplegia (p<0.05), cerebral invasion by mucorales (p<0.05), and treatment with amphotericin B alone (p<0.05).

Conclusions: In patients with diabetes and ROCM, ROCM was the presenting manifestation in one fourth of the patients. Ophthalmic and extensive cerebral involvement predominated in the clinical picture. Delay in treatment due to late presentation and associated complications were major determinants of the survival outcome in these patients.
patients before admission to our centre. The lag time between onset of symptoms referable to mucormycosis and the start of amphotericin B ranged from three to 45 days with mean (SD) of 13.8 (10.3) days. The mean (SD) blood glucose at presentation was 20.6 (8.3) mmol/l with a range of 10.0–53.3 mmol/l. Five patients had diabetic ketoacidosis (blood glucose >13.8 mmol/l, ketonuria, pH ≤ 7.3, and bicarbonate ≤ 15 mmol/l) and 12 had ketosis (blood glucose >13.8 mmol/l, ketonuria, pH >7.3, bicarbonate >15 mmol/l). One patient had hyperosmolar non-ketotic coma with a serum osmolality of 326 mosmol/kg and had acidosis caused by acute renal failure. Two patients were hypertensive: one had dilated cardiomyopathy and other had recent anterior wall myocardial infarction.

Clinical features of these patients are summarised in tables 1 and 2. Eight patients had onset of their disease with toothache with one developing submandibular abscess later, one with otitis externa and perichondritis followed by ophthalmomplegia, and one with catarrh. Eight (29%) patients had altered sensorium at presentation, while two others developed it during their hospital stay, one due to internal carotid artery occlusion, and the other due to hydrocephalus. Ophthalmomplegia (89%) was the most frequent presentation followed by proptosis (83%). Visual loss (80%) was observed in 26 patients at presentation and two patients developed it during their hospital stay. One patient had bilateral proptosis, ophthalmomplegia, and visual loss.

On computed tomography/magnetic resonance imaging, all patients had evidence of paranasal sinuses involvement. The ethmoid (86%) and maxillary sinuses (80%) were most commonly involved, followed by sphenoid and frontal sinus in six (17%) each and pansinusitis in five (14%) (fig 1A). Two patients had a gas shadow over the maxilla suggestive of acute maxillary sinusitis. Two (7%) patients had a gas bubble over the sphenoid sinus suggestive of sphenoid sinusitis. Of the two patients who had panrhinorrhea, one was positive for acid-fast bacilli cultivation from the nasal/sinus aspirate, and the other was positive on PCR for cytomegalovirus.

Table 2 Frequency of non-ophthalmic signs and symptoms; values are percent

<table>
<thead>
<tr>
<th>Clinical presentation</th>
<th>Present study (n = 35)</th>
<th>Yohai et al af</th>
<th>Ferry et al af</th>
</tr>
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<tbody>
<tr>
<td>Sinusitis</td>
<td>77</td>
<td>48</td>
<td>20</td>
</tr>
<tr>
<td>Nasal discharge/</td>
<td>77</td>
<td>48</td>
<td>20</td>
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<tr>
<td>ulceration</td>
<td></td>
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<tr>
<td>Facial swelling</td>
<td>46</td>
<td>30</td>
<td>31</td>
</tr>
<tr>
<td>VII nerve palsy</td>
<td>46</td>
<td>22</td>
<td>–</td>
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<tr>
<td>(infranuclear)</td>
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<td></td>
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<tr>
<td>Facial anaesthesia</td>
<td>34</td>
<td>20</td>
<td>6</td>
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<tr>
<td>Altered sensorium</td>
<td>29</td>
<td>34</td>
<td>–</td>
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<tr>
<td>Palatal necrosis</td>
<td>29</td>
<td>32</td>
<td>19</td>
</tr>
<tr>
<td>Fever</td>
<td>26</td>
<td>36</td>
<td>–</td>
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<tr>
<td>Toothache</td>
<td>24</td>
<td>7</td>
<td>–</td>
</tr>
<tr>
<td>Facial pain</td>
<td>20</td>
<td>23</td>
<td>–</td>
</tr>
<tr>
<td>Headache</td>
<td>20</td>
<td>17</td>
<td>–</td>
</tr>
<tr>
<td>Epistaxis</td>
<td>20</td>
<td>10</td>
<td>–</td>
</tr>
<tr>
<td>Brain abscess</td>
<td>20</td>
<td>8</td>
<td>–</td>
</tr>
<tr>
<td>Meningitis</td>
<td>7</td>
<td>20</td>
<td>–</td>
</tr>
<tr>
<td>Sinusitis</td>
<td>100</td>
<td>79</td>
<td>69</td>
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<tr>
<td>Epistaxis</td>
<td>74</td>
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</tr>
<tr>
<td>Headache</td>
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<td>Headache</td>
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<td>Epistaxis</td>
<td>73</td>
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DISCUSSION

ROCM typically originates in the nasal or oral mucosa, spreads to the paranasal sinuses, and enters the orbit via the ethmoid and maxillary sinuses or via the nasolacrimal duct. Intracerebral extension may occur from the orbit via orbital apex, orbital vessels, or via cribriform plate. Intracerebral extension may occur from the orbit via orbital apex, orbital vessels, or via cribriform plate. Diabetes predisposes to this infection, as is seen in the majority of instances of ROCM (60%–81%) in different series.2 5 11 Ketonuria in diabetes offers an added advantage to this
fungal invasion, as is seen in half of our patients. The acidic milieu reduces the binding of iron to transferrin, thereby more free iron and lack of a dialysable inhibitory factor in patients with diabetes offer favourable conditions for fungal multiplication.

Yohai et al reviewed 145 case reports of ROCM, 60% of them had diabetes, and analysed their ophthalmic and non-ophthalmic signs and symptoms occurring at any time during the course of disease. Similarly Ferry and Abedi reported 16 cases of ROCM; 13 (81%) of them had diabetes. We have compared our observations with these two available series where the majority of the patients had diabetes.

Periorbital swelling and pain were observed in 66% and 43% of patients by us, compared with 43% and 11% respectively by Yohai et al. Ptosis in absence of ophthalmoplegia was reported in 3% of patients, whereas all our patients with ptosis had concomitant ophthalmoplegia. Ophthalmoplegia (89% v 67%) and proptosis (83% v 64%) were more frequently observed by us compared with others. These were attributed to direct infiltration of retro-orbital tissue in 25, cavernous sinus thrombosis in two, and two had both. Visual loss was observed in 80% of our patients, compared with 65% reported by Yohai et al and 25% by Ferry et al. It was attributed to central retinal artery occlusion in seven, endophthalmitis in two, cavernous sinus thrombosis in four, while in others orbital vascular involvement could have been the possible cause. Cavernous sinus thrombosis due to mucormycosis is typically associated with vision loss as was seen in all our patients. Endophthalmitis has been rarely reported (1%) with ROCM but in our series two (6%) patients had it. Overall it seems that orbital manifestations were more common in our patients than reported in the literature. This could be due to delay in admission, thereby permitting spread of infection to the orbital tissue. Orbital manifestations are due to ischaemic necrosis of the intraorbital cranial nerves, orbital cellulitis, or rarely ocular invasion by mucorales.

With regard to nasofacial and oral manifestations, our patients had more extensive involvement than reported by Yohai et al particularly with regard to facial swelling (46% v 30%), facial parasthesias (34% v 20%), nasal ulceration or necrosis (74% v 48%), palatal necrosis (29% v 32%), and infranuclear facial palsy (46% v 22%). Similarly, Ferry et al reported black eschar of skin, nasal mucosa, or palate in only 19% of their patients.

The occurrence of central nervous system involvement in the form of brain abscesses involving the frontal and temporal lobes was observed in 20% of patients whereas Yohai et al reported this in 8% of their patients. However, altered sensorium (29%), hemiparesis (17%), and meningeal signs (11%) were comparable with others. It must be realised that if sensorium does not improve with normalisation of pH, anion gap and electrolytes in a patient with diabetic ketoacidosis, mucormycosis should be considered. Worsening of sensorium in a patient with established mucormycosis suggests cerebral invasion or a major vascular occlusion by mucorales. Of our two patients with sino-orbital mucormycosis who developed altered sensorium
negative and positive results alone are not sufficient to make
with others. Internal carotid artery thrombosis is a rare
lateral convexity, was evident in 11% which was comparable
appears as a filling defect within the enhancing sinus or as a
usually results from spread of infection from the orbit and
complication, which manifests as a massive cerebral infarc-

Figure 2. (A) Gross photograph showing haemorrhage and necrosis of
both orbitofrontal areas of the brain: right more than left. (B) Microphotograph showing aseptate long, broad, slender right angled
branching hyphae of Mucor spp (arrow) with tissue debris in background (Grocott's stain).

during the recovery phase of ketoacidosis, one had internal
carotid artery occlusion and the other had hydrocephalus due
to post-infarct perilisosomal oedema.

Computed tomography or magnetic resonance imaging are
useful modalities to assess the extent of the disease. In our
study paranasal sinuses were involved in all patients, with
ethmoid and maxillary being the most frequent, while Ferry
et al and Yohai et al reported sinuses involvement in 69% and
79% respectively. Orbital involvement observed as an orbital
mass and/or thickening of the recti and optic nerve were seen
in the majority (80%) of our patients. Intracranial extension
with cerebral lobe involvement were observed in 20% com-
pared with 8% by Yohai et al. Cavernous sinus thrombosis
usually results from spread of infection from the orbit and
appears as a filling defect within the enhancing sinus or as a
lateral convexity, was evident in 11% which was comparable
with others. Internal carotid artery thrombosis is a rare
complication, which manifests as a massive cerebral infarc-
tion on imaging, and flow defect on colour Doppler imaging
was seen in one of our patients.

The diagnosis of mucormycosis can be made by direct
microscopy or histopathological examination, or by culture
on Sabroud’s agar. The detection of aseptate hyphae with
right angled branching is pathognomonic. Cultures are often
negative and positive results alone are not sufficient to make
the diagnosis as mucorales can be grown from specimens
from an uninfected mucosal and skin surfaces. All patients
had tissue diagnosis either on smear and/or biopsy from
affected tissues and culture was positive in some (23%) of
them.

Amphotericin B is partially effective therefore surgical
debridement becomes essential. Antral wash, lateral

rhinotomy, pansinusectomy, orbital exenteration, and some-
times intracranial surgery are performed depending upon
the extent of the disease. Extensive orbital involvement by
mucorales required orbital exenteration in 11 (42%) patients
and nine (82%) of them survived. This is in concurrence with
other observers who feel orbital exenteration may be life
saving in an actively inflamed orbit with a blind, immobile
eye.3

Factors associated with poor survival in ROCM include (i)
delay in diagnosis and treatment, (ii) hemiparesis, (iii)
bilateral sinus involvement, and (iv) facial necrosis. Yohai
et al reported survival of 63% of patients with a lag time from
seven to 12 days and 44% in those with a lag time of 13 to
30 days.1 In our analysis, 85% patients survived who had lag
time from three to nine days, but only 55% survived with a
lag time of 10 to 45 days. Similarly, those with hemiplegia,
facial/eye lid gangrene, and cerebral invasion by mucorales
had a poor survival in our series as also reported by Yohai
et al.1 Patients who received surgical treatment in addition to
amphotericin B had a better outcome than those who
received amphotericin B alone. This is in agreement with
observations made by others.10–12 However, survival outcome
was not affected by the presence of ketoacidosis in our study,
possibly because of extensive disease and late presentation.
However, our survival rate was comparable to that reported
in western countries (68%–72%) in different series.1 4 5

In conclusion, our patients with ROCM exhibited more
extensive ophthalmic and cerebral involvement compared
with their western counterparts, probably because of late
presentation. Delay in treatment and associated complica-
tions were major predictors of survival outcome.

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Pre-aortic paraganglioma

A 49 year old man with chronic headaches, longstanding anxiety, and fatigue presented with poorly controlled hypertension. Type 2 diabetes had been diagnosed recently. There was no history of palpitations, flushing, or chest pain; blood pressure was 170/100 mm Hg. Physical examination was otherwise normal.

His history prompted the measurement of urine catecholamines. Urine metadrenaline was raised at 85.6 μmol/24 hours (normal 0–5.5) and urine noradrenaline was markedly raised at 15388 μmol/24 hours (normal 90–600); urine dopamine and adrenaline were normal. $^{131}$I-MIBG scintigraphy showed increased isotope uptake in the epigastric area (arrow, fig 1). Abdominal computed tomography showed a lobulated mass in the region of the left coeliac axis (arrow, fig 2). A large vascular pre-aortic phaeochromocytoma was subsequently removed. Blood pressure and glucose tolerance normalised after surgery.

Phaeochromocytomas are rare tumours accounting for fewer than 1% of cases of hypertension. Extra-adrenal tumours termed paragangliomas occur in 10% of patients and arise from neural crest derivatives. They predominantly secrete noradrenaline. Phaeochromocytomas occur equally in both sexes and usually present in the third and fourth decades of life. Ninety percent of tumours are sporadic, while 10% occur as part of an inherited syndrome like multiple endocrine neoplasia type 2, Von Hippel-Lindau syndrome, or neurofibromatosis.

In the absence of classical paroxysms, the symptoms of catecholamine excess may be protean and non-specific. A high index of suspicion remains the cornerstone of diagnosis.

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