Fungal infections in drug users

C. L. S. Leen and R. P. Brettle

Regional Infectious Diseases Unit, City Hospital, Edinburgh EH10 5SB, UK

Fungal infections may account for 5–50% of serious infections in intravenous drug users, and for 5–50 per 100,000 hospital admissions. The fungi most commonly encountered are Candida and Aspergillus spp. Candidosis may be disseminated, with lesions in superficial structures, the eye and the skeletal system, or limited to the eye, the heart (as endocarditis) or the central nervous system. Aspergillosis usually presents as endophthalmitis or as central nervous system infection. Mucormycosis is also met with occasionally, and various fungi may cause endophthalmitis or endocarditis. Antifungal therapy for intravenous drug use-related infections is no different from that for similar mycoses in other patients, but the management of intravenous drug users requires considerable clinical skill.

Introduction: epidemiology of infections in intravenous drug users

It is difficult to determine exactly how commonly intravenous drug use (IDU)-related infection occurs, because few doctors systematically record drug use as an associated problem. The incidence will also depend on the number of drug users in any particular location although surprisingly similar data have been obtained from very different areas. For instance, the survey by Stone, Stone & MacGreggor (1989) from Glasgow revealed that 0·6% of all consultations at an accident and emergency department were by injection drug users. Similar results were reported from Basel, Switzerland where 0·78% of all admissions to a university hospital during a seven year period involved narcotic drug users (Scheidegger & Zimmerli, 1989). In 30·9% of these IDU-related admissions infection was the exclusive or main reason for admission and a further 20·3% of the infections were as a consequence of viral hepatitis. A pre-human immunodeficiency virus (HTV) series from the USA of 200 consecutive admissions, during a five-month period, to the medical inpatient unit of a hospital devoted to drug addiction also revealed that 58% were related to infection, 30·5% because of acute viral hepatitis and 27·5% as a consequence of other infections (White, 1973). The other infections identified consisted of endocarditis (3·5%), bacteraemia without an obvious source (11%), chest infections (29%) and skin infections (43·5%). A survey of accident and emergency consultations by drug users in Edinburgh revealed that 22% were as a consequence of some form of infection (McGowan et al., 1984). Thus it appears that IDU-related medical problems account for between 0·5 and 1% of all hospital medical problems and that IDU-related infections account for between 20 and 60% of these problems, i.e. 0·1–0·6% of all hospital admissions.

In Edinburgh during 1983–84 there were an estimated 2000 injection drug users and 80 of these attended the accident and emergency department during a four month
period (Haw & Liddell, 1989; McGowan et al., 1984). As stated above, this survey showed that 22% of consultations by drug users were as a consequence of some form of infection (McGowan et al., 1984). The majority of these, some 73%, were described as local infections, 18% as some form of hepatitis and only 9% as a consequence of systemic infection. This suggests an incidence of clinical IDU-related infection of about 2-5% of the drug-using population; 20% of these infections were due to viral hepatitis, and less than 1% was serious infection. During 1984 there were 100 admissions to Lothian hospitals for infections such as hepatitis, endocarditis, pneumonia and skin infections out of a population of 2000, suggesting an incidence of around 5% for IDU-related infections (Haw & Liddell, 1989; Brettle, Flegg & MacCallum, 1991). Eighty one per cent of these infections were bacterial and 15% were serious (pneumonia or endocarditis). Thus the annual incidence of clinical IDU infection for a drug using population is probably somewhere between 2-5 and 5%, about 20% of these infections being viral. The annual incidence for serious infections derived from these data is between 0.25 and 0.75% which is of the same order as the accident and emergency department survey.

A general practice survey in Edinburgh revealed that 50% of drug users had suffered some form of infection during their IDU career (Robertson & Bucknall, 1986). Most IDU-related infection problems at that time were hepatitis B (76%); skin infections accounted for 14% of the total and endocarditis for only 10%. Thus, serious systemic infections such as endocarditis seem to have an annual incidence of about 0.75%, but perhaps a lifetime prevalence of about 10%, compared with an 80-90% lifetime prevalence for blood-borne viral infections. Perhaps surprising is the rarity of systemic infection, considering that, even in Edinburgh, users were injecting three or four times daily. This demonstrates how effective the host defence system is during most of the time.

However, HIV may alter these estimates because it has now been shown that such infection leads to increased susceptibility to bacterial infection. Drug use had been identified as a risk factor for tuberculosis before the advent of the acquired immune deficiency syndrome (AIDS) (Reichman, Felton & Edsall, 1979), but nonetheless the incidence of tuberculosis is much higher in HIV-positive drug users than in other risk groups outside the tropics or in HIV-negative drug users. In the USA, most patients with AIDS and tuberculosis have been drug users (Sunderam et al., 1986; Handwerger et al., 1987). The second of these studies showed a prevalence of 15-1% in drug users with AIDS, but only 44% in other risk groups within a New York hospital. A similar pattern has been shown in San Francisco (Chaisson et al., 1987). In New York, tuberculosis occurred in 4% of HIV-positive drug users but was not found in HIV-negative drug users. The 36% increase in the number of reported cases of tuberculosis between 1984 and 1986 in the USA has been largely ascribed to infection amongst HIV-positive drug users (Centers for Disease Control, 1987; Selwyn et al., 1989).

Encapsulated bacteria such as Streptococcus pneumoniae and Haemophilus influenzae are frequent respiratory pathogens and causes of bacteraemia in HIV-positive individuals (Simberkoff et al., 1984). In a study of bacteraemia from a hospital in Africa, HIV-positive individuals were significantly more likely (26% versus 6%) to have bacteraemia than HIV-negative individuals (Gilks et al., 1990). HIV-positive drug users also have a higher incidence of recurrent bacterial infections such as pneumonia (12%, with a mortality of 2.2%) than HIV-negative drug users (3% with no mortality) (Selwyn et al., 1988a). The annual incidence of pneumonia was 9.7% for HIV-positive
Fungal infections in drug users

Although fungi are important pathogens in drug users, fungal infections have remained uncommon even with the advent of HIV infection. Of 404 IDU-related admissions to a Swiss hospital over a seven-year period only one was related to candidaemia, the commonest fungal infection associated with injection drug use, and this resolved spontaneously without treatment. This suggests an incidence of only 0.25% among hospitalized drug users or 0.8% of all of IDU-related infections (Scheidegger & Zimmerli, 1989). The incidence of fungal infections in series of serious infections such as endocarditis is extremely varied. For instance, of the 200 consecutive admissions reported by White (1973) only two were cases of endocarditis, but one of these was due to candida. However, other series report much lower figures. Sapira (1968) reported only one case of fungal endocarditis in a series of 20 cases from an addiction centre in Kentucky but in his literature review of endocarditis in narcotic drug users there were 13 cases caused by fungi (19%) among a total of 67 cases. Another series of 48 episodes of endocarditis from Bellevue Hospital in New York included six cases (12.5%) in
C. L. S. Leen and R. P. Bettle

Table I. Distribution of lesions in disseminated candidosis in drug users

<table>
<thead>
<tr>
<th>Site and type of lesion</th>
<th>% of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scalp and beard lesions</td>
<td>80</td>
</tr>
<tr>
<td>Folliculitis affecting axillae</td>
<td>15-25</td>
</tr>
<tr>
<td>Ocular lesions</td>
<td>50</td>
</tr>
<tr>
<td>Costochondral foci</td>
<td>10</td>
</tr>
<tr>
<td>Spondylodiscitis</td>
<td>7</td>
</tr>
</tbody>
</table>

which candida was the only pathogen isolated (Louria, Hensle & Rose, 1967). Thus fungi may account for between 5 and 50% of serious IDU-related infections. If taken together with the figure of 0-1% of hospital admissions for serious IDU-related infections, this would suggest that IDU-related fungal admission rates are of the order of 5–50 per 100,000 admissions.

Candidosis

Disseminated candidosis

Candida infection is a well recognized complication of intravenous heroin abuse and outbreaks of disseminated candidosis have been reported among intravenous heroin users worldwide (Mellinger et al., 1982; Collignon & Sorrell, 1983; Calandra et al., 1985; Dupont & Drouhet, 1985). This syndrome, caused by *C. albicans*, is characterized by cutaneous, ocular, osteoarticular and possibly pleuropulmonary involvement alone or in combination (Mellinger et al., 1982). At least 160 cases have been described (Odds, 1988), many of which have indicated the epidemic nature of this condition; the largest outbreak appears to have been associated with the use of Iranian or brown heroin (Mellinger et al., 1982; Servant et al., 1985).

In disseminated candidosis, all patients describe sudden onset of fever, shivers, myalgia, headaches and profuse sweating shortly after the intravenous injection of heroin. The fever usually lasts between one and three days, and is followed by cutaneous signs in more than 90% of cases (Dupont & Drouhet, 1985). These take the form of numerous painful nodules, 0.5–1.0 cm in diameter, occasionally surrounded by some erythema and usually located in the scalp and hairy parts of the body (Table I). Untreated, they gradually resolve within four weeks, generally leaving an area of alopecia. Sometimes, the nodule can discharge thick yellow pus. Painful pustules are also present in some patients; they are 2–3 mm in diameter on an inflamed base and may be widely disseminated. They may resemble streptococcal or staphylococcal folliculitis. Patients often have high titres of *C. albicans* antibodies, but the organism is readily isolated from skin lesions (Collignon & Sorrell, 1983).

The eyes are affected by haematogenous spread in 40% (Dupont & Drouhet, 1985) to 65% (Mellinger et al., 1982) of cases. This usually occurs about one to two weeks after the onset of fever. Patients complain of a painful red eye with photophobia and reduced visual acuity. Lesions are white and cotton-ball-like and are chorioretinal in origin; they can rapidly progress to involve the vitreous (see below).

Osteoarticular involvement occurs in 17% (Mellinger et al., 1982) to 26% (Dupont & Drouhet, 1985) of cases and may appear between 15 days to 5 months after the
Fungal Infections in drug users

Cutaneous nodules. Costochondral involvement is the most frequent and characteristic finding in this syndrome and involvement of vertebral, sacroiliac and other peripheral joints is unusual (Collignon & Sorrell, 1983; Dupont & Drouhet, 1985). One study found gallium scintigraphy to be more sensitive than technetium scanning in the detection of the costochondral tumour (Miró et al., 1988). The diagnosis can be made by isolation of candida from articular or abscess pus, or by bone biopsy. Patients respond well to amphotericin B, ketoconazole, combination therapy with amphotericin B and flucytosine, and surgery. Despite earlier reports of the importance of surgical curettage (Thomas et al., 1977; Yap, Ravitch & Pataki, 1981), many cases of costochondritis resolve without surgical intervention (Dupont & Drouhet, 1985).

Pleuropulmonary involvement was recorded in 8% of cases in one study (Mellinger et al., 1982), but _C. albicans_ was always isolated in conjunction with other pathogens such as _Staphylococcus_ spp. or other yeasts, such as _C. (Torulopsis) glabrata_.

_C. albicans_ has not been isolated from pure heroin samples or from samples seized from drug dealers (Mellinger et al., 1982; Dupont & Drouhet, 1985). Pure heroin has a fungicidal effect against _C. albicans_ (Dupont & Drouhet, 1985; Shankland, Richardson & Dutton, 1986), but this effect cannot be demonstrated with samples of street heroin which only contain 1–15% of pure drug. _C. albicans_ has, however, been isolated from injection paraphernalia, fresh lemons, and bottled lemon juice (Shankland et al., 1986) and, recently, lemon juice has been shown to be an excellent growth medium for the yeast (Newton-John, Wise & Looke, 1984; Podzamczer & Gudiol, 1986). This suggests that a likely source of infection in disseminated candidosis is contaminated lemon juice which is carried by drug users in order to dissolve brown heroin. Miró et al. (1987) showed that the rate of _C. albicans_ carriage among heroin users is high and suggested that users often contaminate their containers of lemon juice because identical yeast strains are usually isolated from users and their containers of juice. In France, it has also been suggested that the yeasts may originate from saliva; injection drug users commonly lick their needles before injecting the heroin and hence may inject _C. albicans_ from saliva into the bloodstream (Barthelemy et al., 1981; Badillet, Pietrini & Puissant, 1983).

*Candida endocarditis*

In a review of 48 cases of endocarditis in narcotic users, Louria et al. (1967) found nine cases caused by candida infection. Seven of the nine occurred in patients with previous rheumatic valve disease. Two cases had concomitant infection with enterococci and pseudomonas. The high proportion cases of candida endocarditis occurring in patients with preexisting rheumatic valve disease or damaged valves suggests that the yeast is usually incapable of initiating infection in a normal valve.

In a larger review of 23 cases of IDU-related fungal endocarditis, _C. parapsilosis_ (52%) was the commonest species isolated (Rubinstein et al., 1975). Other _Candida_ spp. isolated from IDU-related endocarditis have included _C. krusei_, _C. tropicalis_, _C. guilliermondii_, and _C. stellatoidea_. _Aspergillus_ spp. and _C. albicans_ are rarely associated with IDU-related endocarditis: aspergillus endocarditis was not diagnosed among the group of 23 cases, and the only case of _C. albicans_ endocarditis is thought to have occurred in one patient already under treatment for staphylococcal endocarditis (Henderson & Nickerson, 1964).
Joachim & Polayes (1940) isolated \textit{C. parapsilosis} from a package containing heroin and Brandstetter & Brause (1980) isolated the same organism from the injection paraphernalia of a drug user with \textit{C. parapsilosis} endocarditis, but others including Wikler \textit{et al.} (1942) have been unable to culture candida from narcotic drugs though other fungi were isolated. It is therefore likely that infection is caused by organisms colonizing the skin of drug users and that these are introduced as a result of inadequate skin cleaning prior to drug injection. Skin cleaning has been shown to reduce the risks of endocarditis and skin abscesses. Among 110 active drug users in San Francisco questioned about skin cleaning, only 4-2\% of those who cleaned the skin some of the time had had endocarditis compared with 14-5\% of those who did not clean the skin. Forty eight per cent of those who never cleaned the skin had suffered skin abscesses compared with 24\% of those who sometimes cleaned (Herb \textit{et al.}, 1989).

Large vegetations are seen in candida endocarditis and there is a high incidence of embolization to the large arteries. The diagnosis can be made by echocardiography (Pasternak, Cannom & Cohen, 1976) and serology is another useful non-invasive procedure (Child & Shanley, 1979). Complications include the lodgement of septic emboli in pulmonary, cerebral, renal and other medium sized arteries, myocardial abscesses and cerebral haemorrhage.

The mortality rate is high among injection drug users with bacterial endocarditis (28\%) (Louria \textit{et al.}, 1967), but even higher among those with fungal infection (87\%) (Rubinstein \textit{et al.}, 1975). Only three of 14 patients who received some form of anti-fungal therapy survived (Rubinstein \textit{et al.}, 1975).

\textit{Candida} infections of the central nervous system

Cardiac and cerebral candida infections often occur simultaneously (Goodman, Otero & Parker, 1978; Parker, 1980). Indeed in the series reported by Louria \textit{et al.} (1967), four of nine patients developed septic embolization to the brain following candida endocarditis.

In a postmortem series of 19 patients with cerebral candidosis (Parker, McCloskey & Lee, 1981), lesions were detected in other organs in every case; the kidneys were involved in 90\% and the heart in 80\%. The lesions in cerebral candidosis consist of intracerebral microabscesses and noncaseating granulomata without diffuse leptomeningitis. These occur late in the disease, and candida involvement of the heart and kidneys is a major contributing factor to the patient's death (Parker \textit{et al.}, 1981).

Patients usually have clinical symptoms suggesting meningitis but may also present with focal neurological signs. The cerebrospinal fluid (CSF) may be clear with a low grade pleocytosis, the protein concentration may be very high and the glucose concentration may be low or normal. Combination therapy with amphotericin B and flucytosine appears to be better than amphotericin B alone for treatment (Smego, Perfect & Durack, 1984).

To date, there has been only one well documented case of candida meningitis in an injection drug user without any evidence of endocarditis. The patient recovered after receiving intravenous and intrathecal treatment with amphotericin B and flucytosine (Kantor \textit{et al.}, 1984). Only one patient from two French series of disseminated candidosis in 73 heroin users developed meningitis (Mellinger \textit{et al.}, 1982, Dupont & Drouhet, 1985). In this patient, the condition apparently resolved spontaneously with no detectable deficit when reviewed 12 months later (Mellinger \textit{et al.}, 1982).
**Candida endophthalmitis**

Since 1970 fungal endophthalmitis subsequent to fungaemia has been described among injection drug users. Although a variety of organisms have been implicated, *C. albicans* has been the commonest agent since the early 1980s.

The clinical features have been reviewed previously (Griffin *et al.*, 1973; Edwards *et al.*, 1974). Patients complain of blurred vision, ocular pain, photophobia, 'floaters' etc. The intraocular infection probably begins with foci of fungal growth in the choroid or retina. The vitreous body may become involved by a local inflammatory reaction in the cortical vitreous gel overlying the retinal lesion, or fungi may break through the internal limiting membrane of the retina and grow into the vitreous cavity.

The earliest lesion is a small yellow-white retinal exudate (cotton wool spot). This may be unilateral or bilateral and may regress spontaneously or slowly develop into a vitreous abscess. The margins of the lesion become hazy, the vitreous becomes increasingly cloudy and one or more balls of yellowish white exudate protrude into the vitreous. Extension into the anterior chamber is a late finding (Meyers, Lieberman & Ferry, 1973).

Endogenous *Candida* endophthalmitis associated with IDU may present differently from endophthalmitis in immunocompromised patients; in some injection drug users there may be no evidence of systemic candidosis. Anterior uveitis and extensive vitreous involvement are common and retinal lesions, which usually precede or are associated with vitreous inflammation and condensation, are often observed. This may be because of the transitory nature of the retinal lesions or because drug users often present late for treatment (Aguilar *et al.*, 1979).

Various reports highlight the difficulty and delay in diagnosis of ocular fungal infection. At present it is often necessary to perform both a diagnostic paracentesis and vitrectomy. It is difficult to culture *Candida* spp. from the vitreous (Getnick & Rodrigues, 1974; Horne *et al.*, 1975) because the yeasts are sequestered within white cell infiltrates (Axelrod & Peyman, 1973). Vitreous aspiration may fail to recover *Candida* because the organisms are contained within large inflammatory nodules, which are difficult to aspirate through a needle (Aguilar *et al.*, 1979). Vitrectomy is therefore the diagnostic procedure of choice.

Treatment of candida endophthalmitis is complicated by the lack of effective non-toxic antifungal agents that readily penetrate the eye. The ocular penetration of amphotericin B following systemic administration is poor (Green, Bennett & Goos, 1965), and intravitreal injection is now considered the only sure way of achieving therapeutic intraocular concentrations (Stern, Fetenhoure & O'Grady, 1977). Slow intravitreal injection of 5 to 10 µg of amphotericin B has been shown to be safe in rabbits, but larger doses are retinotoxic (Axelrod, Peyman & Apple, 1973). Systemic amphotericin B and flucytosine alone have been successful in maintaining useful vision in certain patients with endogenous candida endophthalmitis.

**Aspergillosis**

*Aspergillus endophthalmitis*

To date, seven cases of aspergillus endophthalmitis have been described in the literature (Sugar, Mandell & Shalev, 1971; Elliott *et al.*, 1979; Doft *et al.*, 1980; Michelson, Freedman & Boyden, 1982; Roney *et al.*, 1986; Lance, Friberg & Kowalski, 1988). The
clinical features are similar to those of candida endophthamitis. However, extraocular involvement prior to the diagnosis of ocular disease has not been a feature of aspergillus endophthalmitis in injection drug users (Sugar et al., 1971; Elliott et al., 1979; Doft et al., 1980), although Michelson et al. (1982) have described one case with a metastatic focus of infection in the seventh rib. Clinical findings include anterior uveitis, vitreitis, and fluffy vitreous infiltrates.

Vitrectomy is indicated both diagnostically and therapeutically in patients with suspected fungal endophthalmitis; pathogenic organisms can be identified and antibiotic sensitivities can be performed. The mechanical removal of large numbers of organisms may result in rapid resolution of the infection. In addition, removal of vitreous matrix may prevent subsequent retinal detachment (Snip & Michels, 1976). Early vitrectomy and intraocular injection of amphotericin B have been successful in treating aspergillus endophthalmitis (Doft et al., 1980; Michelson et al., 1982). In one case, despite extensive retinal and vitreous involvement, the patient recovered useful vision as a result of early diagnostic and therapeutic vitrectomy (Lance et al., 1988). Some patients also received antifungal agents subconjunctivally and systemically (Doft et al., 1980; Michelson et al., 1982).

**Aspergillus infections of the central nervous system**

Aspergilli are ubiquitous organisms that most commonly cause pulmonary infections. To date, only five cases of central nervous system (CNS) aspergillosis have been described in injection drug users (Burston & Blackwood, 1963; Gordon et al., 1976; Kaufman, Thal & Farmer, 1976; Bryan et al., 1980; Morrow et al., 1983). Aspergillus spores often contaminate illicit drugs: Tuazon, Hill & Sheagren (1974) found viable spores in 26 of 109 samples of illicit heroin. It is thought that users of heroin by injection who suffer CNS aspergillosis are infected following direct inoculation of viable spores intravenously. In the rat model of aspergillosis, large inocula of aspergillus spores are needed to cause progressive brain disease, and this may partly explain why CNS aspergillosis is not very common among injection drug users (Turner et al., 1975).

A review of the literature suggests that CNS aspergillosis in drug users is different from that in immunocompromised patients. Immunocompromised patients suffer from single or multiple brain abscesses with marked vascular involvement and secondary tissue infarction, but the meninges and ventricles are rarely involved directly (Meyer et al., 1973). Of the five cases reported among drug users, the one described by Burston & Blackwood (1963) had such a clinical picture, but the others had evidence of direct fungal involvement of the meninges or ventricles. CSF examination showed at least 1000 white cells per cu mm on at least one occasion and low CSF glucose concentrations. The organism was isolated from three of the four patients, usually with great difficulty.

Radionuclide brain scanning with technetium has been successfully used in one drug user to demonstrate areas of cerebral involvement by aspergillus (Walsh, Hier & Caplan, 1985) while computed tomographic (CT) scanning showed only cerebral oedema in the affected area. One study suggested that CT scanning may not be sufficiently sensitive or specific for diagnosis of CNS aspergillosis (Grossman et al., 1981).
Fungal infections in drug users

Aspergillus antigens have been demonstrated in serum and pleural fluid (Weiner, 1980; Weiner et al., 1983) but no reports have appeared describing their detection in the CSF. Serological tests for antibodies to Aspergillus spp. may be helpful in establishing the diagnosis (Schaefer, Yu & Armstrong, 1976). These should be performed if CSF cultures are negative as the condition is potentially treatable, but fatal if undiagnosed.

Mucormycosis (zygomycosis)

Disseminated mucormycosis, which may be defined as the involvement of two or more non-contiguous organs, is a rare condition with less than 200 cases reported in the world literature, less than 20 of which were associated with injection drug use (Ingram et al., 1989). The pathophysiology consists of hyphal invasion of and through blood vessels with consequent haemorrhage, thrombosis and infarction, as well as tissue invasion with necrosis and occasional intense neutrophil invasion.

Infection occurs when a susceptible individual is exposed to sporangiospores of this group of ubiquitous saprophytic organisms. Susceptibility is associated with neutropenia, acidosis and a breakdown in the physical barriers to infection (Ingram et al., 1989). The commonest predisposing factor is malignancy, usually leukaemia, which accounted for 51% of the patients reported. Other associated factors included renal disease (10-8%), injection drug use (7%), gastrointestinal disease (8-6%) and organ transplantation (2-7%) (Ingram et al., 1989). Cell mediated immunodeficiency is not usually on its own a predisposing factor unless there are additional problems such as acidosis and organ transplantation, acidosis and renal failure, AIDS and injection drug use (Ingram et al., 1989).

Hameroff, Eckboldt & Lindenberg (1970) first noted the association between injection drug use and mucormycosis. Injection drug users without HIV infection suffer primary cerebral mucormycosis which presents as a rapid deterioration in neurological state and is associated with a mortality rate of between 70-85% (Hameroff et al., 1970; Masucci et al., 1982; Micozzi & Wetli, 1985; Ingram et al., 1989; Stave, Heimberger & Kerker, 1989). No one drug is associated with the problem and survival seems largely to be associated with rapid recognition, intravenous amphotericin B therapy and surgical debridement. The diagnosis is usually made by tissue biopsy but the organism is easier to culture from paranasal tissue than from either brain tissue or CSF (Sweeney et al., 1980). Mucormycosis in drug users with AIDS has a different clinical presentation with progressive cutaneous disease a prominent feature. Mostaza et al. (1989) reported the case of a male drug user with AIDS who presented with a large thigh haematoma that ulcerated, spread to the adjacent knee joint and eventually killed the patient following rupture of the femoral artery despite surgical debridement and therapy with amphotericin B.

Miscellaneous infections

Various other fungal infections have been reported in injection drug users, but few authors have discussed the role of immunosuppression due to HIV infection (Brahn & Leonard, 1982; Schuster, Valentine & Holzman, 1985; Swan et al., 1985). The heart and eyes are the two main organs involved and it is to be expected that other species will occasionally cause infections at these sites.
Trichosporon beigelii (cutaneum) endocarditis involving the aortic valve has been described in a 42-year-old intravenous heroin user without any significant previous medical history (Brahn & Leonard, 1982). Aortic insufficiency developed and this necessitated a prosthetic valve replacement; *T. beigelii* was cultured from the vegetations. Treatment with amphotericin B and flucytosine was successful, but systemic septic embolization to the left thigh was a complicating feature, which was treated conservatively. The patient was also treated with warfarin, but unfortunately died one year later from a cerebral haemorrhage at which time there was no clinical evidence of persistent fungal infection. A fatal case of *Pseudallescheria boydii* endocarditis in a 43-year-old male injection drug user treated with valve replacement, pacemaker insertion and miconazole was described by Armin, Reddy & Orfei (1987).

A *Penicillium* sp. was recovered from a vitreous aspirate in a 30-year-old male injection drug user (Swan *et al.*, 1985). Treatment with amphotericin B and flucytosine resulted in sterilization of the vitreous but visual acuity was limited to light perception only.

**Conclusion**

Systemic fungal infections in intravenous drug users are undoubtedly uncommon, but, whilst some such infections do resolve spontaneously, others are fulminant and the mortality from an established fungal infection appears to be high, possibly of the order of 80–90%. The management of fungal infection in drug users is no different from that in other patients, but the drug use requires skilful deployment to ensure a continued antifungal effect. The advent of HIV infection in drug users has increased the risks of endocarditis and other systemic infections and it is therefore possible that the problem of serious fungal infections in drug users may increase in the near future.

**References**


Fungal Infections in drug users