CDC Recommendations for **Treatment of Severe Disease, including Inhalation and Gastrointestinal Anthrax, Anthrax Meningitis, and Bacteremia**

Clinical or subclinical meningitis in patients with IA is likely. Meningitis is reported with all 3 clinical forms of anthrax and likely results from hematogenous spread across the blood-brain barrier when bacteremia is present. During the 2001 outbreak, although only 1 of the 11 IA case-patients had meningitis, 4 others had symptoms suggesting meningeal involvement. Confirmation of meningitis was not obtained in these 4 case-patients, and cerebrospinal fluid was not examined in all patients. If these 4 case-patients did have subclinical or early meningitis, then 45% of the 2001 IA case-patients had meningeal involvement ([*33*](http://wwwnc.cdc.gov/eid/article/14/4/07-0969_article.htm#r33)). Additionally, hemorrhagic leptomeningitis was reported from autopsies in 21 (50%) of 42 IA fatalities from the 1979 Sverdlovsk outbreak ([*35*](http://wwwnc.cdc.gov/eid/article/14/4/07-0969_article.htm#r35)); meningoencephalitis was reported in 44% of fatal cases in a review of 82 IA cases from 1900 to 2005 (including the 11 bioterrorism (BT)-related cases from 2001) ([*34*](http://wwwnc.cdc.gov/eid/article/14/4/07-0969_article.htm#r34)). Furthermore, IA studies of nonhuman primates have demonstrated meningeal involvement in up to 77% of experimental animal cases ([*32*](http://wwwnc.cdc.gov/eid/article/14/4/07-0969_article.htm#r32)). Therefore, meningeal involvement should be suspected in IA or other cases of systemic anthrax.

For treatment of anthrax cases with severe systemic or life-threatening disease (including IA and gastrointestinal anthrax), and for cases with fulminant bacteremia, IV ciprofloxacin is recommended over doxycycline as the primary antimicrobial agent unless ciprofloxacin use is contraindicated (fluoroquinolones are bactericidal while tetracyclines are bacteriostatic). Additionally, because meningeal involvement is likely in systemic anthrax cases, ciprofloxacin is theoretically favored over doxycycline; central nervous system (CNS) penetration of ciprofloxacin in the presence of meningeal inflammation is much higher than the poor CNS penetration of doxycycline ([*31*](http://wwwnc.cdc.gov/eid/article/14/4/07-0969_article.htm#r31)). Although ciprofloxacin is the only fluoroquinolone for which data are available, other fluoroquinolones with similar spectrums of activity and CNS penetration may also be appropriate.

At least 1 or more additional agents with adequate CNS penetration and in vitro activity against *B. anthracis* (e.g., ampicillin or penicillin, meropenem, rifampin, or vancomycin) should be used in the treatment of systemic cases of anthrax regardless of clinical suspicion of meningeal involvement. Clindamycin is strongly recommended for inclusion in the antimicrobial regimen because of its ability to inhibit protein synthesis, which may reduce exotoxin production. Participants recommended continuing the current 60-day course of antimicrobial therapy, with adjustment of the regimen based on the clinical course of the disease in the patient ([*36*](http://wwwnc.cdc.gov/eid/article/14/4/07-0969_article.htm#r36)). The use of corticosteroids as an adjunct to antimicrobial therapy may benefit patients with anthrax meningitis ([*31*](http://wwwnc.cdc.gov/eid/article/14/4/07-0969_article.htm#r31)); however, with no efficacy data from controlled clinical trials, this adjunctive treatment may be of no benefit for toxin-mediated tissue edema.

Early and aggressive pleural fluid drainage is recommended for all IA case-patients and is consistent with the standard of care for empyema or complicated pneumonia. This recommendation is based on the experience that chest tubes or early serial drainage of pleural effusions seemed to be beneficial in the successful clinical therapy of the surviving IA patients in 2001 and in the recent 2006 IA case ([*2*](http://wwwnc.cdc.gov/eid/article/14/4/07-0969_article.htm#r2)*,*[*33*](http://wwwnc.cdc.gov/eid/article/14/4/07-0969_article.htm#r33)). Evaluation of the treatment of IA cases from 1900 to 2005 showed pleural fluid drainage to be significantly associated with decreased mortality ([*34*](http://wwwnc.cdc.gov/eid/article/14/4/07-0969_article.htm#r34)). Analysis of serial pleural fluid samples from the 2006 IA case showed high pleural fluid lethal toxin levels. The positive outcome of this case likely resulted from a combination of the mechanical effects on respiration from fluid drainage and the reduction in lethal toxin levels by removing pleural effusions ([*2*](http://wwwnc.cdc.gov/eid/article/14/4/07-0969_article.htm#r2)).

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