Isolation of an Organism Resembling *Clostridium barati* Which Produces Type F Botulinal Toxin from an Infant with Botulism

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All reported cases of infant botulism except one have been caused by proteolytic strains (group I) of *Clostridium botulinum*, toxin types A or B. We describe the cultural and biochemical characteristics of the causative organism of this singular case of infant botulism, caused by type F botulinal toxin. Although this organism produces type F botulinal toxin, it is quite different from proteolytic (group I) *C. botulinum*, being more closely related to *Clostridium barati*.

The first clinical cases of botulism in infants were described in 1976 (6). Unlike classic foodborne botulism, in which preformed toxin is ingested and absorbed, infant botulism is an intoxication caused by the absorption of botulinal toxin produced in vivo in the intestinal tract of the infant after colonization of the tract by and multiplication of *Clostridium botulinum*. From 1975 through 1983, 395 cases of infant botulism in the United States have been reported to the Centers for Disease Control, Atlanta, Ga. (unpublished data). All cases except one have been caused by *C. botulinum* types A or B, although in several of the type B cases, the toxin was atypical (L. M. McCroskey and C. L. Hatheway, Abstr. Annu. Meet. Am. Soc. Microbiol. 1984, C159, p. 263). One case was reported as being caused by *C. botulinum* type F (2). The present report describes the recovery of the causative organism from this case of infant botulism. The organism is culturally and biochemically quite different from the proteolytic strains of *C. botulinum* which have been found in all other confirmed cases of infant botulism, but it produces a lethal, paralytic toxin which is neutralized by type F botulinal antitoxin. The clinical features of this case have been reported previously (4).

The organism was recovered by culturing the feces of the infant by methods published previously (3). From 26 December 1979 to 14 January 1980, 14 fecal specimens from this infant were received for analysis at the Scientific Laboratory Division, New Mexico Health and Environment Department, Albuquerque. Although type F botulinic toxin was detected in fecal extracts and enrichment cultures from 12 of these specimens, attempts to isolate the organism were unsuccessful. All lipase-positive isolates recovered from egg yolk agar were nontoxic. The other two specimens were toxic, but the toxicity was not neutralized by botulinal antitoxins.

On 15 January 1980, two more fecal specimens from this infant were received. Enrichment cultures of these specimens were also positive for type F toxin. On these specimens, however, all clostridial isolates were tested for toxicity. An organism was isolated that produced type F toxin but that, on biochemical analysis, appeared to be more closely related to *Clostridium barati* than to *C. botulinum* group I. This organism produced acid from glucose, lactose, sucrose, maltose, salicin, mannose, and trehalose. Mannitol, xylose, arabinose, starch, rhamnose, raffinose, and inositol were negative. Indole, catalase, and urease were not produced. Gelatin was not digested. Esculin was hydrolyzed, and nitrate was reduced. Acetic, butyric, and lactic acids were detected by gas-liquid chromatography. This lecithinase-positive, lipase-negative, nonmotile *Clostridium* strain is biochemically similar to *C. barati*, as described by Cato et al. (1), except for the positive reaction with trehalose. However, some strains of *C. barati* do ferment this carbohydrate (5; Centers for Disease Control Anaerobe Laboratory, unpublished data). This organism also differs in that it is toxic to mice. The toxicity is not neutralized by type A, B, C, D, or E botulinal antitoxins but is neutralized by polyvalent (ABCDEF) and type F antitoxin. Mice inoculated with this toxin exhibit characteristic signs of botulism; we therefore conclude that this organism produces a toxin that is similar, if not identical, to type F botulinal toxin.

Four additional stool specimens (received between 14 March and 2 May 1980) from this infant were tested. Three of these specimens still contained type F toxin, although the last of these three (received 16 April) appeared to contain less toxin than did the other two (received 14 and 28 March). The last specimen from this infant (received 2 May) was nontoxic. No attempt was made to isolate a toxigenic organism from any of these specimens.

It appears that the organism responsible for this case of infant botulism is of a different species from those found in *C. botulinum* group I. The present nomenclature practice of giving the name *C. botulinum* to clostridial species that produce botulinal toxin disregards the great disparity between the cultural and physiological properties of these organisms. Therefore, as pointed out by Smith (7), *C. botulinum* is not really a single species of bacteria but a conglomerate of four quite distinct groups (groups I, II, III, and IV). These groups are similar only in that they are clostridia and produce toxins with similar action. There are
nontoxic clostridia related to each group, some of which have separate species designations. Since the toxicogenic organism isolated from this case of infant botulism does not fit into any of the present C. botulinum groups, it could be considered as belonging to a fifth group (group V). Although it may be premature to suggest such a classification, the properties of this organism point out the disparate nature of the organisms currently classified as C. botulinum. A comparison of the characteristics of this organism with those of the four groups of C. botulinum is presented in Table 1. This case of infant botulism is the only one reported to date known to be caused by an organism other than proteolytic (group I) C. botulinum.

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LITERATURE CITED