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Bacteriology of a Bear Bite Wound to a Human: Case Report

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Human contact with bears has become more frequent, as has the resultant bear maulings and bite injuries. We report the bacteriology of a patient bitten by a grizzly bear (*Ursus arctos*) from the Rocky Mountains foothills area east of Banff National Park, Alberta, Canada. The patient received field care, including metronidazole and cefazolin. Subsequent deep-wound cultures grew *Serratia fonticola*, *Serratia marcescens*, *Aeromonas hydrophila*, *Bacillus cereus*, and *Enterococcus durans* but no anaerobes.

CASE REPORT

A 49-year-old hunter was attacked by a grizzly bear while hunting elk in the foothills of the Canadian Rocky Mountains. This attack took place in the foothills area outside of and east of Banff National Park, Alberta, within the known grizzly bear range, which is a narrow strip of 60 km between the continental divide and the prairies. He suffered multiple injuries to his scalp and shoulders. In particular, he remembered the bear biting him on the skull. He was able to kill the bear with his gun. He was taken to a local hospital where he received one dose of cefazolin plus metronidazole and a tetanus toxoid injection. The patient was then transferred to a tertiary care hospital where he received 1 g of cefazolin immediately prior to surgical debridement and closure of multiple lacerations. Teeth marks were noted on the cranium. Cultures were taken from the scalp lacerations at the time of surgery, about 12 h after the injuries occurred.

Laboratory data showed 14.1 g of hemoglobin/liter, 10.5×10^9 white blood cells/liter, and 9.1×10^9 neutrophil cells/liter. The erythrocyte sedimentation rate was 25 mm/h. C-reactive protein elevated at 109 mg/dl. Cultures eventually grew strains of *Serratia fonticola*, *Serratia marcescens*, *Aeromonas hydrophila*, *Bacillus cereus*, and *Enterococcus durans*. The gram-negative bacteria were all susceptible to cefotaxime, ceftriaxone, ciprofloxacin, gentamicin, and trimethroprim-sulfamethoxazole but resistant to ampicillin, cefazolin, and cefuroxime. The enterococcus was ampicillin and vancomycin susceptible. No anaerobes were isolated even though an anaerobic culture was obtained.

Postoperatively, the patient was started on 4.5 g of piperacillin-tazobactam intravenously every 8 h. Since the attack was unprovoked, the patient was given rabies vaccine and rabies immunoglobulin. The bear's brain was later examined for rabies virus and was found to be negative; consequently, subsequent doses of rabies vaccine were discontinued. The patient received 1 week of therapy with piperacillin-tazobactam and was subsequently given 875 mg of amoxicillin-clavulanate orally twice a day and 500 mg of ciprofloxacin orally twice a day for three additional weeks. There was a good clinical response.

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As more North Americans enter wilderness areas for recreation and to build homes, the habitats of humans and wild animals begin to merge, and their interactions increase. Bear populations have increased, and bear and human encounters, including maulings and bites, have also become more common (1, 5, 6, 9, 12, 13).

It is estimated that there are approximately 1,000 grizzly bears and 39,000 black bears in Alberta (7). Black bears are the smallest of North American bears and weigh approximately 200 pounds and stand 5 feet tall. Grizzly bears weigh more than 350 pounds and stand 6 1/2 feet tall. Bears feed voraciously in the summer months on an omnivorous diet that consists of 90% plants (grass, horsetail shoots, bulbs, wild lilies, wild onions, cow parsnips, and huckleberries) and 10% animal matter (ground squirrels, insects including ants and beetles, and occasional deer and winter elk) (8, 10). In Alberta, from 1960 to 1998, 42 documented serious or fatal injuries were caused by bears with most (69%) caused by grizzly bears, even though they make up only 2.5% of the total bear population in Alberta (7). Only an estimated 17% of the 1,000 Alberta grizzly bears are located in the national parks in Alberta, but 72% of grizzly attacks occur in the national parks. It is thought that this is mostly due to the large number of people entering into the grizzly bear habitat. For example, Banff National Park, which is located on the western edge of the province of Alberta along the eastern side of the Canadian Rocky Mountains, has over 4.5 million visitors a year and only an estimated 60 to 80 grizzly bears. Ten of the 42 serious or fatal injuries caused by bears in Alberta from 1960 to 1998 occurred in Banff. Similarly, Glacier National Park is located in northern Montana near the Canadian (Alberta)-U.S. border and has an average of 2.1 million visitors annually. It was estimated in 1987 that approximately 500 black bears and 200 grizzly bears live in Glacier National Park (8). In the last 5 years at Glacier National Park, there has been one fatality and an additional 13 people injured in 10 encounters (Gary Moses, personal communication). There is no estimate as to the number of bear sightings. The Interagency Grizzly Bear Committee has a website which includes

TABLE 1. Bacteria most frequently isolated from grizzly and black bears

Organism	% Detection of bacteria in bearflora cultures		
	Grizzly[a]	Black[a]	Grizzly or black[b]
Escherichia	15	17	40
Citrobacter	9	8	10
Streptococcus	7	10	61
Erwinia	8	5	NS
Staphylococcus	5	8	48
Hafnia	7	7	10
Enterobacter	7	4	25
Aeromonas	2	5	NS
Proteus	6	4	6
Acinetobacter	3	4	6

[a] Data from Goatches. et al. (3).
[b] Data from Parry et al. (11). NS, not stated.

advice on how to prevent encounters and what to do in case of attack (http://www.fs.fed.us/r1/wildlife/igbc). They suggest that when in bear country, make noise to make your presence known. If a black bear approaches, try to scare it away by shouting, making noise, or throwing small stones. If a black bear attacks, fight back, whereas if a grizzly bear attacks, play dead; either curl up in a ball or lie face down, using your hands and arms to protect the back of your neck and face.

It has been reported (12) that the risk of infection following bear bite is "considerable," with 4 out of 9 (44%) survivors developing clinical infection. Most surviving bear bite victims receive a variety of therapies in the field, including cleansing of the wounds and early antimicrobial administration prior to hospitalization. However, the bacteriology of these wounds is limited by the absence of systematic study and the paucity of patients cultured, and cultures are not usually taken prior to, or even after the initiation of, antimicrobial therapy (12). Consequently, there are scant data regarding the bacteriology of bear bite wounds (12) or regarding the oral flora of wild bears (3, 11), and conclusions about the most appropriate antimicrobial therapy are moot.

Prior studies with dog and cat bites have shown that it is the oral flora of the biting animal that is usually isolated from bite wound infections and form the basis of empirical antimicrobial therapy (4). Goatcher et al. (3) reported a study of nasal, rectal, and preputial or vaginal swab cultures in black and grizzly bears in northwestern Alberta, Canada, and suggested that "the predominant microflora of both grizzly and black bears were transient and probably influenced by their foraging habits and surrounding environments." They did not specify which bacteria were isolated from individual sites.

Parry et al. (11) took mouth cultures of 31 brown and grizzly bears in several Alaska locales and reported general groupings of isolates with scant specific bacteriological identifications. They found that 21 oral samples from bears had mixed gram-positive and gram-negative flora. Nine had only gram-negative bacteria isolated and one had only gram-positive flora. *Staphylococcus epidermidis* was present in 14 out of 31 (45%), streptococci were present in 13 out of 31 (42%), *Escherichia coli* was present in 8 out of 20 (40%), diphtheroids were present in 18 out of 31 (58%), unidentifiable gram-negative rods were present in 8 out of 31 (26%), and pseudomonads were present in 3 out of 31 (10%) samples (Table 1) (5).

Rose (12) reported 10 cases of bear maulings, with the bacteriology of three of the cases noted (Table 2). One patient's wound-associated cellulitis grew *Staphylococcus aureus*, one patient's wound grew scant *S. epidermidis*, and one patient with a fever had a wound that grew *Proteus vulgaris*, *Citrobacter diversus*, *E. coli*, and *S. epidermidis*. It was unclear if these wounds were the result of claw or bite injuries or both. The investigator was unable to recommend specific prophylactic antimicrobial therapy. Cardall and Rosen (2) reported a case of a grizzly bear attack near Jackson, Wyoming, where the wound was copiously irrigated and the patient was given empirical tetanus toxoid and cefazolin preoperatively. No cultures were reported, and the patient did not develop a postoperative infection.

Our patient showed aerobic gram-negative bacilli and enterococcus but no anaerobes. This may be due to the single dose of metronidazole or lack of anaerobic infection. It seems from the review of available data that patients who are victims of bear maulings and bites should be treated with a broad-spectrum agent with activity against *S. aureus* and aerobic gram-negative rods as was done in this case. The absence of anaerobic bacteria in any of the previously reported cultured wounds may be due to the lack of anaerobic cultures obtained from patients, prolonged transport of samples without adequate anaerobic transport conditions, use of suboptimal anaerobic culture media or methods, or early suppressive antimicrobial therapy. It seems likely that anaerobes should be present in the normal oral flora of bears, as they are prevalent in the oral flora of humans, dogs, and cats and are important pathogens in those bite wounds. Consequently, it seems prudent to administer broad-spectrum antimicrobial agents that also possess anaerobic coverage.

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TABLE 2. Bacteriology of grizzly bear bite wounds in reported cases

Patient data (age/sex)	Bear type	Isolates	Use of prior antibiotics	Source or reference
22/male	Grizzly	*S. epidermidis*	Not stated	10
21/male	Grizzly	*S. aureus*	Not stated	10
56/male	Grizzly	*P. vulgaris, C. diversus, E. coli, S. epidermidis*	Not stated	10
43/male	Grizzly	No growth	Not stated	10
49/male	Grizzly	*Serratia fonticola, Serratia marcescens, A. hydrophylia, B. cereus, E. durans*	Cefazolin + metronidazole	This study

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