SCIENTIFIC ARTICLE

Nontuberculous Mycobacterial Infections of the Upper Extremity: 15-Year Experience at a Tertiary Care Medical Center

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Purpose To present our experience with culture-positive, nontuberculous mycobacterial infections (NTMI) of the upper extremity and to compare the clinical features and outcomes of treatment among immunocompetent and immunocompromised patients.

Methods All patients at our medical center diagnosed with NTMI of the upper extremity from December 1, 2000, through December 31, 2015, were included. We performed a retrospective analysis of patient demographic characteristics, delay to diagnosis, risk factors, clinical presentation, specific location, diagnostic testing, treatment regimens, and outcomes. These variables were compared between immunocompetent and immunocompromised patients.

Results Forty-four patients were identified with culture-positive NTMI of the upper extremity. Of the patients, 27 (61%) were men (median age, 59 years [range, 23−83 years]). Twenty (45%) patients were immunocompromised. Immunocompromised patients had fewer known inoculation injuries compared with immunocompetent patients (45% vs 92%). A significant difference existed in the treatment regimens selected for immunocompetent versus immunocompromised patients: immunocompetent patients were more often treated with both antibiotics and surgery (88% vs 50%), whereas immunocompromised patients were more often treated with antibiotics alone (45% vs 4%). Overall, 24% experienced treatment failure and 9% died. Outcomes were relatively similar between immunocompetent and immunocompromised patients. A shorter delay to diagnosis was associated with a lower failure rate.

Conclusions Diagnosis of upper-extremity NTMI is often delayed because of indolent presentation and lack of clinical suspicion. The clinical presentation, diagnostic delay, and diagnostic testing results are similar between immunocompetent and immunocompromised patients. Although treatment varied significantly between patient groups, outcomes were similar. Timely diagnosis has the greatest impact on patient outcome. *(J Hand Surg Am. 2017;■(■):1.e1-e8.*

Type of study/level of evidence Therapeutic IV.

Key words Infection, nontuberculous, mycobacteria, treatment, upper extremity.

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Nontuberculous mycobacteria (NTM) are ubiquitous and have been isolated in soil, biofilms, aerosols, and water.[1] Approximately 200 NTM species have been identified.[2] These species are divided into rapidly and slowly growing mycobacteria.[3,4] Nontuberculous mycobacteria can cause disease in any organ in the body in both immunocompetent and immunocompromised patients,[4] but they most commonly affect the lungs.[3] Extrapulmonary involvement encompasses about 10% of all nontuberculous mycobacterial infections (NTMI).[5] In the adult population, the skin and soft tissues are the most common extrapulmonary sites of NTMI,[6] and it occurs more frequently in the distal extremities, particularly in the upper extremity.[4,7,8] Several case reports and case series have been described in a systematic review[9] as well as 1 large retrospective study[10] of NTMI in the upper extremity. However, there is limited information in the literature that compares immunocompetent and immunocompromised patients with culture-proven upper extremity NTMI. Therefore, we reviewed our experience with culture-positive NTMI of the upper extremity over a 15-year period, including patient demographic characteristics, delay to diagnosis, risk factors, clinical presentation, specific location, diagnostic testing, treatment regimens, and outcomes and compared characteristics and outcomes of immunocompetent and immunocompromised patients with NTMI.

METHODS

Study patients

This retrospective study was approved by our medical center institutional review board. All patients who were diagnosed with NTMI of the upper extremity (from the shoulder to the fingertips) with a positive culture result between December 1, 2000, and December 31, 2015, at our medical center were included. The following demographic information was collected from the patients' electronic health records: age, sex, delay to diagnosis (period from symptom[s] onset until diagnosis as determined from clinical notes), site of NTMI, exposure to known risks (fishing, gardening, snorkeling), known injuries or trauma (water-related injuries, puncture wounds, local steroid injection, surgical wounds, skin cuts, animal bites at the site of infection), clinical presentation, and history of rheumatological disorders (autoimmune or connective tissue conditions, eg, lupus, rheumatoid arthritis, polymyalgia rheumatica, vasculitis). The NTM species, results of diagnostic testing, treatment regimen (antibiotics and surgery, antibiotics alone, or surgery alone), and outcome (treatment failure, death associated with NTMI) were recorded for each patient. Treatment failure was defined as the absence of substantial clinical improvement (determined by the treating clinician in the medical records) or recurrence of infection, which was based on results of mycobacterial cultures. Death associated with NTMI was defined as death that occurred while the patient was being treated for NTMI or death within 6 months after completion of therapy.

Immune status was defined as follows: Immunocompetent patients were considered to be patients without any known condition that could impair immune response. Immunocompromised patients were those who had any of the following characteristics: chronic steroid use of 15 mg or greater prednisone daily for at least 3 weeks, on active chemotherapy, use of immunosuppressive monoclonal antibodies, active oncological process, solid or bone marrow transplant recipient, diabetes mellitus (hemoglobin A1c $\geq$ 6.5%), end-stage renal or liver disease, or uncontrolled acquired immunodeficiency syndrome.

Microbiology

Cultures for mycobacteria were performed using a mycobacterial growth indicator tube (BACTEC MGIT 960 System; Becton, Dickinson and Company, Franklin Lakes, NJ) and Middlebrook 7H11// 7H11Selective Agar biplates (Becton, Dickson and Company). MGIT tubes were incubated up to 6 weeks in the MGIT 960 instrument. Culture plates were incubated up to 8 weeks at 37°C in 8% CO_2. Culture samples were obtained from skin nodules, ulcers, abscesses, fistulas, bursae, synovium, and synovial fluid of tendon sheaths or joints and bone. Cultures of suspected *Mycobacterium marinum* or *Mycobacterium ulcerans* were inoculated to an additional biplate and incubated at 30°C for up to 8 weeks. Definitive identification was performed using standard biochemical methods and DNA sequencing.[3]

Statistical analysis

Continuous variables were summarized with the sample median and range. Categorical variables were summarized with number and percentage of patients. Comparisons of characteristics, diagnosis information, and treatment information between immunocompetent and immunocompromised patients were made using a Wilcoxon rank sum test or Fisher exact test. Cox proportional hazards regression models