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Clinical presentation and treatment outcomes of extrapulmonary nontuberculous mycobacterial infections with rapid and slow growth rates in Cali, Colombia

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Abstract

Introduction The increasing prevalence of extrapulmonary nontuberculous mycobacterial (NTM) infections poses significant challenges in clinical management due to their inherent drug resistance, the need for prolonged antibiotic regimens and the complexities associated with surgical management. Although these infections are infrequent in daily clinical practice, detailed information on associated clinical outcomes is lacking in the local literature.

Materials and methods This descriptive observational study examined 17 patients with extrapulmonary NTM infection from the General Mycobacteria Registry of Fundación Valle del Lili University Hospital (FVL), a leading reference care center located in Cali, a city in southwestern Colombia. Notably, Cali is classified as a high-risk area for tuberculosis. The study reviewed a total of 391 patients between 2007 and 2021.

Results A predominance of women with a history of cosmetic surgery was observed, with the skin being the most common site of involvement, especially for *M. fortuitum complex* and *M. abscessus complex*. Clarithromycin based therapy was given to 14/18 (82.3%) of the patients. The mean duration of treatment was 4–6 months, for a cure rate of 15/17 (88.2%).

Conclusion The treatment regimens implemented mostly align with the literature recommendations. However, it is essential to note that while the observed cure rate exceeds 80%, this assertion is tempered by the limitation imposed by the lack of confirmatory imaging in some cases. A contributing factor to the higher cure rate observed in this study may be the use of more extensive surgical interventions, with some patients undergoing more than one procedure. Given the limited number of case series on extrapulmonary nontuberculous mycobacterial infections, these findings emphasize the potential importance of surgical management in achieving higher cure rates. The observed cure rate suggests potentially better clinical management of these infections in our region and underscores the need for future research to understand the factors contributing to this comparative therapeutic success.

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Keywords Nontuberculous mycobacteria, Fast-growing mycobacteria, Slow-growing mycobacteria, Extrapulmonary, Clinical outcome

Introduction

NTMs are ubiquitous microorganisms, comprising approximately 190 species. They primarily cause pulmonary infections but can also lead to extrapulmonary infections in both immune-compromised individuals, where they are often disseminated, and immune-competent individuals, where the infection is typically a consequence of trauma or surgery [1, 2]. NTM have been identified in various sources, including water distribution systems, biofilms and aerosols within the households of NTM patients [2]. Locally, pathogenic NTM species such as *M. chelonae* and *M. fortuitum complex* have been detected in drinking water supplies [3].

Proper characterization of NTM infections is crucial due to the global increase in NTM infections, which are linked to genetic mutations, climate change, and immunocompromised populations [4]. Reports in Colombia document NTM infections with cutaneous involvement, often from cosmetic procedures [5]. A case series in Bogotá and Cali showed higher NTM rates among HIV-infected patients [4, 6].

Identifying NTM strains poses several challenges, especially owing to the need for specialized laboratories and molecular testing for species confirmation, which are unevenly available in major cities. Species confirmation guides antibiotic therapy, which is critical due to NTM natural drug resistance. Guidelines recommend specific regimens based on species, with treatment adherence determining clinical outcomes [1, 7].

This study explored the sociodemographic and clinical characteristics, antimicrobial regimens, adverse effects, and outcomes of NTM extrapulmonary (NTM-EP) infections treated in Cali from 2007 to 2021. This study aimed to enhance the understanding of the clinical response and optimize management strategies for patients with NTM infections beyond the pulmonary system.

Methods

Study design and population

A descriptive cross-sectional observational study was conducted by thoroughly reviewing 391 patients from the General Mycobacteria Registry of FVL from 2007 to 2021. These patients were initially selected from the registry, which includes patients admitted daily, some of whom have suspected or confirmed diagnoses of mycobacterial infections, both pulmonary and extrapulmonary. From this initial list, patients meeting the temporal criteria (2007–2021) were extracted ($n = 391$), and subsequently, based on the inclusion criteria of the study, the final selection of 17 patients with NTM infection, extrapulmonary involvement, microbiological identification of NTM, and NTM treatment was made (Fig. 1). The patients included in the registry are individuals who present at our institution. As a nationally recognized reference center, we receive patients from various regions across the country, as well as international patients. The study did not impose restrictions based on geographical location or origin, encompassing both urban and rural patient populations.

Variables

The study analyzed sociodemographic variables and relevant clinical backgrounds potentially predisposing to NTM infection. Details on aesthetic procedures undergone by certain patients were provided, albeit without specific location information as these were conducted outside our institution. The immunosuppressive treatment regimen for select patients and its management during and post-NTM treatment were documented. For HIV patients, their immunological status, current antiretroviral therapy, and subsequent immunological recovery post-NTM treatment cessation were delineated. Additionally, common clinical presentations and infection sites, along with diagnostic methods (comprising microbiological, molecular, susceptibility assays for NTM, radiological, and histopathological tests), were discussed. Surgical interventions undertaken in most patients and respective findings were outlined. Lastly, treatment regimens, follow-up duration, and radiological response in select cases were described. Cure was defined as the resolution of signs and symptoms of infection. Additionally, radiological monitoring was employed in selected cases to further validate cure.

Diagnostic tests

To test for NTM in our institution, we conducted acid fast bacillus (AFB) staining of the samples, cultures of mycobacteria using two main types of tests: the BD MGIT™ TBc immunochromatographic assay from liquid cultures and solid cultures on Lowenstein-Jensen medium. All samples underwent cultures and also were complemented by molecular tests such as *Speed-Oligo Mycobacteria* and *Genotype MTBDR*. The first one is a method based on multiple PCR coupled with a double reverse hybridization system that identifies up to 12 different species, including the *M. tuberculosis complex*, *M. avium-intracellulare-scrofulaceum complex*, *M. chelonae-abscessus complex*, *M. fortuitum complex*, *M. kansasii*, and *M. gordonae* [8]; The GenoType CM/AS method performs multiple amplification with primers labeled

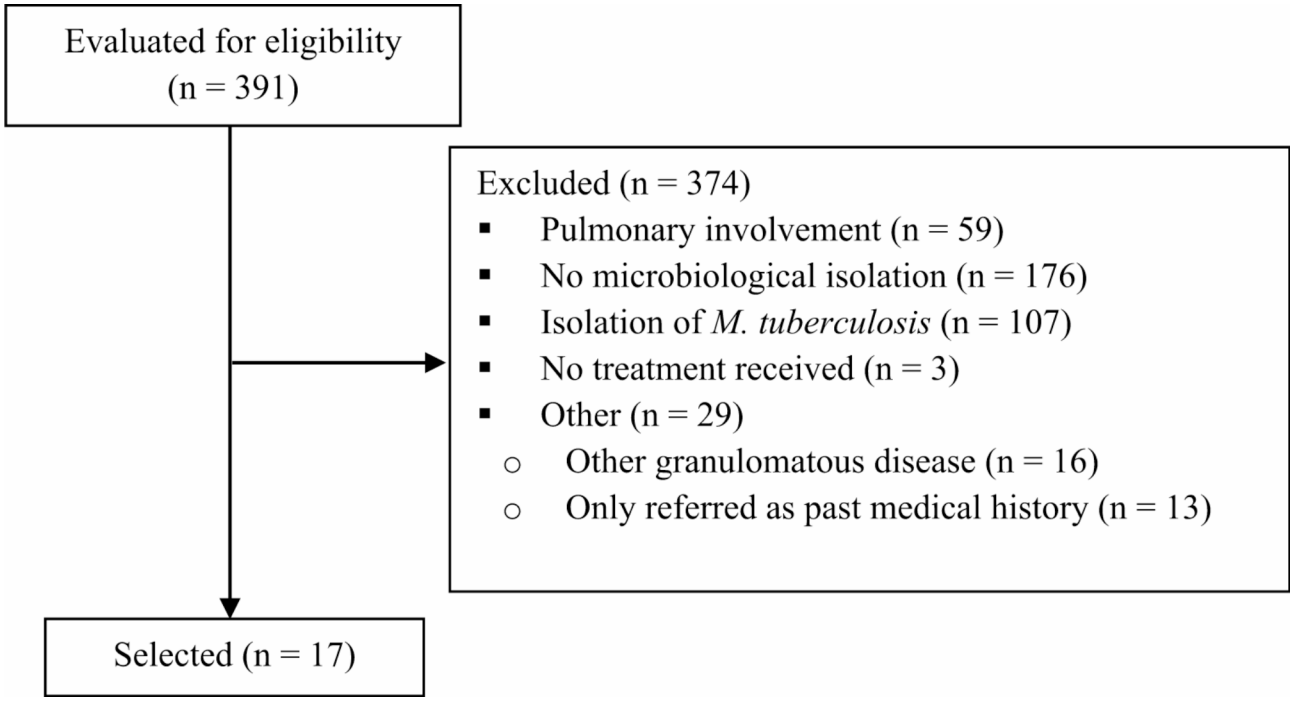

Fig. 1 Methods

with biotin and reverse hybridization that identifies up to 37 *Mycobacterium* species [9].;

Susceptibility tests for NTM were conducted using the Minimum Inhibitory Concentration (MIC) method, in microdilution format, as gene sequencing tests are unavailable at our institution. Additionally, it is important to note that gene sequencing is not routinely covered by the public healthcare system in our country; and it is only performed by the National Institute of Health for research purposes. The MIC determines the minimum amount of antibiotic capable of inhibiting bacterial growth. This method allows for the classification of Mycobacteria isolates as sensitive, intermediate, or resistant to various drugs recommended by the Clinical and Laboratory Standards Institute (CLSI) [10]. It should be noted that for rapidly growing mycobacteria (RGM), the incubation period is generally 3 to 5 days, but for macrolides like clarithromycin, an extended incubation of 14–15 days is required to accurately assess inducible resistance, specifically for *M. abscessus* and *M. fortuitum* complexes, with the exception of *M. chelonae*, which is known to lack the erm gene responsible for inducible resistance to macrolides.

Data collection techniques and management: An active search of the institution's medical records was performed using diagnoses from the International Classification of Diseases, 10th Revision (ICD-10) related to NTM infection. Selected cases were reviewed for data, and quantitative variables were described according to their distribution. The means and standard deviations were calculated, and categorical variables were described using tables of absolute and relative frequencies.

Results

Patient characteristics and clinical presentation

The age ranged from 29 to 42 years, with a median age of 38 years and 13/17 (76.5%) were female. A total of 13/17 (76.5%) of patients self-identified as mestizos, a term commonly used in Latin America to describe individuals of mixed European and Indigenous ancestry (Table 1). Seven patients (41.2%) had history of cosmetic procedures like gluteal biopolymer implants, breast augmentation surgery, mesotherapy, liposuction, lipectomy, among others. A history of immunosuppressive drug therapy was observed in 6/17 (35.3%) patients, primarily based on biological therapies such as rituximab, calcineurin inhibitors like tacrolimus and steroids. Three patients had a history of HIV, all under antiretroviral therapy, but none with undetectable viral load at the time of diagnosis and with CD4 levels outside the normal range. Significant CD4 level recovery was achieved in two of these patients; however, one patient was identified with resistance genotype for some antiretrovirals, making her immunological control more challenging (Table 1).

Fever was observed in 7/17 (41.2%) patients, and a clinical presentation with skin involvement was noted in 12/17 (70.6%) patients (Table 2). The median time between symptom onset and clinical suspicion of NTM infection was 40 days (interquartile range (IQR: 6–79), while the median time between clinical diagnosis and

Table 1 Description of patients with NTM with extrapulmonary involvement

Variable	Patients (*n* = 17)
Gender	
Female	13 (76.5%)
Male	4 (23.5%)
Age Range	
< 20 years	2 (11.8%)
21–40 years	6 (35.3%)
41–60 years	5 (29.4%)
> 61 years	4 (23.5%)
Ethnicity	
Mestizos	13 (76.4%)
Black	2 (11.8%)
Others	2 (11.8%)
Medical History	
Surgery or cosmetic procedures	7 (41.2%)
Immunosuppressive Therapy	6 (35.3%)
HIV infection	3 (17.6%)
Type 2 Diabetes Mellitus	2 (11.8%)
Bariatric surgery	1 (5.9%)
Cancer	1 (5.9%)

Abbreviations HIV: Human Immunodeficiency Virus, NTM: Nontuberculous mycobacteria

Table 2 Clinical presentation of NTM

Extrapulmonary Involvement	Patients (*n* = 17)
Soft tissues	13 (76.5%)
Skin	12 (92.3%)
Muscle	1 (7.7%)
Lymph node	3 (17.6%)
Endocardium (biological mitral valve)	1 (5.9%)

Abbreviations NTM: Nontuberculous mycobacteria

identification of the NTM isolate was 33 days (IQR: 14–189).

Microbiological diagnosis

NTM identification was carried out using the *Speed-oligo® Mycobacteria* technique in 8/17 patients (47.1%) and the *GenoType Mycobacteria* technique in another 8/17 patients (47.1%); in one of them, the identification method used was unknown. The identified RGMs were the *M. fortuitum complex* (test utilized for identifying this mycobacterium does not distinguish between the various microorganisms within the complex for both the *M. fortuitum* complex and the *M. abscessus* complex) in soft tissues and the mediastinum, the *M. abscessus* complex (Mab) in soft tissues and lymph nodes and *M. chelonae* in soft tissues and muscle. The slow-growing mycobacteria (SGM) were *M. avium* complex (MAC) in the lymph node, *M. malmoense* in the biological heart valve and *M. marinum* in soft tissues (Fig. 2).

Sensitivity profile was described for 10/17 (58.8%) patients. One *M. chelonae* strain was sensitive to aminoglycosides, macrolides, fluoroquinolones, and oxazolidinones. One patient with MAI was sensitive to quinolones, macrolides, and aminoglycosides. Among the five Mab strains, 100% were sensitive to aminoglycosides, 100% were sensitive to macrolides, 60% were resistant to doxycycline, 20% were resistant to ofloxacin, and 20% exhibited an intermediate profile of ofloxacin resistance. Among the three *M. fortuitum complex* isolates, 100% were sensitive to aminoglycosides, macrolides, and quinolones.

Radiological findings

the most commonly used diagnostic images were magnetic resonance imaging (MRI), contrast-enhanced computed tomography (CT), and ultrasound. In cases of skin infection, changes in the subcutaneous tissues and the presence of abscesses, fluid collections, and subdermal nodular lesions were observed. In cases of lymph node

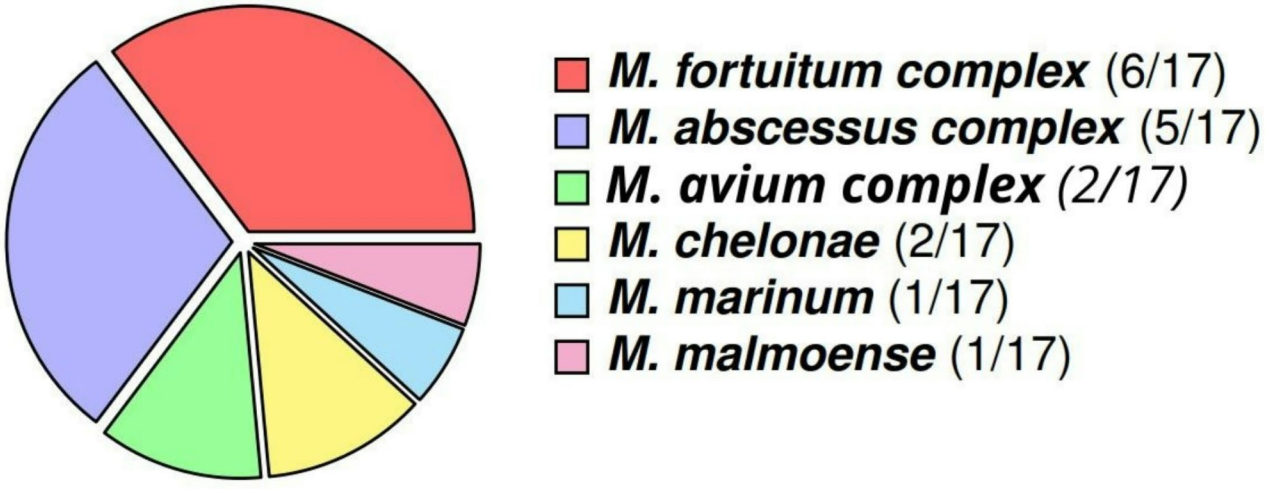

Fig. 2 Isolated mycobacteria (*n* = 17)

involvement, the CT scan revealed disseminated lymphadenopathy. Lastly, in the particular case of endocarditis, the transthoracic echocardiogram revealed vegetation on the mitral valve without signs of insufficiency.

Treatment

Antibiotic treatment: the treatment regimens used were as follows: one case of *M. marinum* treated with rifampicin and moxifloxacin; one case of *M. malmense treated* with rifampicin, moxifloxacin, and clarithromycin; two cases of *M. chelonae* treated with moxifloxacin and clarithromycin; two cases of MAI treated with clarithromycin and ethambutol; one of these cases was additionally treated with amikacin; all five cases of Mab were treated with clarithromycin; three cases additionally were treated with amikacin; and one case was treated with an additional antibiotic, doxycycline, linezolid, or levofloxacin. Among the six patients with *M. fortuitum complex* infection, five were treated with clarithromycin and moxifloxacin, and only one was treated with clarithromycin alone. The duration of treatment was not related to the type of NTM; in 8/17 (47.1%) patients, the treatment duration was 6 months, and in 3/17 (17.6%) patients, it was 4 months. Five (29.4%) patients required a treatment duration equal to or greater than 12 months (Table 3).

Surgical treatment: among the surgical procedures performed 14/17 (88.3%), mitral prosthetic valve replacement was conducted in the case of endocarditis; for soft tissue lesions, excision of nodular lesions, extraction of breast implants, surgical lavages with saline solution and surgical debridement were done; and sampling for biopsies and cultures were performed in all surgical cases. In three patients, assessed by the surgical team, no appropriate surgical area was identified. Therefore, in these cases, lavages and wound care were carried out by the enterostomal therapy group, with satisfactory outcomes. These procedures were performed on average 1–2 weeks before initiating treatment for NTM.

Follow up: to determine cure, follow up was conducted clinically, with resolution of initial signs and symptoms as well as improvement in laboratory parameters in all patients. Radiological follow up was performed in 5/17 patients (29.4%), demonstrating resolution of initial findings without evidence of relapse. Only in two patients the follow-up was not completed; therefore, information regarding treatment duration and outcome is not available for them. The average follow-up duration for the remaining patients was 2.5 years. No deaths were recorded. Finally, significant adverse effects were observed in 3/17 (20%) patients, all of whom required modification of the antibiotic regimen: one patient withdrew from moxifloxacin due to reactive arthritis, and two patients experienced amikacin-related hearing loss and tinnitus. The most common adverse effects without requiring a change in the antibiotic regimen were gastrointestinal symptoms, particularly nausea, vomiting, and dyspepsia.

Discussion

Aspects related to the presentation of NTM infection

The analysis of patients revealed NTM-EP infection in a high-complexity hospital in Cali, Colombia. Information on NTM-EP in Colombia has been limited. Cases of cutaneous infections in patients undergoing cosmetic procedures, especially those involving *M. chelonae* [11, 12], Mab and *M. fortuitum* [12, 13], have been reported. Valvular involvement by *M. peregrinum* has also been reported [14], along with involvement of the MAI, *M. parascrofulaceum*, *M. terrae* [15, 16] and *M. fortuitum* [17] in the HIV population. This study contributes to the understanding of the extrapulmonary manifestations of both RGM (*M. chelonae*, Mab, *M. fortuitum)* and SGM (*M. malmoense*, MAI and *M. marinum).*

In most countries, local studies have estimated the incidence of NTM infection, as it is not considered a notifiable disease. The incidence reported in the United States was 0.011% [18], while in India, it ranged from 0.93% in 2011 to an increase of 1.6% in 2020 [19]. In Colombia, prevalence studies have shown a 1.5% prevalence in respiratory isolates, with *M. fortuitum* and Mab being the most prevalent [20], and a 5% prevalence in the HIV population [4]. The prevalence of MAI infection in the HIV population is estimated to be 7–12% [2, 6, 21], with disseminated presentation [2].

In this study, the presence of *M. fortuitum complex* (46%), Mab (31%), *M. chelonae* (15%), and *M. marinum* (8%) was detected in patients with cutaneous involvement. This differs from reports in India and Japan, where *M. chelonae*, Mab, and *M. ulcerans* are the most reported isolates [19, 22]. In China, the MAI, Mab, and *M. kansasii* are observed [23], and *M. fortuitum* is the most common [24], mostly related to trauma.

The MAI complex can cause pulmonary or disseminated infections in patients with HIV, chronic lung diseases, and hematologic neoplasms, frequently presenting as lymphadenitis in children and immune reconstitution syndrome [25]. *M. malmoense* is associated with medical devices, manifesting as adenitis, tenosynovitis, and occasionally endocarditis [26]. Rapidly growing NTMs, such as *M. abscessus*, linked to various cosmetic procedures, can lead to intravascular and implantable device complications (5). *M. chelonae* shows delayed manifestations compared to other skin colonizers (9), while *M. marinum* affects aquarium workers and swimmers, with its cutaneous manifestation known as "fish tank granuloma.". *M. fortuitum*, has been linked to cutaneous and lymphatic infections, particularly at injection sites and traumatic injuries (5).

Table 3 Clinical characteristics, microbiological identification, resistance profile, and treatment outcomes in extrapulmonary NTM infections

Diagnosis	Clinical profile	Treatment and outcome
Microbiological confirmation: *GenoType Mycobacterium* CM/AS - ***M. malmoense*** - No DST. Transesophageal echocardiogram: mitral bioprosthesis with mobile vegetation. Pathology report: calcifications along with focal zones of necrosis. Positive acid-fast bacilli staining.	A 61-year-old male with dermatomyositis treated with prednisolone and rituximab, with a biological prosthetic mitral valve due to rheumatic valvulopathy, develops fever, dyspnea, and chest pain. Endocarditis on the prosthetic aortic valve is diagnosed.	Surgical treatment: the prosthetic valve is replaced with a biological prosthesis 2 days after starting NTM treatment. The dysfunctional mitral prosthesis was excised. Pharmacological management: CLR 500 mg b.i.d + MXF 400 mg q.d + RIF 600 mg q.d for 12 months. Immunosuppression: Rituximab was suspended and steroid dose was reduced. It was restarted 6 months after completing treatment for NTM. Outcome: An echocardiogram was performed once treatment was completed, showing no evidence of vegetations. The patient exhibited no signs of clinical deterioration with appropriate evolution after 3 years of follow-up.
Microbiological confirmation: *GenoType Mycobacterium* CM/AS in culture of surgical wound secretion and mediastinal fluid. - ***M. fortuitum complex*** - Sensitive to CLR, AMK, and MXF.	A 69-year-old male with a history of liver transplantation (tacrolimus and prednisolone) presents with aortic dissection, managed with replacement of the aortic valve and ascending aorta with a valved tube. However, he is readmitted a week later due to febrile syndrome associated with inflammatory changes in the surgical wound in the chest.	Surgical treatment: surgical exploration and lavage procedure revealed multiple fibrinopurulent membranes, completely dehiscent sternum. Prosthetic material was not removed. The procedure was performed 3 weeks before initiating treatment for NTM. Pharmacological management: CLR 500 mg b.i.d + MXF 400 mg q.d for 12 months. Immunosuppression: Tacrolimus dose was diminished during the first two month of NTM treatment. Outcome: cultures and acid-fast bacilli smears of the mediastinal fluid, conducted after the third surgical lavage (one month post antibiotic initiation), yielded negative results. No evidence of relapse after 3 years of clinical follow-up.
Microbiological confirmation: *GenoType Mycobacterium* CM/AS in soft tissue cultures - ***M. abscessus complex*** - Sensitive to AMK, MXF, and CLR. Resistant to DXC. Pelvic MRI: changes in the skin and subcutaneous tissues indicative of secondary inflammatory changes and information of abscesses.	A 31-year-old female with erythema nodosum and biopolymer implants. Presents with nodular lesions at the right gluteal area.	Surgical treatment: excision of the nodules one week before the initiation of NTM treatment. Pharmacological management: CLR 500 mg b.i.d + MXF 400 mg q.d. for 4 months, discontinued due to gastrointestinal adverse events. Outcome: No evidence of relapse after three years of clinical follow-up.
Microbiological confirmation: *Speed-oligo® Mycobacteria* of intraoperative culture - ***M. abscessus complex*** - Sensitive to AMK, MXF and CLR, resistant to OFL and DXC. Breast ultrasound: free fluid around the prosthesis and increased echogenicity of the subcutaneous tissue.	A 31-year-old female with no relevant medical history except for a breast augmentation surgery and replacement of breast implants one year prior in Mexico, develops inflammatory changes in the surgical wound.	Surgical treatment: Right breast with small abscesses at the periareolar surgical scar and fistulous with drainage of purulent material, edema and inflammatory changes, the implants were removed and saline lavage was done. This procedure was performed 5 days before starting NTM treatment. Pharmacological management: CLR 500 mg b.i.d + DXC 100 mg b.i.d for 6 months. Seven months later, the patient underwent another breast augmentation and developed and early relapse. A second surgical procedure was performed with implant removal. Treatment regimen was modified to LNZ 600 mg b.i.d + CLR 500 mg b.i.d for 6 months. Outcome: No evidence of relapse after 4 years of clinical follow-up.
Microbiological confirmation: *Speed-oligo® Mycobacteria* of soft tissue biopsy - ***M. abscessus complex*** - Sensitive to AMK, CLR, MXF, and DXC, resistant to OFL. Lower limbs MRI: small collection in contact with the muscle fascia. Involvement in the inguinofemoral region, affecting the subcutaneous tissue on both limbs.	A 35-year-old female, with no relevant medical history, who after a session of mesotherapy in both legs, develops nodular lesions with purulent discharge and systemic inflammatory response.	Non-pharmacological treatment: the plastic surgery team reports not finding areas suitable for surgical drainage; therefore, irrigations and dressings were performed by the enterostomal therapy team. Pharmacological management: CLR 500 mg b.i.d + AMK 25 mg/kg t.i.w for 6 months. Audiometry was conducted at the end of the treatment, with no findings, and the patient did not report hearing loss. Outcome: No evidence of relapse after one year of clinical follow-up.

Table 3 (continued)

Diagnosis	Clinical profile	Treatment and outcome
Microbiological confirmation: *Speed-oligo® Mycobacteria* in culture of gluteal secretion - ***M. abscessus complex*** - Sensitive to AMK, CLR, and MXF, resistant to DXC and OFL.	A 28-year-old female with no relevant medical history, except for a liposuction and gluteal lipoinjection, that develops inflammatory changes and erythematous nodular lesions on both gluteal regions with purulent discharge 20 days after the procedure.	Surgical treatment: surgical saline lavage and debridement were performed one week after starting NTM treatment. Pharmacological management: CLR 500 mg b.i.d + AMK 25 mg/kg t.i.w for 6 months. Audiometry was conducted at the end of the treatment, with no findings, and the patient did not report hearing loss. Outcome: no evidence of relapse after one year of clinical follow-up.
Microbiological confirmation: *Speed-oligo® Mycobacteria* in culture of surgical wound - ***M. fortuitum complex*** - DST not available. Soft tissue ultrasound: inflammatory process of the subcutaneous tissue (cellulitis) associated with edema and fluid collection towards the left axillary region.	A 64-year-old female with CREST syndrome (previously treated with methotrexate, now suspended) and breast cancer undergoing chemotherapy, radiotherapy and mastectomy, developed a surgical site infection. She was readmitted to the emergency department due to inflammatory changes in the surgical wound and purulent discharge.	Non-pharmacological treatment: irrigations and dressings were performed by the enterostomal therapy team. No surgery was performed Pharmacological management: MXF 400 mg q.d. + CLI 600 mg t.i.d for 4 months. Immunosuppression: both chemotherapy and radiotherapy were suspended during treatment; hormone therapy was continued. Outcome: no evidence of clinical or radiological (breast MRI was performed 2 months after finishing treatment) relapse after one year.
Microbiological confirmation: *Speed-oligo® Mycobacteria* in culture of surgical wound - ***M. fortuitum complex*** - Sensitive to AMK, CLR, and OFL. Resistant to DXC. Computed tomography (CT) scan of the abdomen: fluid collection with thin walls, well-defined contours with a slight enhancement of its wall located at the level of the subcutaneous cellular tissue.	A 64-year-old female with a history of gastric bypass surgery developed an abdominal hernia requiring surgical correction with mesh placement, which subsequently led to surgical site infection involving the organ space accompanied by fever.	Surgical treatment: fluid collection along with the presence of granulation tissue and purulent secretion were observed. The mesh was subsequently removed. The initial surgery was conducted two weeks prior to the initiation of treatment, followed by two additional surgical lavages performed within a week of each other, with no evidence of infecto-inflammatory processes observed during these procedures. Pharmacological management: CLR 500 mg b.i.d + MXF 400 mg q.d for 6 months. Outcome: no evidence of clinical relapse after one year of follow-up.
Microbiological confirmation: *GenoType Mycobacterium* CM/AS in culture of surgical wound - ***M. fortuitum complex*** - DST not available. Contrast-enhanced abdominal computed tomography: In the subcutaneous tissue, cystic image is observed, associated with thickening of the adjacent skin.	A 56-year-old female with relevant medical history except for a lipectomy, liposuction, and breast implants, develops inflammatory changes in the abdominal surgical wound at the hypogastric level six months after the cosmetic procedures, associated with constitutional symptoms.	Non-pharmacological treatment: the plastic surgery team performed dressings, with no need for surgical intervention. Pharmacological management: CLR 500 mg b.i.d + MXF 400 mg q.d. The duration of treatment is unknown as the patient did not continue follow-up
Microbiological confirmation: *GenoType Mycobacterium* CM/AS in culture of surgical wound - ***M. fortuitum complex*** - Sensitive to AMK, CLR, and OFL. Breast ultrasound: in the left breast, towards the retroareolar area, there is a small fluid collection with clumps inside.	A 45-year-old female with a history of HIV (HIV viral load: 1,536,776 copies/ml, CD4 count: 0% – 104 cells/ml) on ART (ABC, 3TC, NVP) and breast implants, presents with inflammatory changes in the surgical wound in the left breast.	Surgical treatment: in the left breast, inflammatory changes in the skin of the lower quadrants, purulent discharge, inflamed thick capsule and atrophy of the pectoral muscles were noted, leading to the removal of the implants and saline lavage. The procedure was performed 2 days before starting NTM treatment. Pharmacological management: CLR 500 mg b.i.d for 6 months. Outcome: no evidence of relapse after 2 years of clinical follow-up. HIV-status: after finishing treatment, patient had undetectable HIV viral load and a CD4 cell count of 215/cells/ml.
Microbiological confirmation: *Speed-oligo® Mycobacteria* in surgical wound culture - ***M. fortuitum complex*** - DST not available. Pathology report: chronic granulomatous inflammation with caseous necrosis and abscess formation.	A 16-year-old female with a history of asthma and osteotomy of the lower jaw and right condrectomy with osteosynthesis material. One week after the procedure, she develops inflammatory changes in the surgical wound.	Surgical treatment: the patient underwent surgical lavage and sample collection 1 week before the initiation of treatment for NTM. Pharmacological management: CLR 500 mg b.i.d + MXF 400 mg q.d for 4 months. Outcome: no evidence of relapse after one year of clinical follow-up

Table 3 (continued)

Diagnosis	Clinical profile	Treatment and outcome
Microbiological confirmation: *GenoType Mycobacterium* CM/AS in skin biopsy culture - ***M. chelonae*** - Sensitive to AMK and MXF with intermediate profile for DXC. Pelvis MRI: infectious-inflammatory process with multiple bilateral subdermal nodular lesions. Pathology report: chronic granulomatous inflammation with abscess formation.	A 40-year-old female with no relevant medical history, except for a recent liposuction and gluteal lipoinjection, presents with nodular, indurated, erythematous lesions with discharge in the bilateral gluteal region three months after surgery.	Surgical treatment: surgical debridement and lavage performed on the same day as the start of NTM treatment. Pharmacological management: Initial treatment with AMK 25 mg/kg t.i.w + CLR 500 mg b.i.d + IMI 500 mg t.i.d (during 15 days only). AMK was maintained for two months, followed by CLR 500 mg b.i.d + MXF 400 mg q.d for 6 months. Outcome: post-surgical MRI and clinical follow-up with no evidence of relapse after 5 years.
Microbiological confirmation: *Speed-oligo® Mycobacteria* in soft tissue culture - ***M. chelonae*** - DST not available. Pelvis MRI: myositis with involvement of the gluteus maximus and tensor fasciae latae muscles, with a collection in subcutaneous tissue.	A 32-year-old female with a history of bariatric surgery, sarcoidosis, and SLE under rituximab and methylprednisolone therapy, presents with joint pain in the hips, associated with constitutional symptoms, without a history of trauma or procedures. Gluteus major myositis and ipsilateral fascia lata involvement are confirmed without joint or bone compromise.	Surgical treatment: thickening of the fascia lata was noted. Saline lavage performed 1 week before starting NTM treatment.Pharmacological management: CLR 500 mg b.i.d + MXF 400 mg q.d for 12 months. Immunosuppression: Rituximab was suspended and steroid dose was diminished during the NTM treatment. Outcome: one month after finishing, patient experiences a clinical and radiological (soft tissue ultrasound with inflammatory changes and fluid collections) relapse after one month. Treatment is restarted for another 6 months. No surgical procedure was performed after relapse. No evidence of radiological (Pelvis MRI performed 2 months after finishing treatment) or clinical relapse (CPK levels were also decreasing during follow-up)after 5 years.
Microbiological confirmation: *GenoType Mycobacterium* CM/AS in skin biopsy culture - ***M. marinum*** - DST not available. Pathology report: the dermis shows foci of lymphohistiocytic inflammation with some neutrophils and a pseudo-granulomatous structure formed by histiocytes.	A 58-year-old female with type DM2 and rheumatoid arthritis (RA), undergoing treatment with leflunomide and rituximab and exposed to home aquariums. She experiences trauma with a plant object on the fourth finger of the right hand, with lymphatic dissemination after three weeks. She develops a nodular, erythematous, painful lesion on the inner forearm.	Surgical treatment: surgical debridement and lavage were performed 2 months before initiating NTM treatment. Pharmacological management: RIF 600 mg q.d + MXF 400 mg q.d for 6 months. Immunosuppression: Leflunomide and Rituximab were suspended during the first two months of treatment. Re-initiation was prompted by significant functional impairment, pain, and a decline in quality of life due to RA. Outcome: no evidence of relapse after 3 years of clinical follow-up.
Microbiological confirmation: *Speed-oligo® Mycobacteria* in adenopathy biopsy culture - ***M. avium complex*** - Sensitive to MXF, ETB, CLR, and AMK. Neck CT-scan: cervical lymphadenopathies, some with internal necrosis. Pathology report: chronic inflammatory infiltrate with granulomas and extensive caseous necrosis.	A 4-year-old male with a history of perinatal HIV infection under treatment with LPV/rtv-based ART associated with AZT/3TC, (HIV viral load: 451 copies/ml, CD4: 8% – 212 cells/ml), and immune thrombocytopenia (ITP), develops adenopathies without inflammatory response or constitutional symptoms.	Surgical treatment: lymph node conglomerate in the left neck, Zone II, with purulent material inside that is drained and saline lavage is performed 10 days before starting NTM treatment. Pharmacological management: CLR 125 mg b.i.d + ETB 260 mg q.d + AMK 15 mg/kg t.i.w, for 12 months (AMK was administered for only two months) Outcome: no evidence of relapse after 2 years of clinical follow-up. HIV-status: CD4 count at the end of treatment was 30% – 1200 cells/ml, with undetectable viral load (the last 6 months of treatment for NTM with CD4 T cell count within normal range).
Microbiological confirmation: isolated in culture from a lymph node biopsy, identification test unknown - ***M. avium complex*** - DST not available Chest CT-scan: multiple adenopathies in the neck and mediastinal region. Pathology report: chronic inflammatory infiltrate with granulomas and extensive caseous necrosis with positive acid-fast bacilli smears.	A 47-year-old male with a history of HIV on ART with EFV associated with ABC/3TC (HIV viral load: 681,613 copies/ml, CD4: 1% – 28 cells/ml), who develops adenopathy in the neck and mediastinum.	Surgical treatment: deep supraclavicular cervical lymphadenopathy with the discharge of yellowish material. The procedure was performed 2 days before starting NTM treatment. Pharmacological management: ETB 1200 mg q.d + CLR 500 mg b.i.d, for 6 months. Outcome: no evidence of relapse after 2 years of follow-up. Chest and neck CT scan were done after finishing NTM treatment showing resolution of the mediastinal and cervical lymphadenopathy visualized in the previous scan. HIV-status: the recovery of TCD4 lymphocytes was challenging due to a resistance genotype that required multiple changes to different ART regimens.

Table 3 (continued)

Diagnosis	Clinical profile	Treatment and outcome
Microbiological confirmation: *GenoType Mycobacterium* CM/AS in biopsy culture - ***M. abscessus complex*** - Sensitive to MXF, AMK, and CLR, with an intermediate profile for OFL and resistant to DXC. Thoracoabdominal CT-scan: Diffuse interstitial nodular thickening with bilateral hilar and mediastinal adenopathy, along with generalized adenopathies. Adenopathy pathology report: necrotizing lymphadenitis and chronic granulomatous inflammation with abscess formation.	A 41-year-old female presents with no relevant medical history, presents with polyarticular pain syndrome, inguinal lymphadenopathy, ulcerated nodular lesions on the lower limbs, associated with constitutional symptoms. She is HIV-negative but has a decreased CD4 + T lymphocyte count (33% – 59 cells/mL), suggesting idiopathic CD4 T-cell lymphocytopenia. Patient was later diagnosed with GATA2 deficiency.	Surgical treatment: abdominal laparoscopy was performed, with resection of lymph nodes found in the in the region of the mesenteric ileum. The procedure was performed 3 weeks before starting NTM treatment. Pharmacological management: CLR 500 mg b.i.d + AMK 25 mg/kg t.i.w. However, the latter was discontinued by the patient after one month, and she continued monotherapy with CLR for an unknown duration as she did not continue follow up.

It is crucial to acknowledge the compounded risk factors observed among some patients, which further elevate the susceptibility to non-tuberculous mycobacterial infections. For instance, one patient was concurrently receiving immunosuppressive therapy for CREST syndrome while undergoing chemotherapy for breast cancer. Additionally, another patient, who was HIV-positive, had recently undergone breast implant surgery, potentially increasing the risk of infection. Furthermore, another patient with diabetes and immunosuppression due to rheumatoid arthritis, coupled with occupational exposure to aquariums, represents a convergence of multiple risk factors, further amplifying the overall risk of non-tuberculous mycobacterial infections.

Colombia has become a significant destination for cosmetic surgeries, ranking ninth globally [27]. Reports indicate that a considerable number of patients seeking cosmetic procedures in Colombia are from North America, particularly the United States [28]. This raises questions about the quality of care and postoperative complications, especially concerning infectious complications. While cosmetic tourism can offer financial benefits, particularly in Colombia, where costs are often lower than those in other countries, it is crucial to weigh these costs against potential health risks, including the risk of contracting infections such as NTM. Given the ubiquity of NTM, the cleanliness standards of surgical clinics may pose a greater risk than the local incidence of NTM. Therefore, maintaining a balance between the allure of cosmetic procedures and patient safety is paramount in the burgeoning cosmetic tourism industry.

The higher cure rate observed in this study may potentially be attributed to more extensive surgical interventions. While surgical excision alone may be curative for some patients, especially in cases of localized disease, more comprehensive surgical approaches could contribute to improved outcomes. This is particularly relevant in cases where residual infection remains undetected by clinical or radiographic evaluation, underscoring the importance of combining surgical intervention with antimicrobial therapy.

Aspects related to drug susceptibility

Drug susceptibility in NTM is crucial for effective treatment. In more than 50% of the patients studied, resistance to doxycycline and ofloxacin was identified via drug susceptibility tests. However, most NTM strains were sensitive to fluoroquinolones, aminoglycosides, and macrolides in all the tests conducted. It is important to note that while many conventional tuberculosis drugs for drug-susceptible TB do not have activity against RGM, some such as ethambutol remain effective against certain NTM, including MAC. Furthermore, a known discordance exists between in vitro susceptibility and in vivo treatment response, which is specific to certain drug-pathogen combinations; for example, susceptibility tests for macrolides are reliable for MAC, whereas tests for rifamycins and ethambutol are not [29]. Additionally, confounding factors, such as the debridement of an entire infection may make ineffective antibiotics seem effective.

Drug susceptibility varies by geographic region, and correlations have been identified between the minimum inhibitory concentration (MIC) of certain drugs and specific genetic mutations in NTM. In the case of *M. abscessus*, it exhibits multiple resistance mechanisms, including adaptive mechanisms post-antibiotic exposure, notably in response to macrolides, particularly clarithromycin and azithromycin. Macrolides also induce the expression of the erm(41) gene, leading to macrolide resistance. Additionally, acquired resistance can arise not only from prolonged macrolide therapies but also from the use of insufficient companion drugs in combination regimens. This resistance often involves mutations in the rrl gene with macrolide use, and in the rrs gene with aminoglycoside use, leading to significant resistance to drugs such as kanamycin and amikacin [30, 31].

Other resistance mechanisms have been described, such as efflux pumps associated with aminoglycoside resistance and erm(39) gen activity associated with

macrolide resistance in *M. fortuitum;* the presence of proteins that protect DNA gyrase from antibiotic action in MAI along with mutations in rrl that also confers MAI resistance to macrolides [4, 30]. Unlike some RGM species, *M. chelonae* lacks an erythromycin resistance methylase (erm) gene, resulting in the absence of inducible macrolide resistance. This intrinsic susceptibility to macrolides, also observed in *M. senegalense* and *M. peregrinum*, suggests that extended clarithromycin susceptibility testing may be unnecessary for *M. chelonae*,. [32]. In *M. marinum*, resistance mechanisms, such as mutations in the *rpoB* gene, which encodes the beta subunit of RNA polymerase and is the target of rifampicin, are not fully understood. Given the complexity of drug resistance in NTM, prolonged (14-day) drug resistance tests are recommended to identify any inducible resistance to macrolides for RGM, along with molecular methods to detect specific genetic mutations that may influence treatment response.

Discussion on pharmacological treatment aspects

The recommendations for the treatment of NTM-EP infection are limited [7, 32]. Current clinical practice guidelines such as those from ATS/ERS/ESCMID/IDSA focus on pulmonary involvement, addressing complex NTM such as MAI, *M. kansasii*, *M. xenopi*, and Mab in patients without cystic fibrosis and without HIV infection [1]. Debate exists regarding whether stable patients with extrapulmonary involvement should undergo empirical treatment or await susceptibility test results, considering factors such as adverse events, drug interactions, and resistance. Furthermore, there is the added challenge of potentially being unable to confirm the causative organism if it fails to grow after antibiotic initiation, particularly in cases where the organism is uncertain or isolated from a suboptimal specimen [1, 4]. Monotherapy regimens are generally not recommended to prevent the development of resistance [1]. It is worth noting that within the series, one case involved monotherapy. In our study, the overall cure rate exceeded 80%, surpassing that documented in current literature. While data on non-tuberculous mycobacteria in extrapulmonary infection is limited, previous studies have reported a cure rate of 30–50%, with frequent relapses [33].

In this study, we present different pharmacological treatment regimens for RGM (Mab, *M. chelonae*, *M. fortuitum*) and SGM (MAI, *M. malmoense*, *M. marinum*) infections.

Mycobacterium fortuitum complex: all cases of *M. fortuitum complex* infection had a recent history of surgical procedures. Unfortunately, susceptibility profile identification was only performed in 3/6 cases, all of which were sensitive to AMK and CLR. The treatment regimen in all cases included the use of CLR, mostly in combination with MXF, for an average of 4–6 months, except for one case with an extended regimen for mediastinal infection. Surgical treatment was also given in most cases, resulting in clinical cure.

Treatment guidelines for *M. fortuitum* infections recommend using at least two agents with demonstrated in vitro susceptibility, extending therapy for a minimum of four months, particularly in cases involving serious skin, bone, or soft tissue disease. For bone infections, therapy may need to be prolonged up to six months [7]. Injectable agents such as amikacin and cefoxitin are preferred for severe infections, while oral options like fluoroquinolones, doxycycline, and trimethoprim/sulfamethoxazole are commonly used. Dual-agent therapy is often preferred to prevent the development of resistance, a concern especially highlighted with fluoroquinolone monotherapy [34]. In cases of extensive disease or when drug therapy is challenging, surgical intervention, including the removal of foreign bodies like implants, is crucial. These recommendations underscore the importance of a comprehensive, multi-agent approach to achieve a high likelihood of cure and to mitigate the risk of resistance development. It is important to note that *M. fortuitum* itself has an erm gene and is not susceptible to macrolides, unlike other species in the complex like *M. senegalense* and *M. peregrinum* which lack the erm gene and should therefore be susceptible to macrolides [32].

Mycobacterium abscessus complex: this study agrees with the literature indicating that Mab skin and soft tissue infections (SSTIs) usually occur due to surgical or traumatic inoculation [7, 35]. We observed a significant proportion of middle-aged women, with a median time of presentation after aesthetic procedures of approximately 40 days. In all five patients, CLR, MXF and AMK susceptibility was reported. The treatment regimen in all cases included the use of clarithromycin in combination with quinolones or aminoglycosides in most cases for an average of 4–6 months, along with surgical management in the majority of cases, achieving cure during clinical follow-up without evidence of relapse. One patient with lymph node involvement did not continue follow-up, and 50% of patients experienced adverse events during treatment.

It is important to note that Mab subspecies (*abscessus*, *bolletii*, and *massiliense*) are considered highly pathogenic, with high resistance levels and low cure rates [36]. In pulmonary treatment for Mab, a regimen of at least three drugs guided by drug susceptibility testing, is recommended. In cases where there is inducible macrolide resistance, macrolides are primarily utilized for their immunomodulatory effects rather than as active antimicrobial agents [1, 36]. Furthermore, drugs like clofazimine, tedizolid, omadacycline, and bedaquiline, which exhibit low MIC values for *M. abscessus*, show promise.

However, drugs such as cefoxitin, imipenem, or linezolid may demonstrate unpredictable performance [37]. Minor cutaneous infections can resolve spontaneously, with or without surgical debridement. In cases of SSTIs, a macrolide regimen along with parenteral medications for at least 4 months is recommended. In cases of bone infections, treatment extension to 6 months is suggested. Surgery is recommended in cases of extensive disease, abscesses, and the removal of implants or catheters [7].

Mycobacterium chelonae: A patient immunosuppressed by biological therapies who developed joint involvement due to *M. chelonae* infection was treated for 12 months with clarithromycin combined with moxifloxacin and experienced early relapse, and a patient with an infection associated with cosmetic procedures was treated for 6 months with clinical curative criteria and no relapse. *M. chelonae* infection is associated with cutaneous infections in immunocompetent patients, and in Colombia, it has been related to infections in HIV-positive individuals [6, 7, 38].

For mild to moderate *M. chelonae* infections, a two-drug regimen is recommended, and for severe infections, three drugs are suggested. Treatment should include a regimen with two intravenous drugs for 4 to 16 weeks and then two oral drugs selected according to susceptibility test results, with one of them being a macrolide if sensitive, until 12 months after sputum conversion in pulmonary involvement [32]. Drugs such as amikacin, azithromycin, clofazimine, clarithromycin, ciprofloxacin, doxycycline, imipenem, levofloxacin, linezolid, sulfamethoxazole, tigecycline, and tobramycin have demonstrated activity in human studies and in vitro microbiological activity [4, 38].

Mycobacterium avium complex: In this study, two HIV patients with adenitis due to MAI were treated for 12 or 6 months. The first case involved a 4-year-old infant with perinatally acquired HIV who developed idiopathic thrombocytopenic purpura and required immunosuppressive management. At the time of NTM infection diagnosis, the patient had a CD4 + T-cell count of 212 cells/mm3, which could be related to her hematological condition. Treatment consisted of clarithromycin, ethambutol, and amikacin. The second case involved an adult HIV patient on antiretroviral therapy with a CD4 + T-cell count of 28 cells/mm3. This patient received treatment with clarithromycin and ethambutol. Both patients achieved a cure with no evidence of relapse during follow-up.

For the treatment of MAI at the pulmonary level in patients with macrolide susceptibility, a three-drug treatment regimen, including a macrolide (azithromycin or clarithromycin) and ethambutol, is suggested. In cases of cavitary disease, bronchiectasis, or macrolide resistance, amikacin is added to the initial treatment for 2 to 3 months, followed by a 12-month regimen after the culture becomes negative [1]. However, up to 40% of patients may experience unfavorable outcomes, requiring modification of their treatment due to adverse events in up to 84% of cases [39].

Cervical lymphadenitis by MAC typically involves surgical excision as the primary treatment modality, resulting in a cure rate exceeding 90%. In cases of extensive lymphadenitis or inadequate response to primary treatment, the consideration of an antibiotic regimen incorporating macrolides is warranted [7]. In HIV patients with disseminated disease, MAI treatment includes the administration of clarithromycin and ethambutol, with the possibility of adding rifabutin as a third drug. In cases of severe immunosuppression (CD4 + counts less than 50 cells/mm3), the addition of a fluoroquinolone or an aminoglycoside while maintaining treatment for 12 months is considered [2].

Mycobacterium malmoense: this study presents an uncommon case of a patient with endocarditis due to *M. malmoense*, as most reports are related to pulmonary involvement [7, 40]. Reports on extrapulmonary cases are limited, although lymph node, cutaneous, and articular involvement have been documented [7, 41, 42]. In this case, the patient underwent surgery and received a 12-month treatment including clarithromycin, moxifloxacin, and rifampicin, resulting in a cure and no relapse.

M. malmoense is an SGM with inconsistencies in susceptibility testing. It is intrinsically resistant to isoniazid. For pulmonary involvement, a 12-month treatment regimen involving the use of at least three drugs, rifampicin, ethambutol, and a macrolide (clarithromycin or azithromycin), after sputum culture conversion is recommended [32, 43]. Failure and relapse rates of 10% have been reported, with a related mortality of 4% [32]. In cases of macrolide intolerance or resistance, rifamycin or ethambutol, moxifloxacin, and clofazimine are alternatives. Intravenous amikacin can be considered for cavitary lung lesions. However, there are no specific recommendations for managing extrapulmonary involvement caused by this mycobacterium.

Mycobacterium marinum: A patient who developed SSTIs due to *M. marinum* after trauma received a 6-month regimen of moxifloxacin combined with rifampicin and achieved a cure with no evidence of relapse. *M. marinum* has been associated with infections in immunocompromised individuals and SSTIs in immunocompetent patients exposed to aquariums or swimming pools, known as "Fish Fancier's Finger." There are no official recommendations for the management of *M. marinum* infection [4, 44]. In *M. marinum*, there is demonstrated activity in humans for drugs such as amikacin, clarithromycin, doxycycline, ethambutol, minocycline, rifampicin, and sulfamethoxazole, and in vitro

microbiological activity studies for ciprofloxacin, imipenem, isoniazid, levofloxacin, linezolid, moxifloxacin, and tedizolid [4].

Surgical treatment: surgical procedures play a pivotal role in controlling these extrapulmonary infections. In our study, surgical interventions were conducted in 82% of cases to address various aspects of the infection. These procedures encompassed a range of interventions, including mitral valve replacement, excision of subcutaneous nodules and abscesses, implant removal, surgical lavage with saline solution, and debridement, among others. Such interventions are crucial, especially in cases of extensive disease or abscess formation, where drug therapy may be insufficient. Additionally, the removal of foreign bodies, such as breast implants or percutaneous catheters, is deemed essential for facilitating recovery and preventing recurrence [1]. Notably, in cases where invasive surgical procedures were deemed unnecessary by the surgical team, effective lesion management was achieved through dressing changes and follow-up care provided by the enterostomal therapy team, highlighting the importance of a multidisciplinary approach in achieving optimal outcomes in NTM infections. While surgical excision alone is usually curative in children, adults typically receive antibiotics in addition to surgery to address residual disease undetectable clinically or radiographically.

Strengths and limitations

The main limitation is related to the sample size, which stems from the inadequate representation of data in the target population. Despite our thorough search for cases in clinical records, many cases were excluded due to the lack of microbiological confirmation of the NTM species. However, this case series still provides valuable information on NTM-EP infections. Notably, the lack of mandatory reporting for NTM-EP events complicates the clear identification of an epidemiological outbreak, defined as an unusually high incidence of cases compared to expected rates in a specific time and place. It is essential to recognize that certain risk interventions and sources of contamination could signal a potential epidemiological concern and that NTM infections are often mistaken for other diseases.

The lack of molecular tests to detect inducible macrolide resistance, along with other resistance-associated genes in mycobacteria, may have hindered the identification of resistance, despite all bacteria being reported as macrolide-sensitive using the microdilution method. However, one of the strengths of our study is the implementation of an extended incubation period of 14 days specifically for macrolides, such as clarithromycin, to accurately identify inducible macrolide resistance. While the standard incubation period for RGM is typically 3 to 5 days, this extended approach is crucial for detecting resistance in species like *M. abscessus*, ensuring reliable susceptibility testing and effective treatment planning.

One notable weakness identified in this study is the inability to identify the subspecies of *M. fortuitum complex* and Mab, which may exhibit distinct drug susceptibility patterns. Imaging follow-up to assess cure was not conducted for all cases, and another constraint lies in the limited scope of one of the molecular tests, Speed-Oligo, which only identifies 12 NTM species. Lastly, being a retrospective case series, there is certain weakness in adhering to guidelines in some instances (monotherapy regimens). Despite this observed lack of adherence, our manuscript discussion aims to underscore the currently recommended regimens. Another significant strength of this study is the long follow-up period, averaging 2.5 years, which provides important data on the long-term outcomes of these infections. Considering the overlooked nature of nontuberculous mycobacterial infections in our country, our findings carry substantial relevance in this context.

Conclusions

Patients with atypical NTM infections present with chronic, indolent clinical presentations before diagnosis, requiring antimicrobial management guided by susceptibility testing combined with two to four drugs for an extended period. In the management of skin and soft tissue infections, surgical and directed pharmacological management are therapeutic options, but clinical trials are needed.

In summary, while this study sheds light on NTM-EP infections, the limitations underscore the need for standardized reporting mechanisms, improved laboratory practices, and enhanced diagnostic techniques to better understand and manage these infections.

Abbreviations

3TC	Lamivudine
ABC	Abacavir
AMK	Amikacin
ART	Antiretroviral therapy
AZT	Zidovudine
B.I.D	Twice a day
CLI	Clindamycin
CLR	Clarithromycin
DM2	Type 2 diabetes mellitus
DST	Drug susceptibility test
DXC	Doxycycline
EFV	Efavirenz
ETB	Ethambutol
HIV	Human immunodeficiency virus
IMI	Imipenem
ITP	Immune thrombocytopenic purpura
LNZ	Linezolid
LPV/rtv	Lopinavir/ritonavir
LVX	Levofloxacin
Mab	M. abscessus complex
MAI	M. avium complex
MXF	Moxifloxacin

NTM-EP	Nontuberculous mycobacteria– extrapulmonary
NTM	Nontuberculous mycobacteria
NVP	Nevirapine
OFL	Ofloxacin
RGMs	Rapid-growing mycobacteria
RIF	Rifampicin
SGM	Slow-growing mycobacteria
SLE	Systemic lupus erythematosus
SST	Skin and soft tissue
T.I.D	Three times a day
T.I.W	Three times a week

Supplementary Information

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Supplementary Material 1

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Author contributions
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Data availability
For this study, the datasets used and/or analyzed are available through the corresponding author upon reasonable request. The corresponding author can be contacted to access the relevant data supporting the findings presented in the article. This measure is taken to protect the privacy of patients and ensure compliance with relevant ethical regulations.

Declarations

Ethical approval
The risk level for participants, as per Resolution 8430 of 1993 from the Ministry of Health, is minimized and acceptable. This retrospective study, involving no intervention or experimentation, received approval from the Ethics Committee for Biomedical Research of the Valle del Lili Foundation, Cali, Colombia. It entails low risk and does not necessitate informed consent since there is no intervention; it is merely a case review.

Competing interests
The authors declare no competing interests.

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