

***Mycobacterium fortuitum* in implantation of breast prosthesis**

***Mycobacterium fortuitum* em implante de prótese mamária**

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Abstract: The *Mycobacterium fortuitum* is a pathogen found in the environment with a special susceptibility to cause infections associated with aesthetic procedures. Breast surgeries have been reported to be related to the cases of infection by *M. fortuitum*. The aims are to report the case of infection by *M. fortuitum* in a patient who has undergone breast prosthesis implant surgery, to track patient's perioperative progress, to outline the laboratory follow-up of infection, and to describe the risk factors that influenced the occurrence of infection. About the method, it is an exploratory, descriptive, and retrospective study. The sample was related to the first case of infection with *M. fortuitum* notified at the studied hospital. The patient record was also used. The data analysis was performed using clinical case reporting and laboratory analyses. The patient had healthy preoperative conditions. However, the findings were that she has presented redness, heat and localized edema, and superficial dehiscence, fistula, serous secretion and difficulty in cicatrization. In the surgical removal approach of breast implants, a white, odorless secretion was found in moderate quantity covering the left breast prosthesis. The report confirmed mycobacteriosis on the 69th day after the first surgery. A year after surgery was performed, a new bilateral breast prosthesis were implanted. In conclusion, it was reported the case of a patient undergoing breast prosthesis implant that showed complications such as infection with *M. fortuitum*. However, the procedure was performed under good preoperative conditions. In the postoperatively occurred redness, swelling and local heat, fistulisation and difficult healing, beyond the superficial dehiscence. The surgical approach to removal of breast implants was detected the presence of whitish secretion and odorless, a moderate amount, covering the left breast prosthesis. The diagnosis of mycobacteriosis was confirmed after 69 days postoperatively. After a year, there was new breast prosthesis implantation bilaterally.

Keywords: *Mycobacterium fortuitum*, breast implant, infection

Resumo: O *Mycobacterium fortuitum* é um patógeno encontrado no ambiente com suscetibilidade especial para causar infecções associadas aos procedimentos estéticos. Cirurgias de mama tem sido relatadas com casos de infecção por *M. fortuitum*. Os objetivos deste estudo são relatar o caso de infecção por *M. fortuitum* em uma paciente que submetida à cirurgia de implante de prótese de mama, acompanhar a evolução perioperatória da paciente, delinear o acompanhamento laboratorial da infecção e descrever os fatores de risco que influenciam a ocorrência de infecção. Quanto ao método, trata-se de um estudo exploratório, descritivo e retrospectivo. A amostra foi referente ao primeiro caso de infecção por *M. fortuitum* notificado no hospital do estudo. Foram coletados do prontuário do paciente. A análise dos dados foi realizada através da evolução clínica e dos dados laboratoriais. Concluindo, a paciente estava em boas condições pré-operatórias, entretanto, apresentou eritema, calor e edema localizado, além da deiscência superficial, fístula, secreção serosa e dificuldade de cicatrização. Na reabordagem cirúrgica, houve a remoção dos implantes mamários, presença de

secreção esbranquiçada e inodora, em quantidade moderada, cobrindo a prótese da mama esquerda. O relatório confirmou micobacteriose no 69º dia após a primeira cirurgia. Um ano após a cirurgia foi realizado, novo implante de prótese de mama, bilateralmente. Concluindo, relata-se o caso de uma paciente submetida ao implante de prótese de mama bilateral, tendo ocorrido complicações como a infecção por *M. fortuitum*. Entretanto, o procedimento foi realizado em boas condições pré-operatórias. Os achados pós-operatórios evidenciam hiperemia, edema e calor local, fístula e difícil cicatrização, além de deiscência superficial. Na reabordagem cirúrgica de retirada das próteses de mama foi detectada a presença de secreção esbranquiçada e inodora, em quantidade moderada, cobrindo a prótese da mama esquerda. O diagnóstico de micobacteriose foi confirmado no 69º dia de pós-operatório. Após um ano, realizou-se novo implante de prótese de mama, bilateralmente.

Palavras-Chave: *Mycobacterium fortuitum*, implante mamário, infecção.

1 Introduction

Mycobacteria are aerobic bacilli, saprophytic,^{1,2,3} immobile, that form neither spores nor capsules. They have a high lipid content, mainly in the cell wall, which makes their permeability difficult in water or dyed solutions used in laboratories as well as in antiseptic or disinfectant agents.¹ Also, they are resistant to chlorine, favoring infection.²

The mycobacteria are classed as tuberculous and nontuberculous. In its term, the *Mycobacterium fortuitum* is among the nontuberculous.⁴ Nontuberculous mycobacteria (NTM) are often found in the environment, present fast growth,^{4,5} generally in less than an hour, and form colonies visible to the naked eye within three to five days⁶, being found in the water and in the soil.³ They can cause lesions in the skin,¹ soft tissues,^{2,3} chronic lung infection^{4,5,7} and lymph node infections^{1,5} associated with surgical aesthetic procedures.^{2,4,6,8}

In Brazil, from 1998 to 2009, 2520 cases of infection by mycobacteria were registered from the Health Surveillance National Agency (ANVISA) in 27 brazilian provinces. From these, 135 were related to non-invasive surgical procedures. These mycobacteria identified belong to the species of *M. abscessus* (31.3%), *M. abscessus subsp. bolleti* (30.4%), *M. fortuitum* (13.8%) and *M. chelonae* (1.5%). Regarding these cases, 2.7% (21) correspond to other species of mycobacteria. Also, in the period from 2002 to 2009,

117 cases of infection by *M. fortuitum*⁸ were confirmed. Between 2008 and 2009 was the peak of the infection by Mycobacterium in patients with the average age of 37 years old and predominantly in females.⁸

From 1998 to 2009 ANVISA also found 117 (13, 8%) cases of infection by *M. fortuitum*, from those, 57 (57, 6%) were related to breast surgery. The Brazilian provinces with the highest occurrences were São Paulo (45.3% - 53 cases), Rio de Janeiro (24.8% - 29 cases) and the seventh was Minas Gerais (2, 6% - 3 cases).^{6,8}

During the years of 2008 and 2009 in Brazil there was an outbreak of infection by *M. fortuitum* in hospitals. Then, ANVISA implemented a protocol seeking a reduction in the incidence of infections⁸.

The material used to make a microbiological diagnosis customarily aspired in abscesses and/or collected in tissue fragments, packed in sterile flasks, with those bigger than 1 cm³ packed in sterile saline. The use of *swab* is not recommended due to the insufficient sample for the exam fulfillment. Regarding breast implants, it is suggested that the material collected be the secretion adhered in it.⁹

Under suspicion of bacteria colony growth, the Ziehl-Neelsen method is used to confirm the presence of resistant acid-alcohol bacillus (RAAB). In the case of a positive culture, medical teams should be informed and are obligated to notify ANVISA.⁹

Hospital infection is theoretically acquired after patient admission, but can be manifested during hospitalization or after discharge.¹ The infection prevention process in the surgical site involves the patient's preparedness, which includes ambulatory assessment, seeking to reduce the hospitalization duration to less than 24 hours. Patients must receive a pre-operative shower with aseptic degerming solution (chlorhexidine 2%) in order to avoid subacute complications, to treat possible infection, and if needed to postpone the surgical procedure. In the intraoperative, the nose and

mouth must be completely covered with a surgical mask, hair must be covered with a bouffant cap, and shoe covers put on before going into the surgical unit. In the post-operative period, either vein access or long-term ureter catheter must be removed as soon as possible. The antiseptics eliminate or inhibit the microorganism growth on the skin, and the antiseptic solutions authorized by ANVISA are alcohol 70%, chlorhexidine gluconate (degerming solution 2%, alcoholic 0.5%, or aqueous 0.2%), and iodophores such as polyvinylpyrrolidone-iodine (PVP-I topic).¹¹

This case report is justified by the fact that it is the first notification of infection by *M. fortuitum* at the Hospital de Clínicas of the Universidade Federal do Triângulo Mineiro, in Minas Gerais, Brazil.

2 Aims

The aims are to report an infection case by *M. fortuitum* in a patient who has undergone breast prosthesis implant surgery, to track the patient's perioperative progress following a breast prosthesis implant with development of infection by *M. fortuitum*, to outline the laboratory follow-up of infection by *M. fortuitum* in a patient who has undergone breast prosthesis implant surgery and to describe the risk factors that influenced the occurrence of infection by *M. fortuitum* in a patient.

3 Methods

This is a retrospective case report developed at the Hospital de Clínicas from the Universidade Federal do Triângulo Mineiro (HC-UFTM) which is a large public institution covenanted with 27 counties of the macro area of South Triângulo with 287 hospital beds operating that serve an estimated population of 645381 persons. About 1835 ambulatory appointments regarding plastic surgery are done. The plastic surgery summed 425 procedures in 2011 and from these, 26 breast prosthesis implant surgery were performed.

The sample of the study was related to the first case of infection by *M. fortuitum* registered at Hospital de Clínicas of the Universidade Federal do Triângulo Mineiro, which occurred in a patient who had undergone a breast prosthesis implant surgery in December 10th 2010.

Data collection was conducted after the UFTM's Research Ethics Board approval. Data was collected from the *Notification of nontuberculous mycobacteriosis case (NTM) after invasive medical procedures* (appendix), and an instrument of the Epidemiological Surveillance used by the Hospital Infection Control Committee. The patient's record was also examined for further data with regards to the perioperative treatment, symptoms and complications of the infection.

The data analysis was conducted through the case report, tracking the dynamic of the infection process regarding: the signals and symptoms, the clinic-surgical treatment, the post-operative complications, the laboratory diagnoses, and the intra-operative risk factors related to the technical-operative procedures.

4 Results

Hereafter there is the perioperative evolution, the laboratory follow up, and the risk factors of intra operative infection related to infection by *Mycobacterium fortuitum*.

This is about a 29-year-old patient, female, single, Catholic, employed as an administrative assistant, with a medical diagnosis of bilateral hypomastia and recommended for bilateral breast prosthesis implant surgery. The preoperative anamneses and physical examination shows great healthy conditions, according to Table I.

Table I - Physical Assessment and Anamnesis in the pre-operative of a patient with bilateral hypomastia.

Anamnesis and physical examination topics	Patient study's condition
Chief Complaint	Small breast
History of the present illness	Deny
Past medical history	Deny
Past surgeries and aesthesia	Deny
Past hospitalization	Deny
Ambulatory follow-up	Deny
Allergies	Dipyrone
Medications	Deny
Family history	<i>Diabetes Mellitus</i>
Social history	Not included
Anamnesis source	Own patient
Axillary temperature	Afebrile
Heart rate	80 beats per minute
Systemic blood pressure	120/80 mmHg
Weight	58 kg
Height	158 cm
Body mass index	23.23 Kg/m ²
Head and neck	No difference
Cardiovascular system	No difference
Respiratory system	No difference
Breast and armpit	Asymmetric breast (left > right) Centered nipples and preeminent Absence of hogback and/or retraction Heterogeneous parenchyma Absence of nodulations Negative expression
Abdomen	No difference
Genitourinary system/ perianal	No difference
Periphery vascular system	No difference
Musculoskeletal system	No difference
Nervous system	No difference
Skin	No difference

The patient was submitted to three surgical procedures. The first was the bilateral breast prosthesis implant, the second was the removal of the prosthesis, and finally the re-implantation.

In the first surgery there were breast prosthesis implantations (*Allergan*) with a volume of 310 mL in the right breast and 280 mL in the left. At the end of the surgery the surgical wound was covered with a compressive occlusive bandage using a post-surgery model.

The second surgery was recommended to remove the breast prosthesis due to an infection in the left breast. The medical team presented two options for the patient which were the removal of the left breast or both. After her going for the second option, the incisions were done over the previous scar, the dissection was done until the space subglandular.

The left prosthesis was covered by a whitish and odourless secretion in a moderate quantity (10mL). When the breast prostheses were removed, the review and exhaustive wash of the store with 0.9% saline water showed the presence of rare clots at the left breast and clear liquid at the right, and the sucking drain was positioned laterally.

One year after the first surgery, the patient returned to the hospital to undergo a new breast prosthesis (*Allergan*) implant surgery, with a 310 mL volume of textured silicon to the right breast and 280 mL to the left after one gram of immersion of cephalothin in 500 mL of 0.9% saline water.

During the post-operative of the first surgery, there was a report of mild pain at the surgical site and nocturnal emesis, and then the patient was discharged the next day.

The patient returned to the clinic on the 6th day after the post-operative, however, on the 14th day of post-operative, the patient returned to the clinic presenting signals and symptoms of infection, including hyperemia, increased local temperature and local swelling, suture dehiscence with a fistula in the surgical wound, with difficulty of cicatrisation, in addition to a whitish secretion.

Antibacterial therapy was initiated with 1g of Ceftriaxone 12/12 hours and 400 mg of Ciprofloxacin 12/12 hours. After 1 month and 8 days the patient was admitted for the second surgery to remove the breast prostheses, being discharged one day after the post-operative without complications.

The third surgery for the new breast prosthesis implant was done after 1 year, 2 months and 23 days, also with hospital discharge on the 1st day of post-operative without complications.

Initially, the Central Laboratory of the HC-UFTM performed a microbiological analysis of the breast incision secretion. Once the result was positive, it was obligatory that the exam was repeated by the Ezequiel Dias Foundation (FUNED), bound to the Health Department of Minas Gerais and to ANVISA.

The specific national *Notification form of Nontuberculous mycobacteriosis case (NTM) after invasive medical procedures* was filled out, which was sent to the State Sanitary Surveillance of Minas Gerais to follow up the case.

The mammary surgical biological material of the patient was submitted to the lab and spread initially in sheep blood agar in Mac Conkeyagar and thioglycolate. Twenty four

hours after the 35°C incubation period there was no bacterial growth and the culture plaques were re-incubated.

Forty-eight hours after the initial seeding, small bacterial colonies were observed, therefore it was decided that one more 24-hour incubation would be needed. In 72 hours, the colonies were visible, although dry.

The Gram staining was performed and there were thin, straight, and short Gram-positive bacillus present. Suspicion of Fast Growing Bacteria was detected in acid alcohol resistant bacillus (BAAR) after the Ziehl-Neelsen staining (Table II).

Table II - Ambulatory follow up of infection caused by *M. fortuitum* in a patient submitted to breast implant prosthesis with surgical re-approach over three years.

Surgery	10/12/10	02/01/11	26/01/11	17/02/11
Day	1 ^o	22 ^o	24 ^o	46 ^o
Laboratory analysis At hospitalized patients	First surgery	Secretion collection in the 2 nd surgery	External institution laboratorial analysis	Laboratory report <i>M. fortuitum</i>

The secretion collection for laboratory analysis was performed during the breast prosthesis removal surgery on Jan 1, 2011, and forwarded to the institution's central center lab. There was doubt of mycobacteriosis after 72 hours of incubation. To confirm the medical report, the sample was forwarded to FUNED laboratory located in Belo Horizonte-Minas Gerais. The medical report was released on February 17th 2011 proving the growth of *M. fortuitum*.

There are multiple perioperative infection risk factors already checked that could have influenced mycobacteriosis (Table III).

Table III - Risk factors of infection in the intra-operative in the surgery follow up, proposal and re-approach.

Risk factors for infections	1ª Surgery 10/12/10	2ª Surgery 02/01/11	3ª Surgery 23/03/12
Surgery	Insertion of bilateral breast prosthesis	Withdrawal of bilateral prosthesis	Insertion of bilateral breast prosthesis
Operation room (time)	13:00/15:30 (1h30')	09:45/11:35 (1h50')	13:40/16:50 (3h10')
Anesthesia (time)	13:30/19:20 (5h50')	10:05/14:00 (3h55')	14:00/20:15 (7h15')
Surgery (time)	14:00/15:30 (1h30')	10:15/11:30 (1h15')	14:20/16:20 (2h00')
Anesthesia	Epidural (level T3-T4)	Local	General balanced
Anesthetics	Fentanyl 50 mg Midazolam 5 mg Morphine 1mg Propofol100mg Ropivacaine 90mg	Dipyrone 2 g Midazolam hydrochloride 25mg	Atropine 1mg Dipyrone 2g Fentanyl 200mcg Lidocaine 60mg Midazolam 5mg Neostigmine 2mg Propofol 100mg Rocuronium40mg Tramal 100mg
Antibiotic therapy	Cefazolin 1g	Ciprofloxacin 400mg	Cefazolin 2g
Intravenous access	Peripheral	Peripheral	Peripheral
Antisepsis	Alcoholic chlorhexidine 0,5%	Alcoholic chlorhexidine 0,5%	Alcoholic chlorhexidine 0,5% and degermante2%
Surgical incision	5 cm in breast bilateral sulcus	5 cm in breast bilateral sulcus	5 cm in breast bilateral sulcus
Bilateral breast prosthesis	310 mL (right) 280 mL (left)	Prosthesis withdrawal	310 mL (right) 280 mL (left)
Suture	Mononylon 3-0 Mononylon 4-0 Monocryl 4-0	Mononylon 3-0 Mononylon 4-0 Monocryl 4-0	Monocryl 4-0 Mononylon 3-0 Vicryl 2-0
Sterilization control Centre	steam autoclave	Autoclave Hydrogen Peroxide	Autoclave Hydrogen Peroxide

There were neither similarity between the first (5h50') and the third (7h15') surgery, nor relationship with anesthetics, regional and general respectively. However, there was a variation in the antibiotic therapy and the anesthetics during the surgery. The invasive procedure related to peripheral venous catheter (PVC) and the surgical length (5cm in bilateral breast crease) were as similar as the surgical suture used and the breast prosthesis in both surgeries mentioned.

In the last surgery it was found that antiseptics with chlorhexidine and the sterilization material in autoclaved hydrogen peroxide were used in comparison to the first surgery. All the three surgical procedures done had the surgical instruments proper-sterilization documentation registered in the medical report.

5 Discussion

The *M. fortuitum* belongs to a *fast growing mycobacteria*– FGM widely disseminated in a low pH environment, high organic load and variable temperature,^{2,12} present especially in the ground, in the water,^{1,2,3,4,5,7,12,13,14,15,16,17} in the stones,^{2,12} in the wind,^{3,5,12} in biofilms of water distribution and sewer piping systems,^{4,13} beyond swimming pools,^{2,13} where fastgrowing *mycobacterium* shown to be resistant to the chlorination process.¹³

The FGM find favorable colonization conditions in reservoirs and the hospital plumbing, making its eradication harder.¹² This mycobacterium was detected in the hospital water reservoir⁶, which increases the possibility of hospital article's contamination¹, and can also happen during breast implant surgery. Wet environments contribute to FGM, including *M.fortuitum*.¹³ FGM is still a challenge to public health in spite of the pharmacology advances, because it is present in different places.^{1,7} In this study is not possible to affirm which is the infection source in bilateral breast prosthesis implant.

The transmission of mycobacterium does not happen through person to person contact,¹⁵ but due to environmental sources such as the material used in surgical procedures related to cleansing and sterilization of body solution markers¹³, optical fibers and silicon prosthesis mold¹². The infection in patients are related to cleansing mistakes, as well as either disinfection and sterilization of hospital articles or antiseptics of skin.^{2,13,16,17,18,19,20} Degermation and disinfection eliminate pathogenic microorganisms, except those able to make spores.⁶ The ANVISA forbid the chemical sterilization of these articles.^{2,13,16,17,18,19,20} However, it allows sterilization with hydroxide peroxide and vapour.²² In this study, autoclaved vapor and hydroxide peroxide methods were used, precisely documented in the patients' record, although the first and last surgery had different methods.

The *M. fortuitum* is resistant to various agents such as PVPI, formaldehyde and glutaraldehyde.¹² Studies show the resistance of MCR to glutaraldehyde, chloride, benzalkonium chloride, organomercury compound, chlorhexidine, and even autoclaves.¹³ The patient pre-operative antisepsis of this study was done with alcoholic chlorhexidine 0,5% in the first surgery, and in the third surgery the degermation with 2% degermante chlorhexidine.

The incubation period of *M. fortuitum* varies between 2 to 12 months.² The clinical signals of *M. fortuitum* include inflammatory reactions and abscesses, which can develop weeks, months or years after the plastic surgery. The dehiscence of the previously cicatrized wound or hard to cicatrize wound indicates infection¹². Other signals and symptoms are the nodes close to the trauma or serosa secretion in the dehiscence or surgical incision cicatrix,^{2,12,14,15} beyond ulcer and fistula.^{1,12} In this study, patient presented hyperemia, local heat, local edema, fistulisation, suture dehiscence, whitish secretion, and hard cicatrization. Therefore, the data from the literature corroborated with signals that the patient had.

Fever and other systemic manifestations, such as *M. fortuitum* are rare.^{2, 12, 14} The patient of this study did not present post-operative fever despite the fact that infection due to *M. fortuitum* was confirmed.

The identification of the causal agent of mycobacteria infection can be done straight through the Ziehl-Neelsen (ZN) BAAR spot and Lowenstein Jenses (LJ) media culture.²¹

In the presented study, the suspicion of it being a fast-growth mycobacterium occurred after the Ziehl-Neelsen staining procedure done at the Study Institution, where acid alcohol resistant bacillus (BAAR) was identified. Later on, the material was forwarded to the Ezequiel Dias Foundation (FUNED) to obtain the report, with *M. fortuitum* being confirmed.

The *National Manual of Laboratorial Tuberculosis Surveillance and other Mycobacteria* recommends for antibiotic therapy: amikacin, clarithromycin, ciprofloxacin, sulfametazol, tobramycin, imipenem, cefoxitin, doxycycline, and linezolid.²³ The antibiotic therapy is

3years long, and around every 3 months, depending on the infection classification type, its evolution and the patient immunological status, the use of antibiotics is prolonged for 3 to 6 more weeks.^{3,6} When there is a doubt about complex mycobacteria infection it is necessary to initiate antibiotic therapy.⁴ In regards to the patient in this study, the treatment was followed according to the non-tuberculosis mycobacterium protocol. The antibiotics used were Ciprofloxacin and Ceftriaxone, both were introduced on the same day of her 14th post-operative ambulatory appointment, besides the antibiotic therapy during the hospital admission.

Other treatment recommended for extensive infection caused by MCR is the surgical debris.^{4,12,15} The removal of breast prosthesis is indicated during biofilm formation in the material surface, which makes the elimination of mycobacteria from the organism through antibiotics and immune system more difficult.^{4, 6, 12, 14}

The drainage shows a colorless and odourless secretion, with a clean wound aspect.^{1, 2, 6, 12, 14, 15} In this study, besides the antibiotic therapy, the treatment was completed with breast prosthesis removal, in which the left breast had a whitish secretion, thick and odourless in moderate quantity corroborating with the literature. The debris did not happen, since the tissue seemed to be healed.

The ANVISA considers the MCR infection as an epidemiological emergency.¹⁸ In Brazil, during the period of 2008 to 2009 there was the peak of MCR infection. Also, during 1998 to 2009, ANVISA reported 117 cases of infection related to invasive procedures, from these 56 are due to plastic surgery.⁶ World incidence rate of MCR infection in aesthetics procedures varies from 4.8% to 17.8%.¹⁵ This was the first case study reported at the Institution.

6 Conclusion

A case report of a patient submitted to breast prosthesis implant was presented, in which there was complications such as infection caused by *M. fortuitum*. The procedure was held in healthy pre-operative conditions. However, in the post-operative the hyperemia, edema and local heat, fistulisation and hard cicatrization were present,

beyond the superficial dehiscence. At the surgical approach for breast prosthesis removal the presence of whitish and odourless secretion were found in moderate quantity covering the left breast prosthesis. The report of mycobacteriosis was confirmed on the 69th day of the first surgery post-operative, and after a year the re-implantation of bilateral breast prosthesis was done.

7 References

1. Fontana TR. Micobactérias de Crescimento Rápido e a infecção hospitalar: um problema de saúde pública. *Rev Bras Enf* 2008;61(3):371-373.
2. Wildner LM, Nogueira CL, Souza BS, Senna SG, Silva RM, Bazzo ML. Micobactérias: epidemiologia e diagnósticos. *Rev Pat Trop* 2011; 40(3):213-224.
3. Nguyen DQ, Riighini C, Darouassi Y, Schmerber S. Nasal infection due to *Mycobacterium fortuitum*. *European Annals of Otorhinolaryngology. Head and Neck diseases* 2011;128:197-199.
4. Betal D, A MacNeill F. Chronic breast abscess due to *Mycobacterium fortuitum*: a case report. *J Med Case Reports* 2011;18(5):188.
5. Silva TRM, Petersen ALOA, Santos TA, Almeida TF, Freitas LAR, Veras PST. Control of *Mycobacterium fortuitum* and *Mycobacterium intracellulare* infections with respect to distinct granuloma formations in livers of BALB/c mice. *Mem Inst Oswaldo Cruz* 2010;105(5).
6. Carvalho LHJr, Pereira ML, Costa LP, Gonçalves MJB, Soares LFM, Santos RL, et al. Infecção por micobactéria após videoartroscopia: o glutaraldeído pode ser culpado? *Rev Bras Ortop* 2008;43(6):256-260.
7. Set R, Shastri J. Laboratory aspects of clinically significant rapidly growing mycobacteria. *Department of Microbiology* 2011;29(4).
8. Agência Nacional de Vigilância Sanitária. Relatório descritivo de Investigação de casos de Infecções por micobactérias não tuberculosas de crescimento rápido (MCR) no Brasil no período de 1998 a 2009. 2011.
9. Penna GO, Filho ASQ. Nota Técnica Conjunta nº01/2009 – SVS/MS e ANVISA. Infecção por Micobactérias de Crescimento Rápido: Fluxo de Notificações, Diagnósticos Clínico, Microbiológico e Tratamento. Brasília, 2009.

10. Universidade Federal do Triângulo Mineiro. Protocolo de controle de infecção: prevenção de infecção de sítio cirúrgico. Uberaba, 2013.
11. Universidade Federal do Triângulo Mineiro. Manual de antissépticos padronizados do HC/UFTM: antissepsia. Uberaba, 2013.
12. Macedo JL, Maierovitch C, Henriques P. Infecções pós-operatórias por micobactéria de crescimento rápido no Brasil. *Rev Bras Cir Plást* 2009;24(4):544-550.
13. Pitombo MB, Lupi O, Duarte RS. Infecções por micobactéria de crescimento rápido resistentes a desinfetantes: uma problemática nacional? *Rev Bras Ginecol Obstet* 2009; 31(11):529-530.
14. Lizaso D, García M, Aguirre A, Esposto A. Infección protésica mamaria por *Mycobacterium fortuitum* en una paciente com lúpus eritematoso sistémico. *Rev Chil Infectol* 2011;28(5):474-477.
15. Cabral DB, Andrade D. Micobactérias não tuberculosas em cirurgias: desafio passível de enfrentamento no Brasil. *Rev Acta Paul de Enf* 2011;24(5):716-719.
16. Callen EC, Kessler TL. *Mycobacterium fortuitum* Infections Associated with Laparoscopic Gastric Banding. *Rev Obes Surg* 2011;21.
17. Phillips MS, Reyn FV. Nosocomial infections due to nontuberculous mycobacteria. *Instituto Federal Baiano* 2012; 33:1365-1366.
18. Agência Nacional de Vigilância Sanitária. Nota Técnica: micobactéria. 2008.
19. Moraes PRS, Chimara E, Telles MAS, Ueki SYM, Cunha EAT, Honer MR, Leão SC. Identification of non-tuberculous mycobacteria from the central public health laboratory from Mato Grosso do Sul and analysis of clinical relevance. *Rev Braz Journal of Microbiology* 2008;39:268.
20. Régnier S, Martinez V, Veziris N, Bonvallot T, Meningaud JP, Caumes E. Traitement des infections cutanées à *Mycobacterium Fortuitum*: deux cas. *Annales de dermatologie et de vénéréologie*, Paris, 2008; 135(8):592-594.
21. Agência Nacional de Vigilância Sanitária. Curso Básico de Controle de Infecção Hospitalar-Caderno C. 2000, p.18-22.
22. Lahiri CKK, Jena BJ, Pannicker CKK. *Mycobacterium fortuitum* infections in surgical wounds. *Medical Journal Armed Forces India* 2009; 65(1): 91-92.
23. Ministério da Saúde. Manual Nacional de Vigilância Laboratorial da Tuberculose e outras Micobactérias. 2008. doi: 978-85-334-1447-1.