Case Report

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Surgical site infection of laparoscopic hernioplasty site with non-tuberculous mycobacteria — *Mycolicibacterium fortuitum* — Case reports with literature review

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Abstract

Mesh infections have been described as "a surgeon's biggest nightmare." Infection with non-tuberculous mycobacteria (NTM) is often associated with the presence of a foreign substance, such as a catheter or mesh. Poorly sterilized laparoscopic instruments can also serve as a source of infection with NTM. Here, we report three cases of hernial mesh infections that followed laparoscopic surgery, caused by *Mycolicibacterium fortuitum.* NTM isolated in culture, from the samples were identified using 16s rRNA sequencing or Matrix Assisted Laser Desorption Ionization Time of Flight Mass Spectrometry (MALDI TOF MS). The patients presented with slowly progressive swelling at the surgical site over 1–2 months. The lesions healed following extensive surgical debridement and long-term antibiotics: fluoroquinolone with doxycycline/trimethoprim-sulfamethoxazole (6–10 months). Accurate diagnosis and prompt aggressive treatment are needed to cure NTM infections and prevent the development of complications, that can lead to prolonged recovery, multiple hospitalizations, and numerous antibiotic courses.

Keywords:

Laparoscopy, mesh infection, *Mycolicibacterium fortuitum*

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Introduction

The recurrence rate of hernia following mesh repair has drastically come down, making it the gold standard for hernia repair.[1] The implantation of any medical device, if not done under aseptic precautions, could cause an adverse event like an infection, as bacteria attach to it and form biofilms. The true incidence of such events is unknown as they are underreported.[2] The formation of these biofilms protects the bacteria from the action of antibiotics and host defense mechanisms. The common organisms associated with mesh infection include *Staphylococcus aureus*, *Streptococcus* species, Gram-negative bacilli belonging to the Enterobacteriaceae family and anaerobic bacteria. Infections with non-tuberculous mycobacteria are commonly observed in laparoscopic mesh repair surgeries.[3]

Mycobacterium traditionally consists of organisms within the *M. tuberculosis* complex, *Mycobacterium leprae*, and *NTM*.[4] *NTM* encompasses a wide spectrum of environmental and pathogenic acid-fast bacilli in the phylum Actinobacteria. These organisms have been previously known

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as mycobacteria other than tuberculosis (MOTT), environmental mycobacteria, anonymous or atypical mycobacteria, but the preferred term commonly used now is NTM.[5] The thick hydrophobic lipid-rich cell surface allows the organisms to be resistant to disinfectants and antibiotics and helps them survive in diverse and hostile environments.

In 1959, Runyon further classified NTM based on growth characteristics, pigmentation in the presence or absence of light as photochromogens, scotochromogens, nonchromogens, and rapid growers. Rapid-growing mycobacteria (RGM) can be distinguished by their ability to grow in less than seven days. Based on the genomic analysis, the family Mycobacteriaceae is currently divided into five genera, *Mycobacterium*, *Mycobacteroides*, *Mycolicibacter*, *Mycolicibacterium*, and *Mycolicibacillus*.[6] Approximately 190 species and subspecies of NTM have been identified now. RGM that are commonly associated with human infections include *Mycobacteroides* (*Mycobacterium*) *abscessus* complex, *Mycolicibacterium* (*Mycobacterium*) *fortuitum* complex, *Mycobacteroides* (*Mycobacterium*) *chelonae*. Microscopy after staining the appropriate sample is rapid. It can identify the presence of mycobacteria, but not their species, and has a much lower sensitivity when compared with culture and other molecular techniques.[7] After growth is observed in culture media, they can be rapidly identified using newer techniques like matrix-assisted laser desorption ionization time of flight mass spectrometry (MALDI TOF MS) based on the protein analysis and molecular assays that detect the gene of the mycobacteria. Molecular assays can be targeted gene sequencing of genes like 16s ribosomal RNA (16S rRNA), heat shock protein 65 (*hsp65*), beta subunit of RNA polymerase (*rpoB*), *secA* sequencing or whole genome sequencing and line probe assays.[4] Identifying the species of mycobacteria is important as the treatment differs for MTBC and the different species of NTM. Treatment involves the removal of mesh and a prolonged course of antibiotics that depends on the clinical response. Here, we report three cases of post-operative mesh infections caused by *M. fortuitum*. All the patients had undergone totally extraperitoneal (TEP) laparoscopic hernia repair and developed the infection after the surgery. None of these patients had undergone their index surgeries at this institute.

Case 1

A male patient in his early 30s who underwent laparoscopic right inguinal hernioplasty two months back, presented with complaints of swelling and pain in the right inguinal region for six weeks, along with intermittent low-grade fever for two weeks. He had no known comorbidities. The patient was afebrile at the time of examination. He had a 5 cm × 4 cm swelling in the right inguinal canal extending over the groin.

Ultrasonogram (USG) of the scrotum showed a well-defined collection with internal septation in the right scrotal sac above the superior pole of the right testis. A computed tomography (CT) scan of the abdomen showed intraperitoneal collection in the right iliac fossa region with extension into the scrotum through the right inguinal region, with minimal extraperitoneal collection.

Exploration of the right inguinal region with the removal of the infected mesh was done. Intraoperatively, the abscess cavity was seen to involve the spermatic cord, hence right orchidectomy was also performed. The pus was drained, and a thorough wash was given. The drained pus [Figure 1] and the infected mesh were sent to the microbiology laboratory for culture and sensitivity. Gram stain of the specimen did not reveal the presence of any bacteria. The culture of the pus samples grew opaque cream-colored colonies on blood agar and chocolate agar plates [Figure 2]. Gram stain from the culture plates revealed thin Gram-positive bacilli and acid-fast staining showed the presence of acid-fast bacilli (AFB). The organism was identified as *Mycobacterium farcinogenes/fortuitum* by 16SrRNA sequencing (Accession ID OP420744). It was difficult to differentiate between *M. farcinogenes* and *M. fortuitum* using 16SrRNA sequencing as both showed 100% similarity. It was presumptively identified as *M. fortuitum* based on the clinical details

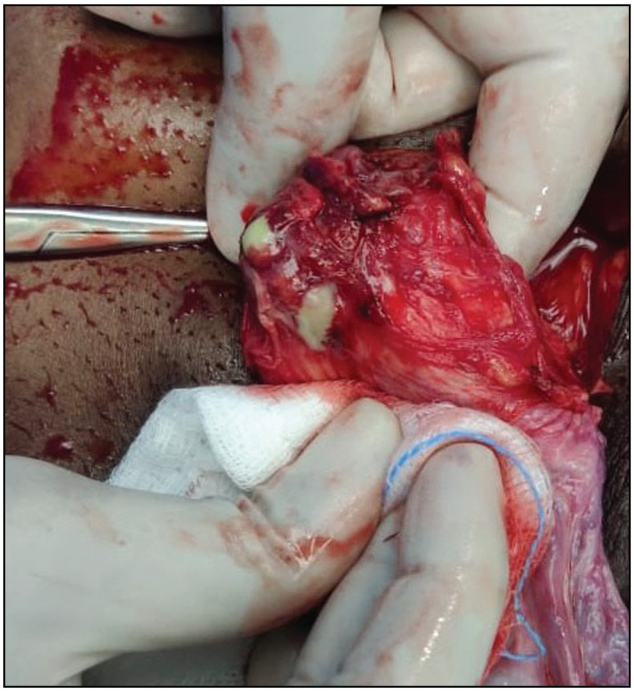

Figure 1: Pus collection at the site of non-tuberculous mycobacterial infection. Intraoperative image showing pus collection involving the right spermatic cord near the site of mesh placement

Figure 2: Colonies of *Mycolicibacterium fortuitum* on chocolate agar. Opaque cream-colored colonies of *Mycolicibacterium fortuitum were* observed on Day 5 on routine culture media used for aerobic bacterial culture

provided and the bacterial morphology in staining. Histopathological examination (HPE) of the tissue revealed necrotizing granulomatous inflammation with foreign body giant cell reaction.

In the late post-operative period, about two weeks after mesh removal, the abscess cavity recollected, and swelling reappeared. The abscess was drained by ultrasound-guided pigtail insertion. A repeat USG done five days after the insertion of the drain showed a complete resolution of the collection. The patient was treated with intravenous amikacin and imipenem for 15 days followed by oral levofloxacin 750 mg per day and doxycycline 100 mg twice a day for six months. Complete resolution of all the symptoms was observed over six months.

Case 2

A male patient in his early 40s underwent laparoscopic left inguinal hernioplasty. A month following the surgery, he developed swelling in the left lower abdomen, that progressively increased in size. Incision and drainage of the abscess was done. He presented to the emergency department a week later with complaints of pain and continuous purulent discharge from the left groin wound, associated with intermittent fever for one week. Physical examination revealed a swelling of about 14 cm × 8 cm in the left groin which was warm and non-tender. USG revealed an ill-defined hetero-echoic collection in the left iliac fossa in the deep subcutaneous plane communicating with the wound superficially.

Incision and drainage of the abscess was performed, with the removal of the mesh and tacker. The drained pus was sent to the microbiology laboratory for culture and susceptibility testing. The wound edges were brought together by loose sutures and allowed to heal by secondary intention. The pus culture grew bacterial colonies on the culture plates that were identified as *M.*

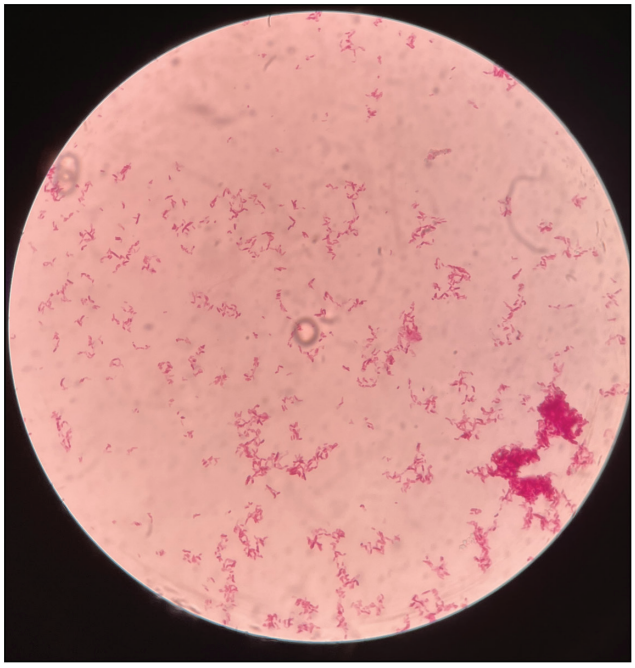

Figure 3: Microscopic picture of acid-fast bacilli from colonies of *Mycolicibacterium fortuitum* observed under 1000× magnification of a compound light microscope

fortuitum using MALDI TOF MS (VITEK MS, Biomerieux, France). The patient was treated with intravenous amikacin and oral ciprofloxacin for 7 days followed by oral ciprofloxacin 500 mg twice daily and trimethoprim-sulfamethoxazole for 10 months. There was no discharge from the wound after seven months of treatment and it healed completely.

Case 3

A female patient in her early 50s presented to the surgical OPD with complaints of abdominal pain for the past two months. She had undergone laparoscopic adhesiolysis with mesh repair of her right lateral hernia four months back. The patient had undergone open hernioplasty for an incisional hernia two years back, at the surgical scar site in the right iliac fossa. She later developed pain in the right iliac fossa six months after the surgery and was diagnosed with recurrent incisional hernia. She was a diabetic with a surgical history of open appendectomy 25 years ago, myomectomy six years ago, and hysterectomy with bilateral ovarian cystectomy three years ago.

On local examination, tenderness was present in the right hypochondrium and epigastrium, and increased resonance was present in the percussion. USG abdomen showed well-defined heterogeneously hypoechoic collection measuring 7.6 cm × 2.4 cm × 5.6 cm in the deep subcutaneous and muscular planes of the anterior abdominal wall in the left paramedian plane of the infraumbilical region. USG-guided pigtail

Table 1: Summary of the clinical course of the patients

Variables	Case 1	Case 2	Case 3
Surgery undergone by the patient before the current infection	Right inguinal hernia repair	Left inguinal hernia repair	Right lateral hernia repair
Clinical presentation	Swelling, pain, and intermittent low-grade fever	Swelling progressively increasing in size	Pain in abdomen
Onset of symptoms after surgery	2 months	1 month	2 months
Body mass index (kg/m^2)	22.5	29.4	27
NTM species	*Mycolicibacterium farcinogenes/ fortuitum*	*Mycolicibacterium fortuitum*	*Mycolicibacterium fortuitum*
Identification method	16 S rRNA	MALDI TOF MS	MALDI TOF MS
Blood Agar (growth observed in days)	Day 5	Day 5	Day 5
Surgical intervention	Exploration of the right inguinal region with removal of the infected mesh and right orchidectomy.	Incision and drainage of the abscess. Removal of the mesh and the tacker.	Pus was drained. Removal of the infected mesh.
Antibiotic intervention	Amikacin, imipenem (15 days) Levofloxacin, Doxycycline (6 months)	Amikacin Ciprofloxacin (7 days) Ciprofloxacin Trimethoprim/Sulfamethoxazole (10 months)	Cefotaxime (7 days)
Response Healed/ Persisting	Healed (6 months)	Healed (7 months)	Healed

catheter drainage was done and 4 mL of yellowish, cloudy fluid was drained. The drained fluid was sent to the microbiology laboratory. Gram staining showed moderate pus cells and no organism. Acid-fast staining revealed the presence of AFB. GeneXpert was negative for MTB. Aerobic bacterial culture grew cream white colonies of AFB [Figure 3] which was identified by MALDI TOF MS (VITEK MS, Biomerieux, France) as *M. fortuitum*. The patient was treated with extensive debridement and removal of the mesh at a different hospital and there was a complete resolution of the symptoms in a few months, even though the patient did not have any long-term treatment with the antibiotics recommended for *M. fortuitum* [Table 1].

Discussion

Impact of Surgical Techniques: The laparoscopic techniques for inguinal hernia repair include transabdominal preperitoneal (TAPP) repair and TEP repair. As per the Health Technology Assessment on behalf of the National Institute for Clinical Excellence in the UK, there was no major difference in the incidence of infection following any of these techniques. The rate of mesh infection was found to be 0.07% in TAPP compared with 0.01% in TEP.[8] Systematic review and meta-analysis comparing both techniques also showed no significant increase in the rates of infection associated with any particular technique.[9] A variety of patient-related factors can contribute to mesh infection including the American Society of Anesthesiologists (ASA) score ≥ 3, history of infection, and other comorbidities like poorly controlled diabetes, obesity, and smoking. In the current study, two patients were overweight with a body mass index (BMI) between 25 and 30 kg/m^2, and one patient was found to be in the healthy weight category (BMI < 25 kg/m^2). Surgery-related factors like improper sterilization of the laparoscopic instrument, the type of mesh used (multifilament hydrophobic polypropylene mesh associated with higher rates of infection), longer operating time, and being in the early part of the surgical learning curve are important factors associated with higher rates of infection.[10] Even though NTMs appear to be less virulent than *M.tuberculosis*, they can cause infection in both immunocompetent and immunocompromised individuals. Infections caused by NTMs can mimic those caused by *M.tuberculosis* in their gradual onset and chronicity of lesions. NTM infections can occur due to the contamination of laparoscopic instruments which are not sterilized but subjected to high-level disinfection with aldehydes followed by washing with water. The source of infection here could be the water which is used for cleaning the instruments after immersion in high-level disinfectant-aldehyde solution. This can be prevented by using disposable laparoscopic instruments or by using adequate sterilization techniques like plasma sterilization or ethylene oxide sterilization. All the patients in this case series had laparoscopic hernia mesh repair, following which they developed NTM infections after 1–2 months of the surgical procedure. As all the patients had undergone the previous surgeries in different hospitals,

further details regarding the technique of sterilization or high-level disinfection of the laparoscopic instruments could not be ascertained. Clinical manifestations noted among the patients included gradual onset of swelling after the mesh repair surgery, pain, and chronic discharge from the infection site. NTM has been gaining recognition as an important human pathogen due to an increase in the number of post-surgical wound infections caused by them.[11]

RGM can cause infections in the lungs, skin, soft tissue, and other parts of the body. As the susceptibility of RGM varies depending on the isolates, treatment strategies differ and there are no clear treatment guidelines for some NTM. *M. fortuitum* complex includes 12 *Mycobacterium* species that are known to cause skin, soft tissue, and bone infections, and are associated with mesh infections since the 1990s.[12] Since then, there have been several reports of *M. fortuitum* causing mesh infections [Table 2].[11,13-15]

Diagnostic Challenges: Collection of specimens for identification of mycobacteria and susceptibility testing should be done in a sterile leak-proof container without any fixatives. There is no requirement of transport media and refrigeration at 4 °C is preferred, if transport is delayed for more than an hour. In the case of soft tissue infections, aseptic collection of pus can be done by aspiration or if a minute amount of tissue is available, it should be immersed in a small amount of sterile saline to avoid drying.[16]

Microscopic examination of the sample after acid-fast staining can detect the presence of NTMs in some of the samples, but the sensitivity is low varying from 20% to 80%. We could identify the presence of NTM by acid-fast staining and microscopy only from one of the three samples. HPE reveals granulomatous inflammation, which can be either foreign body type or tuberculous type, and AFB is detected only in one-third of the samples.[17] HPE was done only for one of the patients which revealed granulomatous inflammation, but acid-fast bacilli were not detected.

Culture is more sensitive and can detect the presence of viable mycobacteria, even if only a few numbers of cells are present, but it can take anywhere from one to six weeks. Isolation of the bacteria can be done in routine

Table 2: Review of literature of *Mycolicibacterium fortuitum* infections following surgery

Serial no.	Surgical procedure	No of patients	Appearance of symptoms after surgery	Treatment received	Year
1.	Ventral hernia synthetic mesh repair	1	Not available	Removal of mesh Long-term sulfamethoxazole	USA 1999[12]
2.	Mesh hernioplasty for inguinal hernia	2	Case 1: 3 weeks Case 2: 4 weeks	Removal of mesh Case 1: Ciprofloxacin (several weeks) Case 2: Ciprofloxacin and amikacin (several weeks)	Spain 2007[13]
3.	Laparoscopic tubectomies-2 Herniorrhaphy-3	5	4 weeks	Removal of mesh Amikacin and ciprofloxacin/ clarithromycin, imipenem and amikacin (6 weeks).	India 2009[22]
4.	Mesh hernioplasty for inguinal hernia-3 Laparotomy anastomosis and resection	4	3–6 weeks	Retention of mesh Clarithromycin (6–9 months) clarithromycin+ ciprofloxacin	India 2010[11]
5.	Hernioplasty for infra umbilical hernia	1	4 weeks	Retention of mesh Cotrimoxazole and Ceftriaxone — 5 days followed by amikacin — 2 weeks ciprofloxacin 4 weeks	India 2016[23]
6.	Post-surgical, chronic surgical site infection	9	2–3 weeks	Extensive surgical debridement with removal of mesh. Ciprofloxacin, clarithromycin and amikacin (6–12 weeks)	India 2017[17]
7.	Post-surgical abdominal wall hernioplasty site	2	Case 1:3 months, Case 2:3 weeks	Extensive surgical debridement with removal of mesh. Case 1: Moxifloxacin, clarithromycin, and Vibramycin for 6 months Case 2: Levofloxacin 3 months	Japan 2024[24]

bacterial culture media like 5% sheep blood agar for RGM or in media specific for the growth of *Mycobacterium* like Lowenstein Jensen (LJ) media or automated platforms like *Mycobacterium* growth indicator tubes (MGIT). *M. fortuitum* can be readily isolated on routine media in the laboratory on prolonged incubation of one week.

Further identification of the NTM can be performed using conventional methods, molecular methods, and MALDI TOF MS. Further identification of two isolates was performed by MALDI TOF MS, and the other isolate was identified by 16SrRNA sequencing. Identification by 16S rRNA sequencing showed poor discriminatory power and 100% similarity between *M. farcinogenes* and *M. fortuitum.* For molecular identification of NTM, PCR based on gene targets *hsp*65, *rpo*B, and 16S–23S internal transcriber spacer (ITS) have more discriminative power. Molecular methods have the advantage of being highly sensitive and can identify the mycobacteria within a short time, either directly from the sample or from colonies on culture media. Once growth occurs in solid or liquid culture media, MALDI TOF MS can be used to identify within minutes, even though it works better for the identification of pure cultures isolated on solid media. It is a cost-effective technique, but may not be able to differentiate all species and subspecies.

Treatment strategies

We could not perform susceptibility testing of the mycobacterial isolates. According to CLSI M24 document susceptibility testing of rapidly growing Mycobacteria (RGM) that includes *M. fortuitum* group, *M. chelonae*, and *M. abscessus* should be performed only by broth microdilution (BMD). Agents that should be included in susceptibility testing include amikacin, cefoxitin, ciprofloxacin, moxifloxacin, clarithromycin, doxycycline (minocycline), imipenem, linezolid, trimethoprim-sulfamethoxazole, and tobramycin.[16]

The isolates are usually found susceptible to amikacin, ciprofloxacin, doxycycline, clofazimine, trimethoprim-sulfamethoxazole (TMP-SMX), tetracycline, linezolid, and resistant to the antituberculosis agents. Susceptibility pattern to macrolides was found to differ based on induced macrolide resistance due to the *erm* gene.[18] Chew *et al*. in their study with 86 *M. fortuitum* isolates, found them resistant to clarithromycin and tobramycin but susceptible to tetracyclines and quinolones. According to the 2019 drug susceptibility study done in Japan, among 43 isolates of *M. fortuitum*; the following rates of drug resistance were encountered — clarithromycin (100%), amikacin (0%), tobramycin (100%), cefoxitin (0%), levofloxacin/moxifloxacin (2.3%), linezolid (39.5%), doxycycline (60.5%), minocycline (55.8%), and cotrimoxazole (32.6%), respectively.[19]

Even though there are American Thoracic Society (ATS), European Respiratory Society (ERS), European Society of Clinical Microbiology and Infectious Diseases (ESCMID), and Infectious Diseases Society of America (IDSA) guidelines for the treatment of pulmonary infections caused by some species of NTM, there are no official guidelines for the treatment of post-surgical/skin and soft tissue infections by NTM.[20]

Antibiotic treatment may be avoided when the source control is done by extensive surgical debridement.[21] Fluoroquinolone with doxycycline is recommended for the treatment of *M. fortuitum* infections for 6–18 months.[21] The determination of the duration of treatment of NTM skin and soft tissue infection primarily relies on the assessment of changes in the patient's clinical manifestations. In this series, the treatment protocol followed included extensive surgical debridement and fluoroquinolone with doxycycline/trimethoprim-sulfamethoxazole (6–10 months).

Conclusion

NTM are being increasingly associated with hernial mesh infections following laparoscopic surgery and need to be diagnosed accurately and treated promptly, which can result in reduced costs and improved patient outcomes.

The symptoms in NTM infections appear gradually one month following the surgery and present as pain, swelling, or discharging sinuses at the surgical site.

The suspicion of NTM infection needs to be appropriately communicated to the laboratory so that acid-fast staining and prolonged incubation of routine or specific culture media for NTM can be done for the specimen.

The molecular identification techniques like PCR and sequencing can be done directly from the sample, which reduces the turnaround time. Newer techniques like MALDI TOF MS can be performed directly from the culture of the sample, for identification of NTM.

The treatment for NTM involves draining the pus collection, removal of the infected mesh, and prolonged antibiotic treatment that depends on the extent of debridement, NTM species involved, and their susceptibility pattern.

Author contributions

TA, SR, KR, AM, NN- contributions to conception, data acquisition, analysis, and interpretation of data. KSS, KBS, IA- Reviewing critically for important intellectual content. All authors have agreed to the final draft submission.

Ethical policy and institutional review board statement

Our study procedures were in accordance with the ethical standards of the responsible committee on human experimentation and with the Helsinki Declaration. Institutional ethical board review was not required as it is a retrospective case study.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published, and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Data availability statement

The authors declare that data supporting the findings of this study are available within the article.

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Conflict of interest

There is no conflict of interest.

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