

Green Nail Syndrome on the Nail Plate and Bed Related with *Enterococcus* and *Fusarium* Coinfection

Vessela V. Ouzounova-Raykova¹

¹ Department of Medical Microbiology, Medical University of Sofia, Sofia, Bulgaria

Corresponding author: Vessela V. Ouzounova-Raykova, Department of Medical Microbiology, Medical University of Sofia, 2 Zdrave St., 1431 Sofia, Bulgaria; Email: pumpi@abv.bg; Tel.: +359 2 9172580

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Abstract

The green nail syndrome is characterized by discolouration of the nail plate frequently accompanied by chronic paronychia and onycholysis. The cause could be either bacterial or fungal infection.

A 24-year-old woman presented to the clinic with a history of discolouration of the nail plate and bed accompanied by onycholysis. Scrapings from the nail were taken twice, microscopically examined, and cultured on media for isolation and identification of bacteria and fungi. The first sample gave positive results for *Enterococcus* spp. After treatment and a lack of complete recovery of the nail, second sample was taken and subjected to the same tests. This time *Fusarium* infection was detected. Additional treatment was performed and the nail's plate and bed were successfully treated.

Keywords

coinfection, *Enterococcus* spp., *Fusarium* spp., green nail syndrome, skin appendage

INTRODUCTION

Green nail syndrome (GNS) is characterized by greenish discolouration of the nail plate (greenish-black, greenish-brown, greenish-yellow), frequently accompanied by chronic paronychia and onycholysis. The causes could be bacteria, fungi or a combination of these microorganisms in persons with predisposing factors such as trauma or consistent exposure of the skin to water, soaps or detergents.^[1-3] We present a case of GNS in a young person developed some weeks after trauma of the finger nail.

CASE REPORT

A 24-year-old woman presented with a history of greenish-yellow-brown discoloration of the fingernail plate accom-

panied by onycholysis developed a few weeks after a trauma. No paronychia was observed (**Fig. 1**). The history revealed no peculiarities related to the profession of the patient (she was a student), or to what her daily activities were. A written informed consent in accordance with the ethical standards of the Ethics Committee of Medical University of Sofia was taken. Nail scrapings were taken from the patient and subjected to microscopy (KOH preparation for direct mycological microscopy) and cultivated on blood agar, MacConkey agar, CHROMagar *Candida* and SDA chloramphenicol (Becton Dickenson). Plates were incubated at 37°C for 24-48 hours for the routine microbiological testing and for additional three days at room temperature for fungi isolation.

The sample was positive for *Enterococcus* spp. and negative for fungi. *Enterococcus* spp. was identified on the bases of colony morphology, Gram staining, catalase and oxidase test, bile-esculin test, and salt tolerance test (6.5% NaCl), biochemical

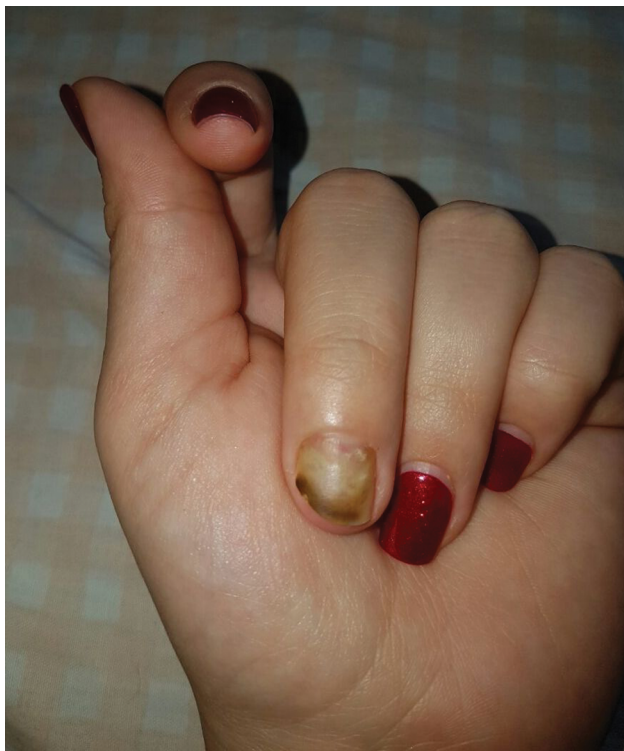


Figure 1. Green nail syndrome with discolouration of the nail plate and bed accompanied by onycholysis.

reactions, as per standard microbiological guidelines. After unsuccessful combined oral and topical antibiotic treatment according to the strain sensitivity, new nail scrapping was taken and subjected to a new identical microbiological testing. In the second sample *Fusarium* spp. infection was detected.

DISCUSSION

Infections of the nails can be caused by fungi, bacteria, viruses or a combination of these.^[4] Fungi, the anthropophilic dermatophytes *Trichophyton rubrum*, *Epidermophyton floccosum*, and *Microsporum gypseum* represent the main causative agents of onychomycoses. These are followed by the yeasts *Candida parapsilosis*, *Candida guilliermondii*, and *Candida albicans*. *Fusarium* species are by far the most common cause of mold onychomycosis.^[4]

Bacterial infections of the nails are not rare. Usually, Gram-negative bacteria are implicated in the process. *Pseudomonas aeruginosa* is the most frequently isolated bacteria. However, *Klebsiella* spp. and Gram-positive bacteria such as *Staphylococcus aureus* or *Streptococcus pyogenes* could be the protagonists in the infection.^[5-7] In the discussed case, the 24-year-old woman presented with a greenish-yellow-brown discolouration affecting more than 80% of the surface area of the nail plate, accompanied by onycholysis developed a few weeks after trauma. Samples were collected and different microbiological tests were performed. Scrapings from the nail were subjected to microscopy study and the results were negative. The cul-

tivation on a selective culture medium for isolation and identification of fungi did not show growing colonies. However, the cultures for bacteria showed positive results for *Enterococcus* spp.

It is known that *Enterococcus* spp. is a group of facultative anaerobic organisms that are part of the normal intestinal flora of humans and animals. They have been long recognized as important human pathogens and are becoming increasingly so. Important clinical infections caused by *Enterococcus* spp. include bacteremia, urinary tract infections, wound infections, endocarditis, meningitis, and diverticulitis. Enterococcal infections of the nails and their adjacent tissues are not common, but there are some data regarding this matter.^[8]

The treatment of nail infections is challenging^[9] and recommendations based on clinical trials or strict guidelines are lacking.^[4] Therapy is based on the microorganism isolated, the number of nails affected, and the percentage of nail plate involvement. In the infectious nail diseases, local or systemic treatment could be applied. The topical therapy is preferred because it avoids the adverse effects over the metabolism.^[10] Frequently, this therapy fails because of the poor penetration of the drug into the nail plate. The treatment usually requires an oral antifungal medication for several months owing to the higher concentration of therapeutic agents in the lesion.^[11,12] So, mild infections affecting less than 50% of one or two nails could be subjected to topical medications, otherwise systemic therapy is recommended. We think that combined topical and oral treatment is probably the most effective regimen. Thus, the therapeutic scheme used for our patient was: amoxicillin/clavulanic acid 1 g BID for 10 days followed by tobramycin eye drops, 2-3 drops 3 times per day for 3 weeks. The medication was prescribed based on the susceptibility of the isolated strain. After two and a half months, the change in the nail structure was not satisfactory. The colour became whitish, the decreased sensitivity of the nail bed has recovered; however, the onycholysis could still be seen (Fig. 2). The lack of desired clinical response made us conduct

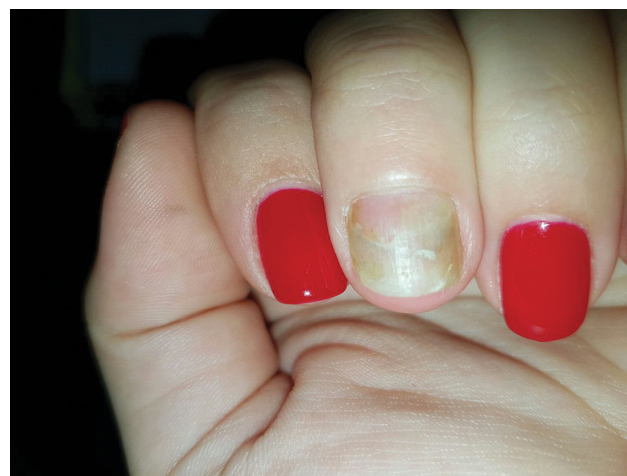


Figure 2. Green nail syndrome with some clinical response after 3 months specific treatment.

another microbiological study. This time *Fusarium* spp. infection was detected.

Fusarium spp. are non-dermatophytic moulds. They are known as soil saprophytes, important plant pathogens as well as aetiological agents of opportunistic human infections and they are one of the three different types of fungi that could lead to the development of onychomycosis.^[4,13]

In our opinion, the patient had sustained a bacterial and fungal coinfection. It is very likely that the inability to prove the mycotic agent resulted from the bacterial overgrowth in the culture, which suppressed the fungi development. When the bacteria were totally eliminated by the applied therapy, the nail remained with the fungal mono-infection alone. Meanwhile, a second sample was taken for a new microbiological test. The results for bacteria showed negative and *Fusarium* spp. was detected.

The new therapeutic strategy consisted of topical treatment with an extempore prepared combination of reagents against fungi (thymolum, salicylic acid, resorcinol, acetic acid, iodine tincture, and alcohol 70°) applied twice per day for a sufficient amount of time. The nail plate was cured within 6 months after the initiation of this treatment.

This is the first case in which *Enterococcus* spp. has been reported as a causative agent of GNS in coinfection with *Fusarium* spp. Although *P. aeruginosa*, known as the causative agent of GNS, was not detected in the sample, on the basis of the greenish-yellow-brown discolouration of the nail plate accompanied by onycholysis, and the detection of *Enterococcus* spp. with the possibility of some enterococci to synthesize yellowish pigment^[14] give us the reason to assume that the described infection could be named as green nail syndrome.

Bacterial and fungal coinfections of nails were described by Yang et al., too.^[15] They found *Fusarium solani* onychomycosis coinfecting with *P. aeruginosa*. The researchers reported that coinfection with bacteria can prevent the isolation of the fungus because of bacterial overgrowth in culture which is consistent with our conclusions.

It is worth noting that only about 50% of discoloured or dystrophic-appearing nails have an infection confirmed with microscope or culture. The differential diagnosis of GNS and other causes of onycholysis should include trauma (tight shoes, nail biting), eczema (irritant or allergic contact dermatitis), lichen planus, subungual melanoma, psoriatic nail disease, systemic diseases such as thyroid disease, diabetes, peripheral arterial disease, idiosyncratic drug reaction (especially tetracyclines, quinolones and psoralens) or chemical exposure to solutions containing pyocyanin or pyoverdine.

CONCLUSIONS

Green colouration of the nails accompanied by onycholysis should raise suspicion for GNS. Based on the practice in which fungi, bacteria, and other microorganisms could affect the nail plate and bed, screening for co-infections is

crucial. This is the first time in which *Enterococcus* spp. has been reported as a causative agent of GNS in coinfection with *Fusarium* spp. The condition, however, was successfully treated (Fig. 3).



Figure 3. Recovered nail plate and bed after 6 months treatment.

REFERENCES

- Hengge UR, Bardeli V. Images in clinical medicine. Green nails. *N Engl J Med* 2009; 360:1125.
- Tosti A, Piraccini BM. Nail disorders. In: Bologna JL, Jorizzo JL, Schaffner JV, editors. *Dermatology*. 3rd ed. Edinburgh: Elsevier; 2012:1134–5.
- Maes M, Richert B, de la Brassinne M. Green nail syndrome or chloronychia. *Rev Med Liege* 2002; 57(4):233–5.
- Nenoff P, Paasch U, Handrick W. Infections of finger and toe nails due to fungi and bacteria. *Hautarzt* 2014; 65(4):337–48.
- Chiriac A, Brzezinski P, Foia L, et al. Chloronychia: green nail syndrome caused by *Pseudomonas aeruginosa* in elderly persons. *Clin Interv Aging* 2015; 10:265–7.
- James WD, Berger TG, Elston DM, et al. *Andrews' diseases of the skin: clinical dermatology*. 10th ed. Philadelphia: Saunders Elsevier; 2006:254.
- Cohen MS, Rutala WA, Weber DJ. Gram-negative coccal and bacillary infections. In: Goldsmith LA, Katz SI, Gilchrist BA, et al., editors. *Fitzpatrick's Dermatology in General Medicine*. 8th ed. New York: McGraw-Hill; 2012:2183–6.
- Tomczak H, Dańczak-Pazdrowska A, Polańska A, et al. Microbiological analysis of acute infections of the nail fold on the basis of bait thread test. *Postepy Dermatol Alergol* 2017; 34(2):110–5.
- Müller S, Ebnöther M, Itin P. Green nail syndrome (*Pseudomonas aeruginosa* nail infection): Two cases successfully treated with topical nadifloxacin, an acne medication. *Case Rep Dermatol* 2014; 6(2):180–4.
- Bae Y, Lee GM, Sim JH, et al. Green nail syndrome treated with the application of tobramycin eye drop. *Ann Dermatol* 2014; 26(4):514–6.

11. Murdan S. Enhancing the nail permeability of topically applied drugs. *Expert Opin Drug Deliv* 2008; 5:1267–82.
12. Shivakumar HN, Juluri A, Desai BG, et al. Ungual and transungual drug delivery. *Drug Dev Ind Pharm* 2012; 38:901–11.
13. Kuruvilla TS, Dias M. *Fusarium Solani*: a causative agent of skin and nail infections. *Indian J Dermatol* 2012; 57(4):308–9.
14. Maraccini PA, Ferguson DM, Boehm AB. Diurnal variation in *Enterococcus* species composition in polluted ocean water and a potential role for the Enterococcal carotenoid in protection against photoinactivation. *Appl Environ Microbiol* 2012; 78(2):305–10.
15. Yang YS, Ahn JJ, Shin MK, et al. *Fusarium solani* onychomycosis of the thumbnail coinfecting with *Pseudomonas aeruginosa*: report of two cases. *Mycoses* 2011; 54(2):168–71.

Синдром зелёного ногтя на ногтевой пластине и ложе, связанный с коинфекцией *Enterococci* и *Fusarium*

Весела В. Узунова-Райкова¹

¹ Кафедра медицинской микробиологии, Медицинский университет – София, София, Болгария

Адрес для корреспонденции: Весела В. Узунова-Райкова, Кафедра медицинской микробиологии, Медицинский университет – София, ул. „Здраве“ № 2, 1431 София, Болгария; E-mail: pumpri@abv.bg; Тел.: +359 2 9172580

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Резюме

Синдром зелёного ногтя характеризуется изменением цвета ногтевой пластины, часто сопровождающимся хронической паронихией и онихолизисом. Причиной может быть как бактериальная, так и грибковая инфекция.

В клинику обратилась женщина 24-х лет с жалобами на изменение цвета ногтевой пластины и ложа, сопровождающееся онихолизисом. Соскобы с ногтя брали дважды, исследовали под микроскопом и культивировали на средах для выделения и идентификации бактерий и грибов. Первый образец дал положительный результат на *Enterococcus spp.* После обработки и отсутствия полного восстановления ногтя был взят второй образец и подвергнут тем же испытаниям. На этот раз выявлена инфекция *Fusarium*. Было проведено дополнительное лечение, и ногтевая пластина и ложе были успешно обработаны.

Ключевые слова

коинфекция, *Enterococcus spp.*, *Fusarium spp.*, синдром зелёного ногтя, кожный придаток
