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Fungal growth on a corpse: a case report

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Abstract: Fungi exist in many environments, in air, bathrooms of houses, on wet floors, grounds, showers, dirty, and wet laundry, air conditioners, and humidifiers, garbage bins, dish racks, carpets, in dark, and humid environments as cellars, and attics. Forensic mycology is a branch of science which describes species of fungi. In the past, forensic mycology was mostly restricted to the examination of poisonous, and psychotropic species, in recent years it starts to play a role in the determination of the time of death, burial place, and time of leaving the body where it was found, and cause of death (hallucination, and poisoning). Forensic mycology is considered as an auxillary method in the determination of the time of death just like forensic entomology. In our study, by presenting a case whose dead body was covered with fungal plaques during postmortem period, we aim to review literature concerning fungal growth on corpses.

Key Words: Fungi, forensic mycology, time of death, fungi on corpse.

INTRODUCTION

Contrary to plants, fungi can not produce their own nutrients. They derive their nutrients directly from living or non-living organisms, and other organic substances [1]. Fungi exist in many environments, in air, bathrooms of houses, on wet floors, grounds, showers, dirty, and wet laundry, air conditioners, and humidifiers, garbage bins, dish racks, carpets, in dark, and humid environments as cellars, and attics [2, 3]. On eatables left at open air, growth of fungal mold may be observed, rarely fungal colonizations are seen on cadavers kept under appropriate conditions during postmortem period [2]. Forensic mycology is a branch of science which describes species of fungi [4]. In the past, forensic mycology was mostly restricted to the examination of poisonous, and psychotropic species, in recent years it starts to play a role in the determination of the time of death, burial place, the time of leaving the body where it was found, and cause of death, hallucination or poisoning [1].

In our study, by presenting a case whose dead body was covered with fungal plaques during postmortem period, we aim to review literature concerning fungal growth on corpses.

CASE REPORT

As it was learnt, a 42-year-old woman leading a solitary life had been receiving long-term treatment for schizophrenia. The death incident happened in the first week of April in cold weather when her stove had been lighting. Upon declaration of her brother, she was seen alive three days ago. When any news about her health could not be received, her relatives walked into her home, and found her dead body.

On the scene investigation, her dead body was found on the entrance of the alla turca toilet, bending forward with her knees flexed, and her face resting on the toilet stone. Stove in the room was cold, and stove pipe was displaced. Inside the room a smoky smell was felt.

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At autopsy, her dead body was extremely cachectic. Decomposition, and cherry red postmortem lividity (livor mortis) were observed. Diffuse greenish white fungal mold plaques were seen around her mouth and nose, in nostrils, anterior surface of the chest, on the right, and left sides of the neck, chin region, right eye lid, at the middle, and left side of the forehead, and also mold plaques were observed on posterior surface of the left forearm, and, posterior, and anterior surfaces of the right forearm (Figs 1-2). Widespread green discoloration secondary to putrefaction was seen on the anterior surface of the abdomen. Internal examination revealed greenish white discoloration due to molding around the mouth, and greenish white molds on periepiglottal region (Fig. 3). Internal organs assumed a light red color accompanied by manifestations of partial decomposition. As a striking feature, blood was light red. Since necessary ultrastructural conditions for forensic mycologic sampling in our city, and surroundings are lacking, we couldn't perform mycological analysis. Histopathological examination revealed cerebral congestion, pulmonary autolysis, edema, emphysematous changes, renal, and hepatic autolysis, a mild degree of perivascular-interstitial fibrosis in the heart.

Toxicological analysis demonstrated the presence of 58.1% carboxyhemoglobin (HbCO) in blood samples. As a result of autopsy, we determined that the death was caused by carbon monoxide poisoning.

DISCUSSION

Forensic entomology is a branch of science which provenly allows estimation of postmortem interval by evaluating developmental phases of insects, and insect succession on the corpse (5–10). However, forensic mycology is considered as an auxillary method in the determination of the time of death just like forensic entomology [11]. However adequate information is lacking about the role of fungi in the decomposition of human corpses [12]. It has been claimed that Candida spp. are effective during the early phases of decomposition, while in the advanced stages of corpse decomposition, fungi present in the soil may have role in this putrefaction process [13].

Development of fungi on corpses found in dark, and humid environment may be observed [3]. However in Turkey, growth of fungi on the corpse is very rarely seen in the practice of forensic medicine. Growth of fungi on corpses is priorly seen on face, and especially oral region, subsequently fungal lesions spread over chest, leg, arm, and abdomen [14]. Mostly, aerobic fungi are found in decaying corpses, thus it has been indicated that growth of fungi is restricted to the surface of the corpse [13]. In our case the corpse was found in the dark, and humid toilet of a house, and fungal plaques were seen on the face, neck, and chest of the deceased. Fungi involved

Figure 1. Greenish white molds on the forehead, perioral, and perinasal areas, and anterior chest wall.

Figure 2. Greenish white molds on the right side of the cheek, anterior part of neck, and chest.

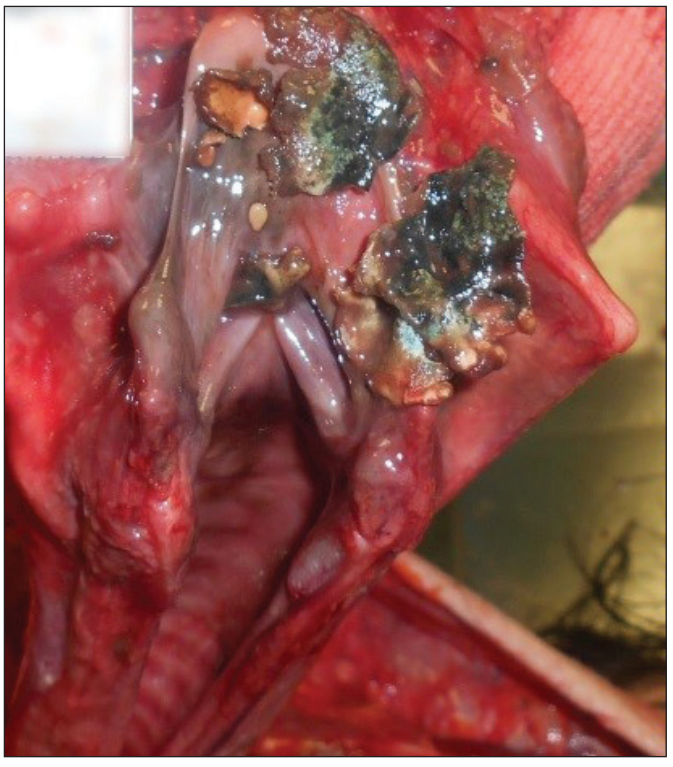

Figure 3. Greenish white molds on the periepiglottal region.

only periepiglottal region, and did not pass into trachea or esophagus.

Firstly, in the year 1982, Van de Voorde, and Van Dijck recommended potential use of fungal growth in the determination of time of death [15]. In their studies, they incubated fungi they found on the eye lid, and groins of a 57-year-old dead woman lying in the bedroom of an old mansion under room temperature, and accordingly they estimated that the woman had died 18 days ago. They also indicated that this postmortem interval was also confirmed by judicial investigation. At the end of the study, they suggested that fungi on the body surface may aid in the determination of time of death within 10-20 days after the death incident. Nearly 23 years after this study of Van de Voorde, and Van Dijck, Ishii *et al.* in the year 2006, isolated osmophilic soil fungi ie. Eurotium spp. (E.rebens and E. rubrum) in a two mummified, and completely skeletonized corpses [16]. In their study, they also indicated that with the detection of fungal species on human corpses, local habitats of fungi may be disclosed. In addition, they stated that postmortem interval could not be precisely determined by means of identification of fungal species found on high degree decayed human corpses, while they also added that forensic mycology might become a relaible auxillary technique in the determination of postmortem interval thanks to the studies to be performed on increased number of forensic cases [11]. However Menezes *et al.* indicated that accurate estimation of the time of death based on the developmental stages of fungal species detected on the corpse by Ishii *et al.* would demonstrate potential use of forensic mycology [17]. In a study, Hitosugi *et al.* presented a nearly 71-year-old case died accidentally as a result of fall into a well from a height of 6 meters because of hemorrhagic shock related to retroperitoneal bleeding secondary to pelvic fracture [3]. They reported that they had isolated Penicillium spp. and Aspergillus terrous on the face of the corpse, and indicated that these fungi had colonized within 3-7 days after the death incident. Judicial investigation disclosed that the victim had been seen lastly 12 days ago, and the authors suggested that the victim had died nearly 10 days ago based on the results of mycological analyses. On the contrary Menezes *et al.* stated that the results of mycological examination of the corpse in the study by Hitosugi *et al.* indicating a postmortem interval of 10 days were devoid of scientific value, because lack of data about both fungal growth rate on the human corpses, and factors effective on these rates. Menezes *et al.* also added that Hitosugi *et al.* did not estimate postmortem interval based on mycological evidence, but with reference to information provided by the police. Besides, they emphasized that fungal growth should be analyzed in different climatic conditions, and further experimental studies should be conducted on growth rates, and patterns of fungi [10]. Unfortunately, in our case, any further investigation was not performed concerning fungal species found on the corpse, and duration of their development. However literature studies have demonstrated a postmortem interval of at least 3-7 days is required for realization of fungal growth on corpses. In our case, at least three days passed after death incident which allowed formation of mold plaques, and signs of decomposition, and testimonies taken during judicial investigation also supported this postmortem interval. We think that death taking place in a humid alla turca toilet with the victim found bending forward with her knees flexed, and her face resting on the toilet stone facilitated fungal growth on the corpse.

Very few studies have been performed on fungal colonizations on corpses [2, 4]. Sidrim *et al.* analyzed a total of 234 samples collected from 60 corpses in the bloated, putrefication and skeletonization stages, and determined that Aspergillus spp. (A. Flavus, A. Niger), Peniciliium spp. (P. Piceum, P. Rugulosum, P. Verruculosum), and Candida spp. (C. Albicans, C. Parapsilosis) are related to putrefied human corpses (4). While Schwarz *et al.* investigated 23 autopsized cases in Germany, and reported identification of 24 different fungal species in these decomposed corpses including Aspergillus flavus, Aspergillus fumigatus, Aspergillus pseudoglaucus, Candida albicans, Candida glabrata, Candida tropicalis, Debaryomyces hansenii, Helicostylum elegans, Lichtheimia corymbifera, Mucor circinelloides, Mucor flavus, Mucor plumbeus, Mucor saturninus, Mucor racemosus, Penicillium brevicompactum, Penicillium chrysogenum, Penicillium crustosum, Penicillium expansum, Penicillium polonicum, Pseudogymnoascus pannorum, Rhizopus microspores, Rhizopus stolonifer, Scopulariopsis brevicaulis, and Yarrowia lipolyticasa [2]. Just like flies and insects show postmortem consecutivity in forensic entomology, fungal species need further studies on whether they also show postmortem consecutivity and they may also be used in specifying postmortem interval.

CONCLUSION

Determination of postmortem interval is one of the most updated subjects of forensic medicine. Though experimental studies have been performed using various methods, in recent years species of fungal colonies grown on cadavers, and duration of fungal colonization have been tried to be determined to estimate postmortem intervals.

Though some species of fungi as Penicillium spp. and Aspergillus spp. are widespread, colonization on cadaver requires at least a period of at least 3-7 days [3]. When the corpse of the victim living solitarily at home was found, development of decomposition signs, and fungal mold plaques on the corpse were observed. For the formation of these fungal plaques, death incident should take place at least three days ago, decomposition

signs, and testimonies given during judicial investigations supported the time of death.

We think that by (a) identifying fungal species on the corpse to detect the presence (if any) fungal consecutivity, (b) analyzing fungal growth in diverse climatic conditions, and (c) performing further experimental studies concerning fungal growth rates, and patterns, presently forensic mycology may be adjunct to forensic entomology in the determination of postmortem interval or replace it in cases where forensic entomology is not feasible.

Conflict of interest. The authors declare that there is no conflict of interest.

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