Covid19 autopsy in Oklahoma detects the facultatively anaerobic *Proteus mirabilis* in lungs - reason of death written as “complications of hepatic cirrhosis” with renal nephrosclerosis and acute bronchopneumonia - all symptoms associated with *Proteus mirabilis*

Sandeep Chakraborty

Letter

The hypothesis of SARS-Cov2 enabling anaerobic bacteria colonize the lungs in Covid19 is based on sequencing data from several studies across the globe [1]. Here, the autopsy of a 42-year-old obese man with muscular dystrophy shows [2] the presence of *Proteus mirabilis* in the lungs (found by culturing), a facultatively anaerobic bacteria that is often implicated in the reasons cited for the cause of death.

Autopsy results

1. nasopharyngeal swabs were positive for SARS-Cov2
2. lung parenchymal swabs were negative for SARS-Cov2
3. ‘No viral inclusions, mucus plugging in airways, eosinophils, or myocarditis’.
4. ‘lungs revealed foci of acute bronchopneumonia’.
5. ‘liver cirrhosis’
6. ‘renal nephrosclerosis, tubular fan-shaped crystals (kidneys)’
7. ‘cause of death was listed as “complications of hepatic cirrhosis”’

Bacteria cultured - and not all bacteria culture well - were classified as nontoxicogenic

They reported that aerobic/anaerobic cultures of the lung tissue grew ‘nontoxicogenic *Escherichia coli*, *Candida tropicalis*, and *Proteus mirabilis*.’ [2]. However, the facultatively anaerobic *Proteus mirabilis* is implicated in several of the reasons responsible for the death of the patient.

Kidney

Urease is an important virulence factor for *Proteus mirabilis*. It hydrolyzes urea, leading to stone formation [3]. Within the stones, ‘COM crystals are arranged radially into fan-shaped profiles with distinct concentric laminations’ [4] (see autopsy results). *Proteus mirabilis* has unique kidney pathology, and is a unique species that causes a large number of kidney stone formation, and greater kidney damage in rats than other similar bacteria with urease enzymes [5].

Liver

Patients with cirrhosis have a higher proportion of *Proteus* species compared with control, their presence in the gut are known to contribute to the pathogenesis of hepatic encephalopathy by breaking down urea into ammonia and carbonic acid [6]

Pneumonia

Proteus mirabilis is not associated with pneumonia very often. However, 13 patients with *Proteus mirabilis* pneumonia in Japan showed resistance for levofloxacin [7], while extended-spectrum β -Lactamase producing *Proteus mirabilis* was implicated in pneumonia in Korea [8].

Proteus mirabilis grows in anaerobic conditions

Nutrients (iron, zinc, amino acids, and dioxygen) are important for the growth and swarming behavior of *Proteus mirabilis* [9]. Also, anaerobic respiration uses a ‘complete oxidative TCA cycle’ that drives multicellular swarming [10]. *Proteus mirabilis* swarming growth is the development of concentric rings of growth, producing a bull’s-eye colony [11].

Role of hemolysin in *Proteus mirabilis*

The calcium-independent hemolysin HpmA [12] seems to be the primary virulence factor responsible for cytotoxicity to human renal proximal tubular epithelial cells (a protective barrier for the kidney) [5] HpmA damages kidney tissues [13].

Conclusion:

The detection of the facultatively anaerobic *Proteus mirabilis* during the autopsy of a patient must be considered more seriously as a causative agent of mortality since it is implicated in all of the reported maladies, especially in the kidneys.

References

1. Chakraborty S (2020). Sars-cov2 enables anaerobic bacteria (prevotella, et al) to colonize the lungs disrupting homeostasis - symptoms (ards, septic shock, blood clots, arterial stroke) finds resonance, with key differences, in the ‘forgotten disease’ lemmiere syndrome, caused by anaerobic bacteria enabled by epstein barr virus. doi:10.31219/osf.io/usztn. URL osf.io/usztn.
2. Barton LM, Duval EJ, Stroberg E, Ghosh S, Mukhopadhyay S (2020) Covid-19 autopsies, oklahoma, usa. American Journal of Clinical Pathology .
3. Jones B, Mobley H (1988) *Proteus mirabilis* urease: genetic organization, regulation, and expression of structural genes. Journal of bacteriology 170: 3342–3349.
4. Khan SR, Pearle MS, Robertson WG, Gambaro G, Canales BK, et al. (2016) Kidney stones. Nature Reviews Disease Primers 2: 1–23.
5. Armbruster CE, Mobley HL, Pearson MM (2018) Pathogenesis of proteus mirabilis infection. EcoSal Plus 8.
6. Hamilton AL, Kamm MA, Ng SC, Morrison M (2018) *Proteus* spp. as putative gastrointestinal pathogens. Clinical microbiology reviews 31: e00085–17.
7. Okimoto N, Hayashi T, Ishiga M, Nanba F, Kishimoto M, et al. (2010) Clinical features of proteus mirabilis pneumonia. Journal of infection and chemotherapy 16: 364–366.
8. Ryou SH, Bae JW, Baek HJ, Lee DH, Lee SW, et al. (2015) Pulmonary pneumatocele in a pneumonia patient infected with extended-spectrum β -lactamase producing proteus mirabilis. Tuberculosis and respiratory diseases 78: 371–374.

9. Wilkerson ML, Niederhoffer EC (1995) Swarming characteristics of *proteus mirabilis* under anaerobic and aerobic conditions. *Anaerobe* 1: 345–350.
10. Alteri CJ, Himpsl SD, Engstrom MD, Mobley HL (2012) Anaerobic respiration using a complete oxidative tca cycle drives multicellular swarming in *proteus mirabilis*. *MBio* 3: e00365–12.
11. Belas R, Schneider R, Melch M (1998) Characterization of *proteus mirabilis* precocious swarming mutants: Identification of *rsba*, encoding a regulator of swarming behavior. *Journal of bacteriology* 180: 6126–6139.
12. Mobley HÁ, Chippendale G, Swihart K, Welch R (1991) Cytotoxicity of the *hpma* hemolysin and urease of *proteus mirabilis* and *proteus vulgaris* against cultured human renal proximal tubular epithelial cells. *Infection and immunity* 59: 2036–2042.
13. Cestari SE, Ludovico MS, Martins FH, da Rocha SPD, Elias WP, et al. (2013) Molecular detection of *hpma* and *hlya* hemolysin of uropathogenic *proteus mirabilis*. *Current microbiology* 67: 703–707.