Case report

SARS-CoV-2 with Panton-Valentine leukocidin-producing Staphylococcus aureus healthcare-associated pneumonia in the Indian Ocean

Nicolas Allou, Jérôme Allyn, Nicolas Traversier, Marie Baron, Renaud Blonde, Céline Dupieux, Nathalie Coolen-Allou, Julien Jabot, Guillaume Miltgen

Keywords:
- Panton-valentine leukocidin
- SARS-CoV-2
- Mayotte
- Reunion Island
- Staphylococcus aureus

ABSTRACT

At this time, the literature reports only one case of superinfection with Panton-Valentine leukocidin (PVL)-producing Staphylococcus aureus in a patient with severe acute respiratory distress syndrome secondary to coronavirus 2 (SARS-CoV-2) pneumonia. Here we report the first two cases of PVL-producing S. aureus healthcare-associated pneumonia in patients hospitalized for SARS-CoV-2 pneumonia in the Indian Ocean region. The two isolated strains of S. aureus were found to belong to the ST152/t355 clone, a known PVL-producing clone that circulates in Africa and is responsible for infections imported into Europe. Our two cases reinforce the hypothesis that SARS-CoV-2 infection favors the occurrence of PVL-producing S. aureus pneumonia. Production of PVL should be searched in patients returning from the Indian Ocean region who present with severe SARS-CoV-2 pneumonia complicated by superinfection with S. aureus even in the case of late onset healthcare-associated pneumonia.

Dear Editor,

Bacterial superinfections in patients with severe acute respiratory distress syndrome secondary to coronavirus 2 (SARS-CoV-2) pneumonia are relatively rare and are often caused by Staphylococcus aureus [1]. At this time, the literature reports only one case of superinfection with Panton-Valentine leukocidin (PVL)-producing S. aureus in a patient with SARS-CoV-2 pneumonia[2]. Here we report the first two cases of PVL-producing S. aureus healthcare-associated pneumonia in patients hospitalized for SARS-CoV-2 pneumonia in the Indian Ocean region.

1. Case summary # 1

In February 2021, a 56-year-old obese patient (body mass index (BMI) of 30 kg/m²) who was not vaccinated against SARS-CoV-2 consulted the hospital in Mamoudzou, Mayotte, for dyspnea and fever persisting for four days. He was detected positive for SARS-CoV-2 using Polymerase Chain Reaction (PCR) assay. A thoracic computed tomography (CT) scan showed parenchymatous involvement typical of SARS-CoV-2 infection along with bilateral pulmonary embolism. The patient’s respiratory status deteriorated 16 days after the onset of symptoms (oxygen saturation of 84% on 15 L/min of oxygen and respiratory rate of 35/min), requiring hospitalization in the intensive care unit (ICU) of Mayotte hospital. On admission to ICU, the patient was treated with invasive mechanical ventilation after failure of high flow nasal cannula therapy. He received dexamethasone, effective anticoagulation, and deworming with albendazole. The evolution was marked by acute respiratory distress syndrome (ARDS) complicated by healthcare-associated pneumonia caused by Streptococcus pneumoniae (cytobacteriological examination of the sputum collected on admission was positive for this pathogen). After five days of ICU care, the patient was transferred by plane to Reunion Island to free up beds in Mayotte hospital. On admission to the Reunion Island ICU, microbiological analysis of the tracheal aspirate was negative.

Corresponding author.
E-mail address: nicolas.allou@hotmail.fr (N. Allou).

https://doi.org/10.1016/j.heliyon.2022.e10422
Received 19 February 2022; Received in revised form 4 July 2022; Accepted 18 August 2022
porting the patient. The evolution was favorable. On Day 16, the patient was decided not to perform a CT scan because of the difficulty in transport. The patient received dexamethasone, deworming with ivermectin, and a tocilizumab injection. Eight days after the onset of symptoms, the patient was hospitalized in the pneumology department of Reunion Island University Hospital for dyspnea with hypoxemia requiring oxygen at 3 L/min. A thoracic CT scan showed pulmonary involvement typical of SARS-CoV-2 but no pulmonary embolism or abscess (Figure 2). The patient received dexamethasone, deworming with ivermectin, and a tocilizumab injection. Eight days after the onset of symptoms, the patient was hospitalized in the ICU (leukocyte count of 6.2 G/L, C-reactive protein of 35.1 mg/L, and procalcitonin of 0.08 ng/mL), but the evolution was rapidly unfavorable. On Day 1 of admission, the patient presented with refractory severe ARDS. The patient was treated with meropenem and linezolid (FiO2 of 60 mmHg) due to healthcare-associated bacteremic pneumonia caused by methicillin-susceptible \textit{S. aureus}. The leukocyte count was normal (8.7 G/L). The patient was treated with meropenem and linezolid. A thoracic CT scan showed necrotizing pneumonia (Figure 1). The \textit{S. aureus} strain was positive for PVL by PCR, leading to change antibiotic therapy to oxacillin and clindamycin (for a duration of 14 days). After developing three other nosocomial infections (one healthcare-associated pneumonia caused by \textit{Klebsiella pneumoniae}, one central venous catheter-related bacteremia due to \textit{Pseudomonas aeruginosa}, and one male urinary tract infection with \textit{Escherichia coli}), the patient had a favorable evolution. He was weaned from invasive mechanical ventilation on Day 52 and discharged from the ICU on Day 54.

2. Case summary # 2

In November 2021, a 38-year-old obese patient (BMI of 43 kg/m²) with hypothyroidism presented with fever and cough. The patient was not vaccinated against SARS-CoV-2 and had no recent travel history. A PCR performed in a community laboratory was positive for SARS-CoV-2. Five days after the onset of symptoms, the patient was hospitalized in the pneumology department of Reunion Island University Hospital for dyspnea with hypoxemia requiring oxygen at 3 L/min. A thoracic CT scan showed pulmonary involvement typical of SARS-CoV-2 but no pulmonary embolism or abscess (Figure 2). The patient received dexamethasone, deworming with ivermectin, and a tocilizumab injection. Eight days after the onset of symptoms, his respiratory status deteriorated and he was hospitalized in ICU. There was no inflammatory syndrome on admission to ICU (leukocyte count of 6.2 G/L, C-reactive protein of 35.1 mg/L, and procalcitonin of 0.08 ng/mL), but the evolution was rapidly unfavorable. On 1 Day of admission, the patient presented with refractory severe ARDS, which required the use of veno-venous extracorporeal membrane oxygenation. Microbiological analysis of bronchoalveolar lavage fluid was negative. On Day 6, the patient developed sepsis with a leukocyte count of 37.2 G/L. He was treated with piperacillin/tazobactam and linezolid after the onset of symptoms showed excavations in right lower lobe with residual ground glass opacities.

Figure 1. Chest computed tomography-scan performed on day 31 after onset of symptoms showed ground glass opacities and condensations with excavations in right middle lobe.

Figure 2. Chest computed tomography-scan performed on day 40 after onset of symptoms showed excavations in right lower lobe with residual ground glass opacities.
Our two cases reinforce the hypothesis that SARS-CoV-2 infection could favor the occurrence of \textit{S. aureus} pneumonia by inducing inflammation in the bronchial epithelium and facilitating bacterial adhesion, as described for influenza virus. The presence of PVL may aggravate this pneumonia by preventing an adequate cellular response and promoting the invasive and necrotizing nature of the infection [2]. Although the link between PVL and the severity of healthcare-associated pneumonia due to \textit{S. aureus} has not been clearly demonstrated, and the fact that is difficult to identify the role of this toxin with respect to other \textit{S. aureus} virulence factors in our cases, these two patients presented a notable clinical severity. Production of PVL should therefore be searched in patients returning from the Indian Ocean region who present with severe SARS-CoV-2 pneumonia complicated by superinfection with \textit{S. aureus} even in the case of late onset healthcare-associated pneumonia [12].


declarations

Author contribution statement

All authors listed have significantly contributed to the investigation, development and writing of this article.

Funding statement

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Data availability statement

Data included in article/supp. material/referenced in article.

Declaration of interest’s statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

Acknowledgements

We wish to thank Pr. F. Vandenesch and Dr A. Tristan from the French National Reference Centre for Staphylococci for their help in proof-reading this manuscript.

References

[1] S.M. Gerver, R. Guy, K. Wilson, S. Thelwall, O. Nwonwu, G. Rooney, C.S. Brown, B. Mulles-Pobedy, B. Hope, V. Hall, National surveillance of bacterial and fungal coinfection and secondary infection in COVID-19 patients in England: lessons from the first wave. Clin. Microbiol. Infect 27 (11) (2021 Nov) 1658–1665.
[2] C. Duployez, R. Le Guern, C. Tine, A.L. Lejeune, L. Robiquet, S. Six, C. Loiez, F. Wallet, Panton-valentine leukocidin-secreting Staphylococcus aureus pneumonia complicating COVID-19, Emerg. Infect. Dis 26 (8) (2020 Aug) 1939–1941.
[3] S. Jarraud, C. Mougel, J. Thioulouse, G. Lina, H. Meugnier, F. Forey, X. Nemme, J. Etiene, Vandenesch FRelationships between Staphylococcus aureus genetic background, virulence factors, agr groups (alleles), and human disease, Infect. Immun. 70 (2) (2002 Feb) 631–641.
[4] S. Holtfreter, D. Grumann, M. Schmudde, H.T. Nguyen, P. Eichler, B. Strommenger, K. Koponen, J. Kolata, S. Giedrys-Kalabena, I. Steinmetz, W. Witte, B.M. Broker, Clonal distribution of superantigen genes in clinical Staphylococcus aureus isolates, J. Clin. Microbiol 45 (8) (2007 Aug) 2669–2680.
[5] C. Vanbecke, R. Girerd, M. Dujardin, N. Zemali, R. Manaquin, D. Pu Dort, N. Traversier, K. Mougin-Damour, D. Vandroux, Retrospective study of pneumonia due to Panton-Valentine leukocidin-producing Staphylococcus aureus in Reunion, Med. Mal. Infect 49 (7) (2019 Oct) 534–539.
[6] N. Khamer, N. Sicot, P. Vanherms, O. Dumitrescu, V. Meyssonier, A. Tristan, M. Bes, G. Lina, F. Vandenesch, Y. Gillet, J. Etiene, Severe leukopenia in Staphylococcus aureus necrotizing, community-acquired pneumonia: risk factors and impact on survival, BMC Infect. Dis 13 (2013 Aug) 1, 359.
[7] D. Dekker, M. Wolters, E. Martens, K.G. Bouwen, R. Krumkamp, D. Eibach, N.G. Schwartz, Y. Adu-Korant, H. Rohde, M. Christner, F. Marks, N. Sarpong, J. May, Antibiotic resistance and clonal diversity of invasive Staphylococcus aureus in the rural Ashanti Region, Ghana. BMC Infect. Dis. 16 (1) (2016 Nov 29) 720.
[8] B. Egyir, J. Bentum, N. Atam, A. Fox, N. Obeng-Nkrumah, L. Apiah-Korang, E. Behene, S. Kumordjie, C. Yehoba, A. Aghodjoh, E.E. Bentoe, R. Tagoe, B. Kofi-Adu-Tabi, F. Owusu, N.T.K.D. Dayie, E.S. Donkor, J. Nsad, K. Assah-Opono, E. Nyarko, E. Asamanu, A.R. Larsen, D.M. Wolfe, A.G. Letizia, Whole genome sequencing and antimicrobial resistance of staphylococcus aureus from surgical site infections in Ghana, Pathogens 10 (2) (2021 Feb 12) 196.
[9] M.T. Samutela, A. Kalonda, J. Mwansa, C. Lukwesa-Musyani, J. Mwamba, E.M. Mumbula, D. Mweesyza, E. Simulundu, G. Kwenda, Molecular characterisation of methicillin-resistant Staphylococcus aureus (MRSA) isolated at a large referral hospital in Zambia, Pan Afr Med J. 26 (2017 Feb) 28, 108.
[10] D. Nurjadi, B. Friedrich-Janicke, J. Schaefer, P.J. Van Genderen, A. Goorhuis, A. Perignon, A. Neumayr, A. Mueller, A. Kantele, M. Schunk, J. Gascon, A. Stich, C. Hatz, E. Caumes, M.P. Grobusch, F. Fleck, F.P. Mockenhaupt, P. Zanger, Skin and soft tissue infections in international travelers and the import of multi-resistant Staphylococcus aureus to Europe, Clin. Microbiol. Infect. 21 (6) (2015 Jun) 567e1, 567–e10.
[11] C. Dupieux, R. Blonde, C. Bouchiat, H. Meugnier, M. Bes, S. Laurent, F. Vandenesch, F. Laurent, A. Tristan, Community-acquired infections due to Staphylococcus aureus genospecies I lineages isolates barouing the Panton-Valentine, France, 2014, Euro. Surveill 20 (23) (2015 Jun 11), 21154.
[12] D. Tappe, M.H. Schulze, A. Oesterlein, D. Turnwald, A. Müller, U. Vogel, A. Stich, Panton-Valentine leukocidin-positive Staphylococcus aureus infections in returning travelers, Am. J. Trop. Med. Hyg 83 (4) (2010 Oct) 748–750.