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# Myelodysplastic syndrome in a kidney transplant recipient after SARS-CoV-2 infection: can SARS-CoV-2 induce myelodysplastic syndrome?

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## Abbreviations

MDS	Myelodysplastic syndrome
CMV	Cytomegalovirus
EBV	Epstein–Barr virus
HHV-6	Human herpes virus-6
HTLV-1	Human T cell leukemia virus-1
MMF	Mycophenolate mofetil

Editor,

Numerous microbiological pathogens, mostly viruses, have been involved in the pathogenesis of hematologic malignancies. Different oncogenic viral mechanisms have been described [1]. A myelodysplastic syndrome (MDS) is a group of heterogenous clonal hematopoietic stem cell malignancies characterized by dysplasia and ineffective hematopoiesis. We report a case of MDS after SARS-CoV-2 infection in a kidney transplant recipient.

At the age of 46, a patient received a kidney from a deceased donor with standard immunosuppressive therapy of basiliximab, tacrolimus, MMF and steroids. After delayed graft function in the immediate posttransplant period, good and stable graft function was established. In the later post-transplant course that was otherwise uneventful, MMF was

replaced with azathioprine due to intolerance. Nine years after kidney transplantation patient presented with febrility and respiratory symptoms, and was diagnosed with SARS-CoV-2 infection with the radiological finding of bilateral pneumonia. He was treated with levofloxacin, steroids, oxygenotherapy and reduced immunosuppressive therapy with good clinical outcome. Regular outpatient follow-up after SARS-CoV-2 infection revealed significant EBV and CMV viremia, previously not detected, while graft function remained stable. Six months after SARS-CoV-2 infection patient presented with severe anemia (hemoglobin 62 g/l) and leucopenia (WBC  $1.8 \times 10^9/l$ ) with normal platelet count. Bone marrow puncture revealed abundant hematopoietic tissue with the shift in favor of a red line (1.6:1). Erythrocytopoiesis was multiplied, morphologically altered megaloblastoid, binuclear and multinuclear forms with nuclear budding and fragmentation. Granulocytopoiesis was represented predominantly by transient and mature forms while thrombocytopoiesis was moderately abundant and represented by mature and developmental forms of megakaryocytes. Cytomorphological finding suggests MDSs.

Although the precise pathogenesis of MDS remains unclear, two main mechanisms may be involved: the malignant transformation of a pluripotent bone marrow stem cell and immune dysregulation mechanisms, including cytokines production, immune and inflammatory signaling pathways, and immune cells activation [2]. Several studies have discussed the potential role of viral agents in the pathogenesis of the MDS. Viral infection promotes immune system activation, including dysregulated cytokine production creating bone marrow microenvironment and cytokine milieu favoring clonal expansion [3]. Several viruses have been connected with development of MDS in the literature including CMV [4], HTLV-1 [5], parvovirus B19 [6], and HHV-6 [7].

Immune response to SARS-CoV-2 infection is rather diverse and still remains poorly understood. Studies have

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shown heterogeneous CD8, CD4 T cell and B cell response, immune and inflammatory signaling pathways activation and cytokine production [8]. It has been shown that patients with SARS-CoV-2 infection are prone to develop herpesviruses reactivation, including EBV, CMV and HHV-6 [9]. Follow-up after SARS-CoV-2 infection revealed CMV and EBV viremia in our patient, previously not detected. Based on the existing evidence in the literature, MDS in our patient could be induced by CMV and EBV reactivation promoted by SARS-CoV-2 infection. However, immune response to SARS-CoV-2 infection creates cytokine milieu that could favor clonal expansion and myelodysplastic syndrome development.

In conclusion, we suggest possible causative relation between SARS-CoV-2 and MDS. The SARS-CoV-2 infection could induce MDS development directly or indirectly by creating opportunistic milieu and promoting reactivation of other viruses such as CMV and EBV. Further studies are needed to clarify the possible role of SARS-CoV-2 in the pathogenesis of the MDS.

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## Declarations

**Conflict of interest** The authors declare that they have no conflict of interest and they have nothing to disclose.

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