

High-resolution computed tomography over chest radiography: how the pandemic changed our evaluation policy of potential kidney transplant recipients

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Introduction Kidney transplantation is the treatment of choice for most patients with end-stage kidney disease, leading to improvement in quality of life and reduced risk of mortality relative to maintenance dialysis. Potential kidney transplant recipients should be thoroughly evaluated in an efficient and cost-effective manner to detect and treat the coexisting illnesses that may impact both perioperative risk and posttransplant survival as well as eligibility for transplantation.^{1,2} Pulmonary assessment of kidney transplant candidates should be consistent with that of the general population, as there are limited data on the optimal pretransplant evaluation of dialyzed patients with lung disease.^{1,2} According to the latest Kidney Disease Improving Global Outcomes (KDIGO) guidelines of 2020,³ chest imaging is recommended prior to transplantation in all candidates (level of evidence 2C), with chest computed tomography (CT) suggested for current or former heavy tobacco users (≥ 30 pack-years) and for patients with cancer, whereas chest X-ray is recommended for other potential kidney transplant recipients (level of evidence 2C). Collaboration with a pulmonologist in the assessment process is suggested, but this recommendation is not graded.

The COVID-19 pandemic has created many logistic challenges that pose ethical and financial obstacles for the established deceased-donor organ transplantations programs.⁴ All potential kidney transplant recipients should be screened for COVID-19 before transplantation.⁵ In general, a thorough history of symptoms and exposure is collected and physical examination, chest imaging, and reverse transcriptase-polymerase

chain reaction (RT-PCR) of an upper respiratory tract specimen are performed. A chest X-ray is usually sufficient in asymptomatic patients, while chest CT is recommended in cases with even minor respiratory symptoms.⁵ Measures adopted at the University of Washington Medical Center included chest imaging in every donor (at least an X-ray, and in most cases a CT) and screening for COVID-19 in both donors and potential recipients.⁶ In our center, a policy was adopted to perform a fast RT-PCR assay (CovGenX) of an upper respiratory tract specimen (nasopharyngeal swab) and high-resolution CT (HRCT) of the chest.

This report describes our experience in conducting deceased-donor kidney transplants during the COVID-19 pandemic at a single transplant center located in Warsaw, Poland. The main objective of the study was to evaluate the safety of deceased-donor kidney transplantation during the COVID-19 pandemic.

Methods All adult patients who underwent a deceased-donor kidney transplantation from May 1, 2020 to November 30, 2020 were included in the study and followed until December 10, 2020. We used medical data from the central transplant waiting list to obtain the characteristics of patients (age, sex, etiology of end-stage kidney disease, mode of dialysis, dialysis vintage, etc.) as well as the imaging and endoscopy studies and all the required consults, and checked their validity. Upon admission to the Department of General, Vascular and Transplant Surgery, potential recipients were tested for COVID-19 and underwent a blood chemistry test and dialysis (if needed). If the RT-PCR test was negative, HRCT

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was performed. Due to the fact that transplantation is a standard procedure performed in the hospital, additional ethical approval was not required for the study. Written, informed consent to participate was obtained from each potential recipient. Additionally, a special informed consent to undergo transplantation during the pandemic was obtained. Physical examination was performed and a history of the following symptoms was collected: cough, dyspnea, fever, chills, chest pain, fatigue, headaches, body aches, rhinorrhea, sore throat, conjunctivitis, anosmia, dysgeusia, altered mental status, nausea / vomiting, abdominal pain, and diarrhea. An immunosuppressive regimen was prescribed by a nephrologist. In case of any suspicious findings on HRCT, a pulmonary specialist was consulted to decide whether to proceed with the transplantation.

Results and discussion Overall, 25 patients underwent a transplantation from May 2020 until mid-December 2020. A total of 5 out of 30 potential kidney transplant recipients (17%) were disqualified after HRCT and pulmonary consult due to pathologies found on chest imaging. After disqualification, another potential recipient was evaluated for transplantation. All of the candidates had chest radiographs performed at the time of evaluation before approval by the waiting-list coordinator. There were no pathologies detected on the chest radiographs, except for a single patient with pleural thickening and subpleural fibrotic changes in the upper parts of the lungs. Characteristics of all transplant candidates are presented in Supplementary material, *Table S1*. The most remarkable case was that of a female patient in whom a breast tumor with enlarged lymph nodes was found on HRCT performed at our hospital as part of the qualification process before transplantation, despite no abnormalities found on chest X-ray (taken at the dialysis unit just before transfer to our center). She had a history of immunosuppressive treatment for membranoproliferative glomerulonephritis with cyclophosphamide (about 8 g in total), cyclosporine (complicated by seizures), and mycophenolate mofetil (taken for 17 months with no clinical effect, no effect on proteinuria and kidney function) and with steroids, without even partial remission, but with progression to end-stage kidney disease requiring dialysis.

We did not find any published reports on the use of HRCT as an imaging modality prior to transplantation. Only in the study performed at the University of Washington Medical Center was chest CT used to rule out COVID-19 in some kidney transplant donors.⁶ In a retrospective study conducted at the Miami Transplant Institute in the United States to evaluate the safety of deceased-donor kidney transplantation during the COVID-19 pandemic, 76 patients received a kidney allograft from March 1, 2020 to April 30, 2020.⁷ Multiple preventive measures were implemented: recipients were evaluated for

symptoms of COVID-19 and underwent an RT-PCR test and chest X-ray. The authors concluded that the deceased-donor kidney transplantation program could remain active during the COVID-19 pandemic provided that preventive measures were strictly followed and the hospital was not at maximum capacity.⁷ In addition, according to a solid organ transplantation protocol from Baylor College of Medicine,⁸ transplant candidates in the COVID-19 era had to have a negative SARS-CoV-2 nasopharyngeal swab test and no abnormalities on chest CT to exclude COVID-19 before proceeding to transplantation. They concluded that the need for chest CT in asymptomatic patients admitted for solid organ transplantation should be carefully evaluated, as it has low specificity for COVID-19.⁹ As per the KDIGO guidelines,³ a chest X-ray is sufficient, with CT recommended in selected cases (heavy smokers). A chest X-ray is cost-effective and easy to perform; however, it has its limitations. As reported, it shows no abnormalities in 10% to 15% of symptomatic patients with proven infiltrative lung disease, in up to 30% cases of bronchiectasis, and in close to 60% of individuals with emphysema. It has an overall sensitivity of 80% and a specificity of 82% for the detection of diffuse lung disease.¹⁰ Due to the fact that chest X-ray, in general, provides a reliable diagnosis in 1 out of 4 patients, HRCT is used as a supplementary modality in inconclusive cases. It has a sensitivity of 95% and a specificity of up to 100%,¹¹ and provides more information than conventional CT and, obviously, chest X-ray. Our rationale for performing HRCT in potential kidney transplant recipients together with the RT-PCR test for SARS-CoV-2 was to exclude infection in asymptomatic patients. There was a case of a patient (a liver transplant recipient) deferred for transplantation due to multiple pathologies (**FIGURE 1A**) who later developed COVID-19 pneumonia with a fatal outcome. However, at the time of evaluation, she had a negative RT-PCR result, and HRCT findings were not suggestive of viral infection. Our findings were surprising, as we detected breast tumor (**FIGURE 1B**) and tuberculosis (**FIGURE 1C**) serendipitously in 2 consecutive patients. Because the KDIGO guidelines³ were developed before the pandemic and published in April 2020, they did not even consider the need for COVID-19 screening. We are fully aware that more detailed chest imaging may detect abnormalities that will require further evaluation by needle biopsy or even surgery, with associated morbidity and mortality (even though most of them are benign).¹² In our study, we detected a case of tuberculosis requiring therapy (**FIGURE 1C**), but in another patient only active surveillance was recommended (**FIGURE 1D**). In yet another patient with several lung pathologies (**FIGURE 1E**), further diagnostic was recommended to rule out malignancy. It also has to be considered that extended follow-up of nodules, which may last for several years and be associated with anxiety/fear of the possibility

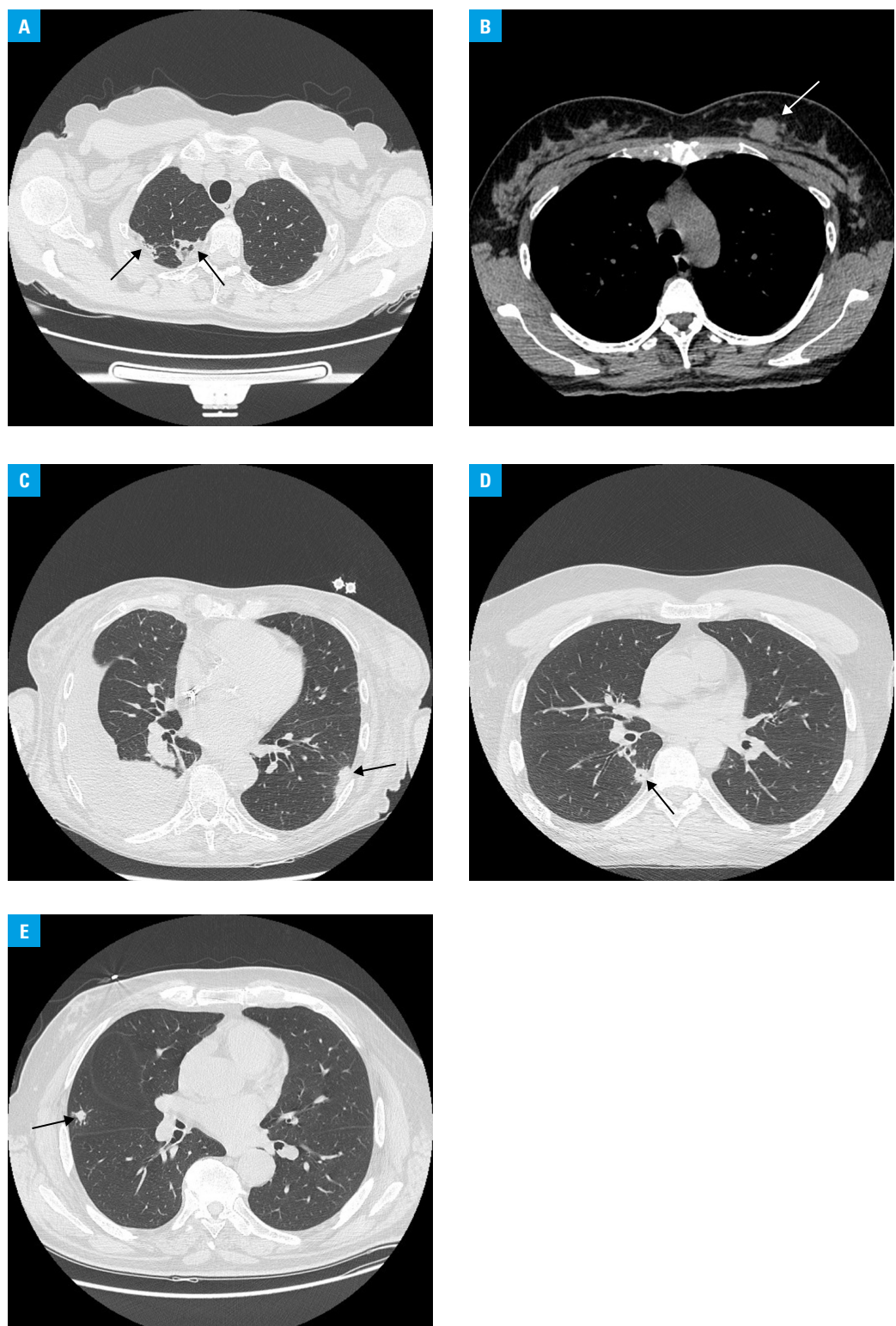


FIGURE 1 High-resolution computed tomography of potential kidney transplant recipients **A** – pleural effusion up to 35 mm in lower and middle lobes of the right lung (arrows), consolidated interstitial opacification, possible atelectasis from compression; calcification of 7 mm in diameter in segment 9 of the right lung, thickening of the pleura (up to 2.5 mm) in the diaphragm and rear part of the right lung; subpleural focus of consolidated compaction ($24 \times 8 \times 34$ mm) in segment 6 of the left lung (possibly inflammation or cirrhosis); single nodules up to 2 mm in both lungs; **B** – a focal lesion (27×17 mm) in the upper left quadrant of the breast (arrow); enlargement of left axillary lymph nodes (up to 8 mm); **C** – cirrhotic, fibrotic lesions and bronchiectasis on the top of the right lung, less pronounced fibrotic lesions on the top of the lower lobe of the right lung and the top of the left lung (arrow); in addition, a nodule up to 4 mm in segment 5 of the left lung; **D** – a nodule of 13–14 mm in diameter in segment 6 of the right lung (arrow), with central hypodense area; cavitation (possibly tuberculosis or mycobacteriosis); **E** – an irregular nodule ($13 \times 6 \times 11$ mm) in the lower part of the upper lobe of the right lung over the intralobar horizontal and oblique fissures (arrow), surrounded by small peribronchial nodules filled with discharge, widened bronchi, and small peribronchial lesions

of malignant lung tumour, may create problems with patient evaluation for a kidney transplant. If a chest X-ray is performed during the evaluation, the process is facilitated. However, it has to be noted that even if there are no abnormalities on chest X-ray we may still miss important pathologies which could result in fatal outcomes after transplantation, particularly in patients receiving an induction regimen.

Our study has several limitations. First, it is a retrospective study. Second, our sample size was relatively small and the follow-up was relatively short. The incidence of COVID-19 increased in Poland, therefore we could have identified cases of COVID-19 among our patients if they had been followed for a longer time.

In conclusion, our analysis demonstrated that deceased-donor kidney transplantation could be safely performed during the COVID-19 pandemic if preventive measures were implemented and followed. Due to the fact that COVID-19 poses new challenges for the evaluation of individual kidney transplant candidates and donors as well as for the process of organ transplantation, HRCT should be considered a standard evaluation imaging modality in potential kidney transplant recipients despite the possibility of overdiagnosis. As showed in our study, it may also be a life-saving approach allowing to detect extrapulmonary pathologies. However, more extensive studies with longer follow-up are needed to confirm our results.

SUPPLEMENTARY MATERIAL

Supplementary material is available at www.mp.pl/paim.

ARTICLE INFORMATION

CONFLICT OF INTEREST None declared.

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