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**Ryzyko występowania ostrego uszkodzenia nerek u pacjentów w  
różnych stadiach przewlekłej choroby nerek poddawanych  
tomografii komputerowej.**

**Rozprawa na stopień doktora nauk medycznych i nauk o zdrowiu  
w dyscyplinie nauki medyczne**

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### 3. Streszczenie w języku angielskim/Summary

Nephropathy after administration of contrast media, or post-contrast nephropathy, was defined in the 2018 guidelines as acute kidney injury (AKI) meeting the KDIGO criteria (increase in serum creatinine  $\geq 0.3$  mg/dL or  $\geq 1.5$ - $1.9$  times baseline) and which occurred within 48-72 hours after contrast agent administration. It is worth noting, that the above guidelines distinguish between two definitions of acute kidney injury after contrast media, depending on the potential relationship with the use of contrast agents. The first is PC-AKI (post-contrast acute kidney injury), which includes all incidents of kidney injury that will meet AKI definition and time criteria. The second one, CI-AKI (contrast-induced acute kidney injury) includes a narrower group in which we can prove the relationship between AKI and the administration of contrast agent. Applying these definitions to clinical practice is extremely difficult as the only way to demonstrate the nephrotoxicity of a contrast agent on renal function would be to exclude all potential causes of acute kidney injury. It is estimated that the incidence of AKI in hospitalized patients treated in internal medicine departments may be approx. 10%, while among patients in intensive care units, these values are much higher and reach even 30-60%. Thus, we can see that is a common complication of hospitalization, which may depend on the patient's condition, age, comorbidities, or treatment.

It seems reasonable at this point to ask how often acute kidney injury is due to the direct action of iodinated contrast media. In one of the first publications on post-contrast acute kidney injury, it was estimated that this complication occurs in up to 50% of patients with reduced eGFR who underwent contrast-enhanced computed tomography (CT). Iodine contrast agents have been shown to be the third most common cause of AKI among hospitalized patients. On the one hand, in the currently publications, the incidence of nephropathy is between 0.6-12% in the general population and approx. 40% in risk groups, and on the other hand, there are more and more reports that these values are exaggerated. Some even argue, contrary to popular belief, that the use of iodinated contrast agents does not significantly increase the risk of AKI. Determining the actual risk of using iodinated contrast agents is important from the clinician's point of view, as it would allow for more efficient planning of diagnostic, and thus probably faster diagnosis and implementation of appropriate treatment.

Analyzing the current state of knowledge, preparing a review paper on the management of acute kidney injury, and then a chapter on contrast agents used in radiology and their influence on kidney function, we were unable to answer our questions. In fact, it can be said that doubts about the safety of using iodinated contrast agents have multiplied, especially in CT. We also wondered how safely we could administer contrast in our patients with chronic kidney disease, because we knew that this was a group of patients with a high risk of complications. In everyday practice, it seemed that contrast nephropathy was not a common complication of CT in patients hospitalized in our clinic, but we did not have specific figures to confirm our feelings.

A retrospective analysis was performed to initially assess the incidence of AKI after contrast-enhanced CT compared to the incidence of AKI after non-contrast CT. For this purpose, all CT examinations performed in our Clinic from the period of three months in 2019

were collected. The concentration of creatinine and eGFR were analyzed at four time points: before the examination, 1-7 days, 15-28 days and over 28 days after the examination. AKI was diagnosed if at any time point there was increase in creatinine concentration meeting KDIGO criteria. Additionally, data on the patient's risk factors (age, sex, comorbidities) and on the test procedure (type and amount of contrast, examination mode) were collected. AKI was found in 3.25% of patients undergoing CT with contrast and as much as 6.9% in patients undergoing CT without contrast. None of the above-mentioned risk factors influenced the obtained result.

Then, the analysis was extended to include all computed tomography performed in the Clinic in 2019. The type of data collected in the study was the same as in the pilot part. A total of 706 computed tomographs were analyzed, of which those without control creatinine measurements and those performed in dialysis patients were excluded. The remaining 284 CT were performed with contrast enhancement and 67 CT without it. To eliminate the disproportions in the numbers of both groups and a more reliable assessment of the occurrence of AKI, two groups with identical characteristics (age, sex, comorbidities) were created, each of which consisted of 67 patients. It was found that in the group of patients undergoing CT with contrast AKI occurred in 17.9% and in the group of patients undergoing CT without contrast 25.4%. In the urgent mode, AKI occurred with a similar frequency, regardless of whether contrast was administered (27% vs 27.9%), while the situation was different in the case of elective mode, where AKI was recorded much more often after non-contrast CT (6.7% vs 18.2%). It also seems that the result was not affected by the type of contrast agent used – AKI was diagnosed with a similar frequency after administration each of available contrast agents. (18.2% vs 18.2%).

In addition, patients from both study groups were divided according to the stage of chronic kidney disease (CKD). In the representation of each of the CKD stages, the incidence of AKI after CT without contrast and with contrast was checked. Analyzing the results, no correlation was found between the advancement of CKD and the incidence of kidney injury. It was found that in the group with advanced CKD (G3b, G4, G5), AKI was observed slightly more often after CT with contrast than after CT without contrast (58.3% vs 47.1%). The result would indicate the relatively safety of performing contrast-enhanced CT even in patients with advanced kidney disease.

Based on our research, it cannot be clearly stated that we can now use iodinated contrast media without any problems. The study conducted at the Clinic is valuable, but further studies, preferably prospective, on a larger group of patients needed to complete the picture. At this point it should be emphasized that the risk associated with the use of iodinated contrast media should always be considered, but the fear of contrast induced nephropathy must not paralyze clinical management.