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The Role of Computed Tomography Findings in Prediction of Stone Composition

Bilgisayarlı Tomografi Bulgularının Taş Kompozisyonunu Öngörmedeki Rolü

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Abstract

Hounsfield units (HU) provides a quantitative assessment of stone density in the urogenital tract on non-contrast computed tomography (NCCT) and has the ability to predict treatment success. The difference in HU (HUdiff) value was measured on NCCT in two patients. Our opinion is that HUdiff can predict stone composition before treatment.
Keywords: Hounsfield units, non-contrast computed tomography, stone composition, kidney stone, stone homogeneity/heterogeneity

Öz

Hounsfield ünitesi (HU), üriner sistem taş dansitesinin kontrastsız bilgisayarlı tomografi (NCCT) değerlendirmesinde kantitatif veri ile tedavi başarı oranlarını gösterme yeteneğine sahiptir. Bu yazıda, iki hastanın NCCT'sinde HU değerleri arasındaki fark (HUdiff) ölçülmüştür. Bize göre, HUdiff değeri tedavi öncesi taş kompozisyonunu öngörebilmektedir.
Anahtar Kelimeler: Hounsfield ünitesi, kontrastsız bilgisayarlı tomografi, taş kompozisyonu, böbrek taşı, taş homojenitesi/heterojenitesi

We evaluated two 18-year-old patients who presented to our clinic with flank pain. The patients underwent metabolic evaluation and non-contrast computed tomography (NCCT). In 24-hour urine analysis, patient-1 had high oxalate and low citrate levels, while patient-2 had a high homocysteine level. NCCT images revealed a renal stone in the right kidney in both patients. Stone diameters and Hounsfield units (HU) were measured with large magnification in bone window on NCCT images (Figure 1). The difference in HU (HUdiff) was calculated as the difference between maximum and minimum HU for estimated and predicted stone homogeneity/heterogeneity and stone composition. After percutaneous nephrolithotomy, stone analysis found a calcium oxalate (CaOX) stone in patient-1 and a cystine stone in patient-2.

In recent studies, HU values were evaluated on NCCT to detect a predictive cut-off value of mean HU for the prediction of treatment success (1,2,3,4). In the studies, HU values and stone analysis were compared for the prediction of stone composition. The average mean HU was reported as 565-698 HU for cystine and 700-1438 HU for CaOX stones in different studies (5,6,7,8). In current patients, the mean HU value, HUdiff value, standard deviation (SD) value and stone analysis were detected as 1445 HU, 592 HU, 128 HU and CaOX for patient-1 and 662 HU, 236 HU, 52 HU and cystine for patient-2, respectively. In a recent study, stone heterogeneity index was described in ureteral stones by Lee et al. (9) and it was defined as the SD of HU on NCCT. They calculated minimum, maximum and SD of HU values on NCCT images. After the analysis, a strong relationship was found between a large SD of HU and stone heterogeneity in stone composition in their reports. In fact, our study supports this study. HUdiff provides similar indications to SD of HU value in recent and our studies. The SD of HU was calculated on

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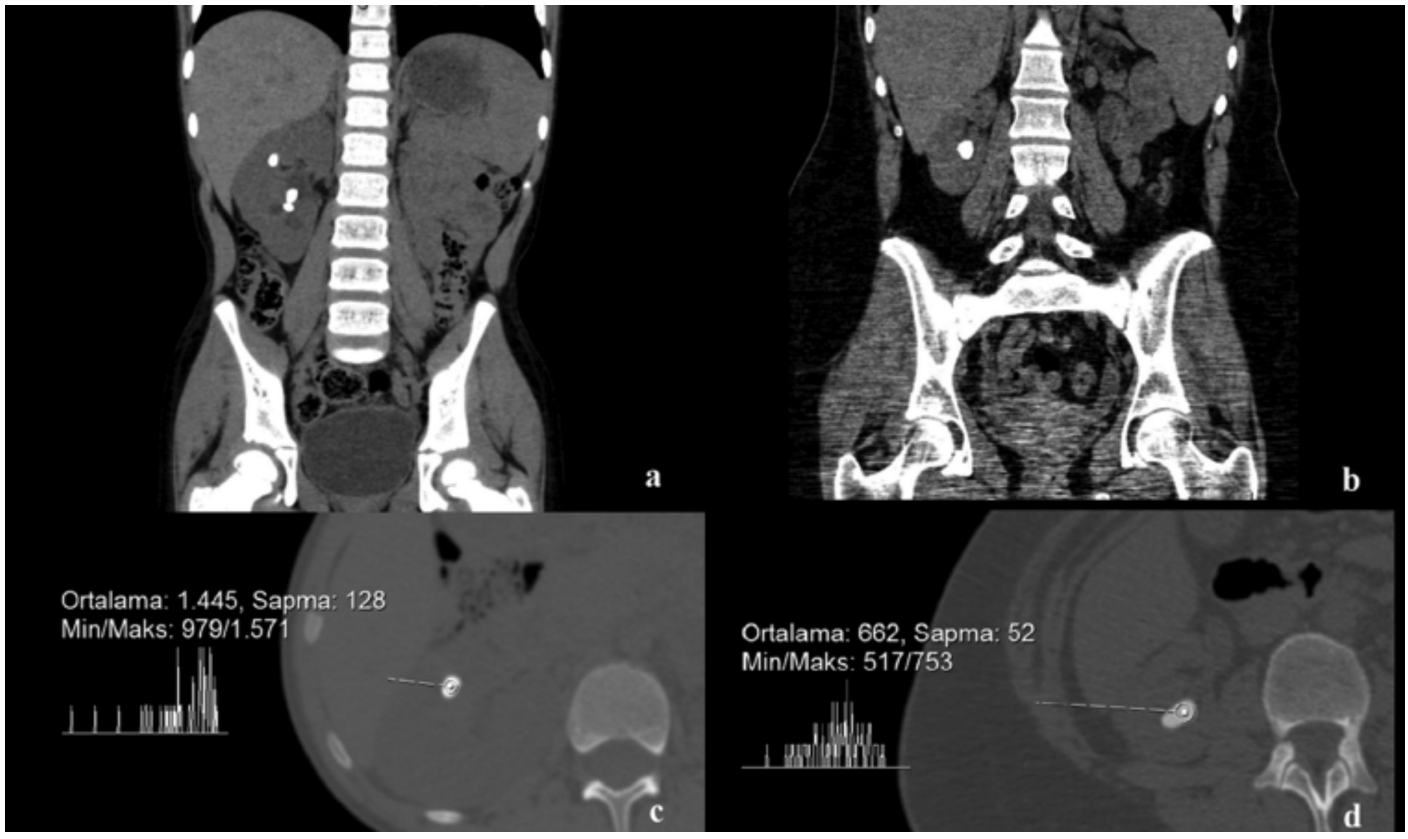

Figure 1. Kidney stones of patient-1 (a) and patient-2 (b) on coronal non-contrast computed tomography images. (c) The stone in the right kidney of patient-1; stone diameter (9.3 mm), maximum Hounsfield units (1571), minimum Hounsfield units (979), mean Hounsfield units (1445), standard deviation (128) and the difference in Hounsfield units (592) were calculated on axial non-contrast computed tomography image. (d) The stone in the right kidney of patient-2; stone diameter (11.6 mm), maximum Hounsfield units (753), minimum Hounsfield units (517), mean Hounsfield units (662), standard deviation (52) and the difference in Hounsfield units (236) were calculated on axial non-contrast computed tomography image

Min: Minimum, Max: Maximum, SD: Standard deviation

NCCT images, HUdiff was calculated as the difference between maximum and minimum HU measurements.

In conclusion, we found that HUdiff was correlated with stone heterogeneity and inversely correlated with stone homogeneity, similar to SD of HU value.

Ethics

Informed Consent: Consent form was filled out by all participants.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: S.Ç., O.B., Ö.D., Concept: S.Ç., C.A., Design: S.Ç., C.A., Data Collection or Processing: S.Ç., C.A., F.G.K., Analysis or Interpretation: S.Ç., C.A., O.B., Ö.D., M.S., Literature Search: S.Ç., C.A., O.B., Writing: S.Ç.

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