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Review

Morphometric scores for renal tumors: What does the radiologist need to know?

Ingrid Millet[a], Fernanda Curros Doyon[a], Emma Pages[a], Rodolphe Thuret[b], Patrice Taourel[a,*]

[a] Department of Imaging, CHU Montpellier, France
[b] Department of Urology, CHU Montpellier, France

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ABSTRACT

Numerous therapeutic options are possible in the treatment of renal carcinomas including radical nephrectomy, partial nephrectomy, cryoablation, radiofrequency, active follow-up and among surgical treatments, different approaches may be used such as laparotomy, laparoscopy, robotic-assisted intervention. The choice between these different procedures is partially based on the anatomic conditions of the tumors. Different anatomic scores determined from cross-sectional imaging have been built to predict the complexity of the surgical procedure. The goals of this article are to review the relevant morphologic pattern for management of patients with renal tumors, to know how to calculate these different scores and to understand the clinical applications of these scores.

Anatomic complexity scoring systems for renal tumors are used to an increasing extent by urologists, with two main goals: to offer a standard for comparing care patterns and to improve surgical decision-making, especially given the development of new nephron sparing surgery techniques, including open, laparoscopic and robotic-assisted partial nephrectomy. These scoring systems have been almost exclusively used, tested and compared by urologists whereas they are based on cross-sectional imaging criteria. Urologists explain that radiologists are not involved in reviewing CT scan images to assess these scores because radiologic characteristics included in the different scores are not present in routine radiological reports [1]. Consequently, radiologists should have knowledge of the relevant morphologic pattern for management of patients with renal tumors, while also knowing how to calculate these different scores and understanding the clinical applications of these scores.

1. Morphologic parameters used to plan management in patients with localized renal cancer

1.1. Tumor size

Clinical tumor size is the most relevant parameter used to plan treatment in patients with localized renal cancer. In tumors ≤4 cm (American Joint Committee on Cancer tumor category: T1a), open partial nephrectomy is considered to be the gold standard treatment, although guidelines highlight the possible role of radical nephrectomy in patients in whom partial nephrectomy is not technically feasible [2]. In patients with high surgical risk, thermal ablation (cryoablation or RFA) is an available treatment option which may be advantageous, considering the increased risk of cancer recurrence [3].

In tumors in the 4.1–7 cm range (American Joint Committee on Cancer tumor category: T1b), radical nephrectomy should be discussed as standard care in patients with a normal contralateral kidney, whereas partial nephrectomy is a reasonable option when technically feasible, particularly when there is a need to preserve renal function, although it may be associated with increased urologic morbidity in patients with comorbidities [3]. However, there is currently a trend toward partial nephrectomy in treating T1b renal cancer when technically feasible. Otherwise selected cases with surgical contraindications may be considered for thermal ablative treatment.

Radical nephrectomy is considered as the reference treatment for operable tumors measuring more than 7 cm.

1.2. Tumors extending deep within the renal parenchyma

Tumors extending deep within the renal parenchyma influences the thickness of the safety area around the tumor, with the minimum thickness ranging from 0 to 1 mm and maximum values ranging from 7 to 23 mm [4], with some authors considering

* Corresponding author. Tel.: +33 0467338600.
E-mail address: p-taourel@chu-montpellier.fr (P. Taourel).

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that deep intraparenchymatous penetration may make it difficult to have a 1 cm safety margin [4,5]. Conversely, highly exophytic masses tend to be more easily resected with or without hilar clamping.

1.3. Relationship between the tumor and the upper collecting system or hilar vessels

The relationship between the tumor and hilar vital structures, such as the vasculature and collecting system, explain the different partial nephrectomy complication rates for peripheric and central renal tumors. Partial nephrectomy is more technically demanding and associated with increased ischemia time, blood loss and incidence of collecting system violation in central renal tumors [6–9]. Furthermore, a multicentric French retrospective study assessing predictive factors of complications after robot-assisted laparoscopic partial nephrectomy showed that the main independent factor of major complication was the opening of the collecting system [10].

1.4. Longitudinal tumor location

Besides being more often situated away from hilar vital structures with their subsequent lower risk of complications, polar tumors may be resected by segmental polar nephrectomy [11]. This type of surgery can be performed by isolating and ligating the segmental apical or basilar arterial branch while allowing unimpaired perfusion to the remainder of the kidney from the main renal artery [12].

1.5. Anterior or posterior tumor location

This is a relevant variable for renal tumor management because of the multiple approaches to manage kidney disorders: open surgery, laparoscopic surgery, robotic surgery, percutaneous or laparoscopic thermal ablative therapy. The anterior tumoral localization may hamper percutaneous guidance of renal tumor thermal ablation. A metaanalysis, including 27 series, to assess the role of the tumoral location in selecting the anatomic approach of tumor treated by cryoablation has shown that anterior tumors were preferentially cryoablated under surgery by the surgical approach whereas a large majority of posterior tumors were perctaneously cryoablated approach. [13].

1.6. Scores

Over the last 5 years, different pre-therapeutic scoring systems were developed by urologists to standardize the description and the way in which these parameters are considered in the treatment of patients with localized renal cancer. The two most widely used scores in clinical practice are the RENAL score [14] and the PADUA score [1]. The C index [15], although based on only one variable, appears to be more complex to implement and requires a longer learning curve. The renal tumor invasion index, which quantifies the tumor invasion depth within the parenchyma [16], and the renal pelvic score, which evaluates the renal pelvic anatomy regardless of the renal tumor [17], have encouraging results but these have only been obtained in one study in each case.

1.7. RENAL nephrometry score [14]

The RENAL nephrometry score is based on 5 important reproducible anatomic features of renal masses. Of the 5 components, 4 are scored on a 3-point scale (Table 1).

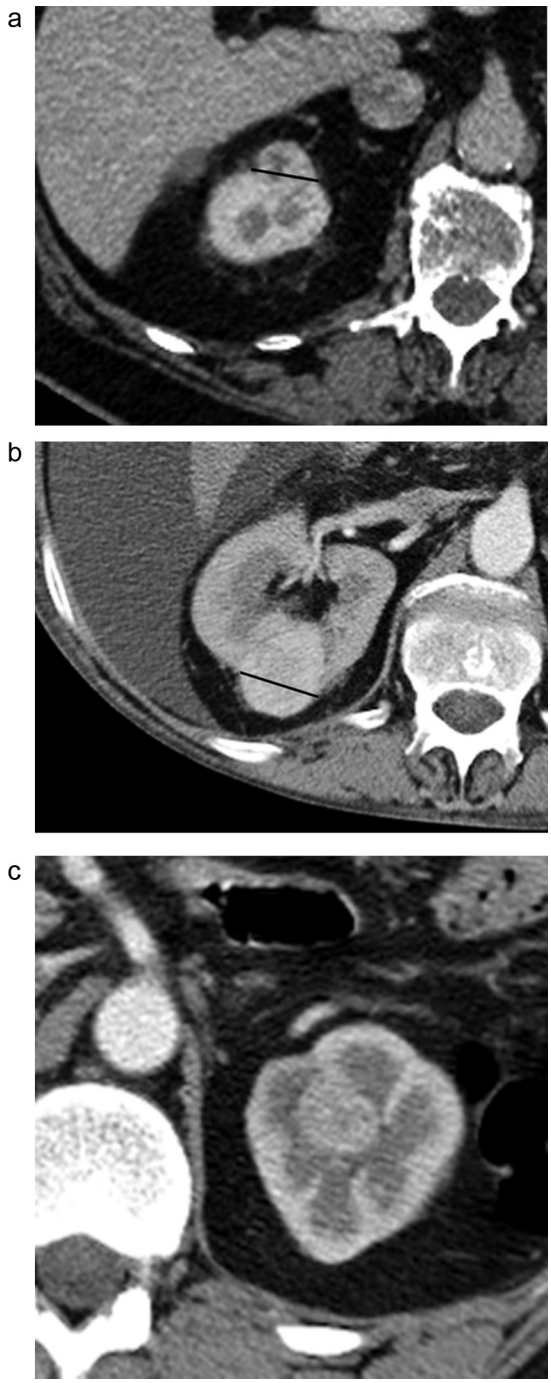

Fig. 1. E descriptor in the RENAL nephrometry scoring. In (a) tumor of the right kidney projects more than 50% outside cortex and should be assigned "E" score of 1. In (b) tumor of the right kidney is <50% exophytic with "E" score of 2. In (c) tumor of the left kidney is entirely endophytic with "E" score of 3.

The "R" (radius) descriptor represents the maximum diameter of the mass. Lesions ≤4 cm are assigned 1 point, those >4 but <7 cm are assigned 2 points, and those ≥7 cm are assigned 3 points.

The "E" descriptor describes the exophytic or endophytic location of the tumor (Fig. 1). Lesions that project more than 50% outside the renal cortex are assigned 1 point, those less than 50% are assigned 2 points, and those that are entirely endophytic are assigned 3 points.

The "N" descriptor denotes the proximity to the collecting system measured in millimeters and is best determined on excretory images. Tumors are divided into three categories (Fig. 2): 7 mm or