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Original article

External histopathological validation of the surface-intermediate-base margin score

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Abstract

Purpose: The surface, intermediate, and basis (SIB) is a system based on surgeon's visual assessment of the thickness of healthy parenchyma remaining on the intrarenal portion of the tumor. This system has been proposed to standardize the nomenclature of the resection technique (RT) during partial nephrectomy (PN). Our study aims at evaluating whether the SIB score visually assigned is related to the thickness of parenchyma measured by microscopy.

Materials and methods: Data of 52 patients submitted to PN from April to October 2015 were perspectively collected. All the excisions were performed following a "nonanatomical" strategy according to our institutional intention to resect the tumor with a visible margin of parenchyma. After the removal of the specimen, 2 trained examiners applied the SIB system: the intrarenal portion of the nodule was ideally divided into 3 circumferential sectors (surface, intermediate, and basis); on each of these was identified the area covered by the lowest amount of parenchyma (score specific area [SSA]); and a score descriptive of the thickness of parenchyma was assigned to each area. The RT performed (enucleation, enucleoresection, or wedge resection) was defined by the sum of the scores. The same examiners inked every SSAs with a different color and then dedicated pathologists, blinded of the scores assigned, and microscopically measured the parenchyma covering each SSA. The relationship between these values and the SIB scores was assessed.

Results: According to the SIB nomenclature, the technique performed was enucleation for 31 patients (60%), enucleoresection for 16 (31%), and wedge resection for 5 (9%). For the surface SSA, the median/mean values of the thickness for $S = 0$ vs. $S = 1$ was 0.35/0.84 vs. 2.00/2.26 mm and for the intermediate or base SSA, the median/mean value of the thickness for $S = 0$ vs. 1 vs. 2 was 0.35/0.47 vs. 1.00/1.50 vs. 2.00.5/2.33 mm. All the comparison reached statistical significance.

Conclusions: The visual description of the surgical plane followed during PN according to the SIB system is related to the microscopic thickness of healthy parenchyma covering the tumor. The SIB system can correctly discriminate among different R techniques, and therefore could be a crucial tool to standardize the nomenclature of PN.

Keywords: Renal cell carcinoma; Partial nephrectomy; Kidney neoplasm; Nephron-sparing surgery

1. Introduction

When technically feasible, partial nephrectomy (PN) is preferred over radical nephrectomy for all cT1 renal tumors, because it offers equal cancer-specific survival but longer overall survival [1–5]. Clearly, even if organ-sparing, PN must be adherent to the principles of oncological radicality. Historically, to achieve this goal the removal of a macroscopical margin of healthy parenchyma through a wedge resection WR was advocated as necessary. However, in more recent years, a large amount of data have showed that an excision around the tumor contour keeping a smaller margin of a few millimeters is equally adequate, so this technique—enucleoresection (ER)—has become the gold standard [6,7]. Some institutions further emphasized this trend toward the progressive reduction of the width of the margin, turning to a pure enucleation (E) that removes just the "minimal" layer of

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tissue adherent to the pseudocapsule [8]. Thus, briefly, 2 possible strategies can be planned before PN: the first is "anatomic" when the surgeon follows the tumor-parenchyma interface with the intention to perform an E; the second is "non-anatomic" when the dissection goes through the parenchyma far from the tumor margins with the intention to perform an ER or a WR [9]. The implications of the resection technique (RT) on surgical morbidity, preservation of renal function, and oncological safety have been widely debated in the literature, with a general agreement on the equivalence of the different strategies [10–16].

Nevertheless, it is underestimated that all these studies rely just on the institutional intentions rather than on a case-by-case analysis of the RT effectively performed, merely assumed to be consistent with the declared intentions. Conversely, the procedure can differ from the intentions of the surgeon, due to the incompleteness or penetration of the pseudocapsule [17] or nephrosclerosis [18] or difference in histologic subtype [19]. Morevover the approach can change from the surface of the nodule, where the borders are easily recognizable, to its basis where they must be realized and the vascular and excretory structures need to be preserved [20]. However, almost all of the published series are heterogeneous, composed by a mixture of surgical procedures, and this discrepancy between the reported vs the truly performed RT represents a huge bias in the literature on this topic.

The surface-intermediate-base (SIB) score has been recently proposed by Minervini and Kutikov [21] to standardize the nomenclature of the PN techniques. Briefly, the first step is the identification of 3 circumferential sectors in the nodule, the more superficial (surface, S), the intermediate (intermediate, I), and the deeper one (basis, B); then, the area with the minimum thickness of parenchyma (score specific area [SSA]) is individuated on each of these sectors and a score is assigned by the visual assessment of the amount of normal tissue covering the SSA; and finally, the sum of the scores defines the procedure effectively done.

The first requirement the system should satisfy is that the human eye, driven by the rules of the system, is able to discriminate between different thicknesses of parenchyma. This issue has recently been investigated by Minervini et al. [22] in a so-called "histopathological validation" of their system, showing a good correlation between the scores and the width of the parenchyma removed. However, this study suffers from a few limitations related to the poor heterogeneity of the cohort, composed by cases all submitted to robotic PN after an "anatomical" RT. Therefore, the conclusions reached may not be applied to cohorts treated with an open PN or a "non-anatomical" surgical strategy.

The present study aims at providing a further histopathological validation of the SIB score, but in a cohort of patients treated at an institution that follows a nonanatomical strategy, to assess the reproducibility of the system also in this specific setting.

2. Materials and methods

Since the 1980s, our institution followed a "nonanatomical" strategy in the approach to PN by dissecting the tumor on a safety margin of normal parenchyma, with an aim to perform an ER as the final procedure. From a technical point of view, after a circumferential sharp incision of the renal capsule done a few millimeters far from the borders of the tumor, a mixed sharp and blunt dissection is done maintaining a few millimeters of healthy parenchyma on the tumor.

After institutional review board approval, the data of 52 consecutive patients submitted to PN between April and October 2015 were prospectively collected. The surgical procedures were done by 6 experienced surgeons (1 for robotic surgery and 5 for open PN) through an extraperitoneal lumbotomic or robot-assisted transperitoneal or retroperitoneal access, according to the patient's features or surgeon's preferences; however, in every case, the renal artery was isolated but clamped during the excision depending on tumor features and surgeon preference.

2.1. SIB score assignment

For the present study, 2 examiners (M.S. and M.F.), after a short education consisting in the reading and critical discussion of the dedicated literature, assigned the SIB score still in the operating theater, orienting the specimen with the help of the surgeon; a senior author (A.A.) was consulted to solve any disagreement. After the methodology suggested by Minervini et al. [21], the intrarenal portion of the tumor was divided into 3 equal circumferential macroareas (surface, S; intermediate, I; and base, B) and within each of them the area covered by the minimum thickness of parenchyma, defined as SSA, was identified (Fig. 1). Then, a score was given according to the definitions reported by Table 1 to describe the amount of healthy renal tissue on each SSA. Finally, the RT effectively performed was defined by the sum of the scores, according to the following intervals: 0 to 1—pure E; 2—hybrid E; 3—pure ER; 4—hybrid ER; and 5—WR.

2.2. Specimen preparation and measurement of healthy parenchyma on SSAs

The 2 examiners inked the SSA that they had previously identified with different colors (basis SSA—black ink, intermediate SSA—green ink, and surface SSA—blue ink), after a preliminary dunking of the tumor in acetic acid 60% to stabilize the ink, and then fixed the specimen in a 10% formalin solution. Two dedicated uropathologists (R.T. and S.F.) were preliminarily informed on the features of the SIB system and involved in the design of the study, so that a pathological protocol was defined. The pathologists remained blinded of the assignment of the SIB by the surgeon until the completion of the analysis of all the patients. According to the protocol, a section of the central portion of each inked SSA was taken and the thickness of