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A single enhanced phase is sufficient for the initial computed tomography evaluation of retroperitoneal tumors in children

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Pediatric radiology;
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Abstract
Purpose: The goal of this study was to evaluate the incremental value of unenhanced phase in the initial evaluation of retroperitoneal tumors in children by comparison with an enhanced phase alone using computed tomography (CT).
Materials and methods: A total of 53 patients (26 girls, 27 boys) with a total of 53 tumors who had CT examination of the abdomen and pelvis for the initial assessment of retroperitoneal tumor were retrospectively included. All CT examinations were obtained with an unenhanced set of CT images and a set of CT images obtained after intravenous administration of iodinated contrast material. One junior and one senior radiologist independently evaluated the two sets in two separate reading sessions. CT images were analyzed for tumor calcifications, tumor location, vascular encasement, local invasion and tumor content.
Results: Calcifications were present in 24/53 tumors (45%). On the enhanced set, the senior radiologist was able to detect calcifications in 22/24 tumors (92%) and the junior radiologist in 20/24 tumors (83%), yielding sensitivities of 92% and 83%, and specificities of 96.5% and 100%, respectively. Inter-observer agreement was excellent (Kappa = 0.89). Tumor location was correctly determined by the senior radiologist in 53/53 tumors (100%) and 37/53 tumors (70%)

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by the junior radiologist. Using the unenhanced set, the senior radiologist was able to assess vascular encasement in 26/53 tumors (49%) against 21/53 (39%) for the junior radiologist. For tumor content, agreement between the enhanced and combined unenhanced and enhanced CT was 77% for both radiologists.

Conclusion: Enhanced CT performs as well as unenhanced CT for evidencing calcifications and is therefore sufficient for the initial assessment of retroperitoneal tumor in children.

The initial assessment of retroperitoneal tumors in children is based on the results of biological tests and imaging. A characteristic presentation on imaging may often obviate the need for diagnostic biopsies. In addition, imaging allows assessing the extent of the disease to start optimal treatment.

Although often preceded by ultrasound and despite the development of magnetic resonance imaging, computed tomography (CT) is still considered as the reference imaging modality in retroperitoneal tumor in children because it provides more information [1—4]. In addition, CT is widely available and offers high spatial resolution but at the penalty of radiation exposure [5,6].

The morphological evaluation of retroperitoneal tumors in children is mainly based on CT images obtained after intravenous administration of iodinated contrast material. International guidelines recommend using a combination of unenhanced and enhanced phases. Regarding the diagnosis of retroperitoneal masses, the determination of tumor location (i. e., intra- or extrarenal) is a major criterion. CT images obtained after intravenous administration of an iodinated contrast material also allow determining the presence of vascular encasement and involvement of retroperitoneal space that are, when present, two major indications for surgery.

The main role of unenhanced CT is to provide some clues with regard to tumor characterization, mainly by visualizing calcifications that could otherwise be obscured because of tumor enhancement after intravenous administration of iodinated contrast material [2]. The unenhanced phase may also serve as reference images for the analysis of tumor enhancement.

Radiation exposure is a major concern in general and is even more critical in children [7—9]. Therefore, the optimization of CT protocols in young children is paramount [10,11]. In this regard, researchers have already started questioning the added value of the unenhanced phase CT in oncology in order to reduce radiation exposure in children [12,13].

The goal of this study was to evaluate the incremental value of unenhanced phase in the initial evaluation of retroperitoneal tumors in children by comparison with an enhanced phase alone using CT.

Materials and methods

Study population

The study included children under the age of 15 years and 3 months followed in our university hospital who underwent CT examination that included unenhanced and enhanced CT images for the initial evaluation of retroperitoneal tumor between January 2007 and March 2014. The children were included retrospectively based on reports extracted from the archiving system of our department (Xplore®, EDL, La Seyne-sur-Mer, France) and from the cancer database of our institution. CT examinations obtained in outside institutions were also included, after completeness and quality were confirmed. CT examinations were entered in our picture archiving and communication system (PAC) (Carestream Vue PACS, Carestream Health Rochester, NY, USA). Patients with incomplete CT examinations (acquisitions that did not show the entire tumor or no unenhanced phase available) and those with poor quality CT examinations with artifacts or reconstruction sections > 2 mm were excluded. Sixty-four patients were initially included; of these, 11 patients were further excluded because of missing unenhanced phase ($n = 6$), incomplete coverage of tumor ($n = 3$), or too thick CT sections ($n = 2$).

The study population ultimately included 53 patients (26 girls and 27 boys), with a mean age of 5 years (range: 7 days—15 years). Medical records of each patient were analyzed with respect to age, gender, tumor type, and tumor location (i. e., intra- or extrarenal).

CT examinations and image analysis

CT examinations were extracted from the PACS system to allow a double reading directly on the workstation by a senior radiologist and a junior radiologist. The enhanced CT included both arterial and venous phases. When available, late enhancement phase was not considered for review. The senior radiologist was a staff pediatric radiologist who heads the multidisciplinary pediatric oncology meetings. The junior radiologist was a resident who had a one semester training our pediatric radiology department. CT examinations were read on a high resolution screen (RadiForce RX 340, Eizo Inc., Cypress, CA, USA) without any time restriction. The two observers were free to adapt the viewing parameters, perform attenuation value measurements with regions of interest and obtain multiplanar reconstructions.

The two radiologists read independently and during three separate reading sessions three sets of CT examinations only for tumor content: first the enhanced set, then the unenhanced and finally the combination of enhanced and unenhanced sets. The radiologists known only the age and gender, and that the patient had a retroperitoneal tumor. During each reading session the radiologists completed a standardized form with several possible responses. Except for the criterion ''presence of calcification'', the radiologist

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