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Optical coherence tomography for grading of upper tract urothelial carcinoma: a first validation of the attenuation coefficient cut-off for low-grade and high-grade UTUC

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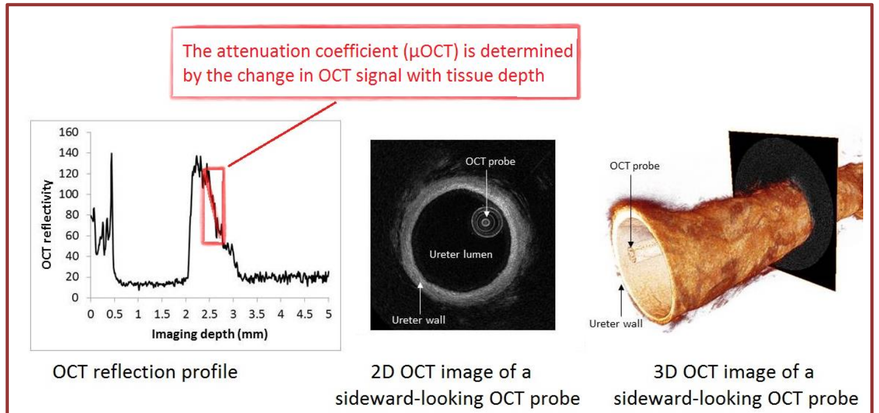
INTRODUCTION

Optical coherence tomography (OCT) is considered as the optical analogue of ultra-sound imaging. The backscatter of the emitted near-infrared light is detected to create digital grey-scale OCT reflection profiles, 2D and 3D helical OCT images (fig. 1). Based on the OCT reflection profile, the change in OCT signal with tissue depth can be calculated (fig. 1). This quantification of OCT signal is called the attenuation coefficient (µOCT).

In 2016, Bus et al. reported a µOCT cut-off value (2.4 mm^{-1}) to differentiate between low-grade and high-grade upper tract urothelial carcinoma (UTUC). Quantitative differentiation of UTUC grade during ureteroscopy could enable real-time risk stratification to improve treatment selection.

Figure 1



OCT reflection profile | 2D OCT image of a sideward-looking OCT probe | 3D OCT image of a sideward-looking OCT probe

AIM

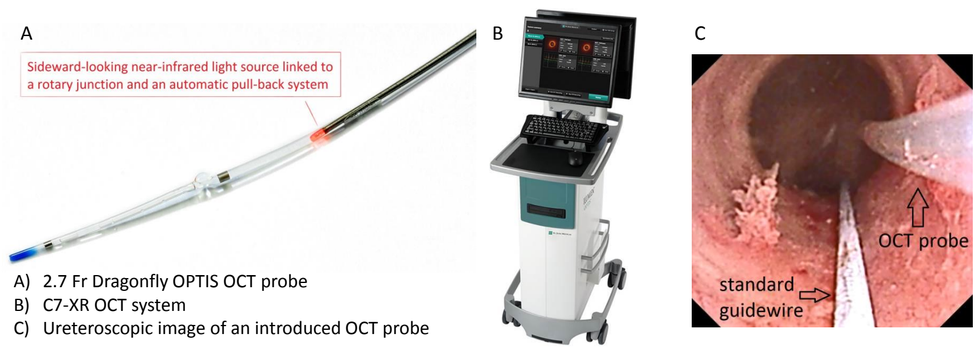
A first validation of the reported µOCT cut-off value for the differentiation of low-grade and high-grade UTUC.

MATERIALS & METHODS

OCT was performed during diagnostic flexible ureteroscopy. The C7-XR OCT system with 2.7 Fr sideward-looking Dragonfly probes (St Jude Medical) was used for OCT imaging prior to endoscopic biopsies.

Postoperatively, two raters, blinded for clinical data, performed µOCT calculations in five OCT images of the tumor with ImageJ software. According to the reported µOCT cut-off (HG ≥ 2.4 mm^{-1}), the calculated µOCT averages were used to predict the histologic grade.

Histologic grading of the ureteroscopic biopsies was performed by a uropathologist, who was blinded for OCT data.



A) 2.7 Fr Dragonfly OPTIS OCT probe
B) C7-XR OCT system
C) Ureteroscopic image of an introduced OCT probe

RESULTS

38 patients with 40 ureteroscopic biopsy-confirmed UTUC's were included (table 1).

Based on 2x2 tables, µOCT-based grade differentiation resulted in a sensitivity range of 83% to 86% and a specificity range of 9% to 36% (table 2).

The intraclass correlation coefficient for inter-observer agreement between µOCT values was 0.41.

Table 1: patient characteristics

Number of included patients	38
Gender (female : male)	9:29
Mean age (SD)	68.6 (12.4)
Number of diseased renal units	40
Laterality (left : right)	21:19
Tumor location (ureter : renal pelvis + calyces)	15:25
Histologic grade (LG : HG)	29:11

LG = low-grade, HG = high-grade

Table 2: 2x2 tables

Rater 1		
	Histologic LG	**Histologic HG**
OCT LG (µOCT < 2.4 mm^{-1})	24	7
OCT HG (µOCT ≥ 2.4 mm^{-1})	5	4
	29	11

Rater 2		
	Histologic LG	**Histologic HG**
OCT LG (µOCT < 2.4 mm^{-1})	25	10
OCT HG (µOCT ≥ 2.4 mm^{-1})	4	1
	29	11

LG = low-grade, HG = high-grade

CONCLUSION & DISCUSSION

In this first validation, the proposed µOCT to differentiate between low-grade and high-grade UTUC yielded a sensitivity that is in concordance with the primary study. However, the specificity for UTUC grade differentiation is substantially lower than in the primary study.

The discrepancy in results may arise from the limited sample sizes and the heterogeneity between the two study cohorts (prevalence of high-grade UTUC, difference in index test).

Therefore, we propose a re-evaluation of the µOCT cut-off in a larger cohort to fully explore its diagnostic potential for UTUC grading.

REFERENCES

Bus MTJ et al: Optical Coherence Tomography as a Tool for In Vivo Staging and Grading of Upper Urinary Tract Urothelial Carcinoma: A Study of Diagnostic Accuracy. J. Urol. 2016

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