A comparison of the diagnostic performance in CT-Colonography interpreted by experienced radiologists and trained radiographers. Résumé of a Ph.d. thesis by Carsten Lauridsen

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Rèsumè of a Ph.d. thesis by Carsten Lauridsen

Introduction

Computed tomographic colonography (CTC) has been proposed as an alternative to optical colonoscopy (OC) for detecting colorectal polyps and cancer. CTC is appealing because it does not involve conscious sedation, and recovery time associated with OC. CTC represents a modified CT examination in a patient who has undergone bowel preparation and colonic distension, in which the images are then interpreted using advanced 2D and 3D display techniques.

Purpose

To investigate the diagnostic performance of four trained radiographers in comparison with that of two experienced radiologists in the evaluation of CTC-examinations with those of the reference standard (OC).

Materials and Methods
A comparison of the diagnostic performance in CT-Colonography interpreted by experienced radiologists and trained radiographers.

Résumé of a Ph.d. thesis by Carsten Lauridsen

This PhD thesis is mainly based on three studies and to accomplish the purpose of the thesis it was essential to create an educational platform for the radiographers. The first study (study I) included an assessment of the diagnostic performance of four radiographers who underwent training in CTC using a tele-training program generally based on the interpretation of 75 training cases. Subsequently, the radiographers went through a test of 20 CTC-examinations.

In the second study (study II) 126 consecutive patients were examined at two hospitals and went through same-day CTC and OC. The four trained radiographers and the two experienced radiologist interpreted the CTCs and were blinded to all clinical findings and each other’s findings. The OCs were performed by experienced gastroenterologists and the results were annotated in the study protocol. Sensitivity, specificity, and positive and negative predictive values from the CTC-interpretation were calculated per-polyp and per-patient including 95 % confidence interval.

The aim of the third study (study III) was to identify the pitfalls in CTC through analyses of false positive and false negative findings on CTC. The readers and the study population were the same as mentioned in study II. The number, locations, and the reasons of the false positive and false negative findings were calculated and analyzed.
A comparison of the diagnostic performance in CT-Colonography interpreted by experienced radiologists and trained radiographers.

Résumé of a Ph.d. thesis by Carsten Lauridsen

**Results**

In the training cases in study I the radiographers achieved an overall per-polyp sensitivity of 57 % (95 % CI 46.1-67.9) and 69.1 % (95 % CI 50.6-87.5) for lesions ≥6 mm and ≥10 mm respectively. Overall per-patient sensitivity, specificity and PPV were 86.4 % (95 % CI 76.7-96.1), 85.4 % (95 % CI 77-93.9) and 78.3 % (95 % CI 64.9-91.7), respectively.

In the test cases overall per-polyp sensitivity was 80.7 % (95 % CI 69.5-92) and 94.7 % (95 % CI 85.6-100*) for lesions ≥6 mm and ≥10 mm, respectively. Overall per-patient sensitivity, specificity and PPV were 92.9 % (95 % CI 83.1-100*), 64 % (95 % CI 13.1-100*) and 87.8 % (95 % CI 71.7-100*), respectively.

There was a statistically significant improvement in per-polyp sensitivity for lesions ≥6 mm in the test cases.

In study II, a total of 40 lesions were detected in 22 patients and the lesions included four masses and 36 polyps. Among the 40 lesions, 28 had a sessile morphology, 6 pedunculated, 2 flat and 4 were categorized as mass.
A comparison of the diagnostic performance in CT-Colonography interpreted by experienced radiologists and trained radiographers.

Résumé of a Ph.d. thesis by Carsten Lauridsen

For the radiographers, overall per-polyp sensitivity using bootstrapping was 60.3 % (95 % CI 50.3-70.3) and 60.7 % (95 % CI 42.2-79.2) for polyps ≥6 mm and ≥10 mm, respectively.

For the radiologists, overall per-polyp sensitivity was 59.2 % (95 % CI 46.4-72.0) and 69.0 % (95 % CI 48.1-89.6) for polyps ≥6 mm and ≥10 mm, respectively.

Overall sensitivity per-patient with polyps ≥6 mm using bootstrapping was 76.2 % (95 % CI 61.4-91.0) and 76.2 % (95 % CI 61.7-90.6) for the radiographers and radiologists, respectively.

Overall specificity per-patient with polyps ≥6 mm using bootstrapping were 81.4 % (95 % CI 73.7-89.2) and 81.1 % (95 % CI 73.8-88.3) for the radiographers and the radiologists, respectively. There was no statistically significant difference in the overall per-patient sensitivity between the radiographers and the radiologists.

In study II and III, 39 patients (three from hospital A and 36 from hospital B) were excluded because of inadequate preparation or insufficient distension. There were six incomplete OCs. In these cases, the CTCs were compared with the deficient OC-examination, but only with the colon segments that had been examined with both technologies. The six incomplete OCs included two cases
A comparison of the diagnostic performance in CT-Colonography interpreted by experienced radiologists and trained radiographers.

Résümé of a Ph.d. thesis by Carsten Lauridsen

with stenosing masses, one case with a polyp in the ascending colon and three cases which showed no polyps.

For the four radiographers and the two radiologists the false negative rate was 39.7 % versus 40.8 % and 39.3 % versus 31.0 % for polyps ≥6 mm and ≥10 mm, respectively.

For both groups of readers, the most frequent location of the false negative lesions was in the left hand side of the colon. The most frequent reason for the false negative findings was categorized as multiple lesions in one patient for both the radiographers and the radiologists.

The false positive rate per-patient was 18.6 % and 18.9 % for the radiographers and the radiologists, respectively. The most common reason for the false positive findings was mentioned as stool including 79.4 % of these lesions.

**Conclusion**

In conclusion, the results of this thesis suggest that dedicated radiographers trained in interpretation of CTC-examinations can achieve diagnostic accuracy comparable with that of experienced radiologists in the evaluation of CTC. The
A comparison of the diagnostic performance in CT-Colonography interpreted by experienced radiologists and trained radiographers.

Rèsumè of a Ph.d. thesis by Carsten Lauridsen

results in this study also show that the diagnostic performance can still be improved with further experience and better techniques.

This finding is of particular interest in double-interpretation screening for CRC.