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Munkedal, DLE, Rosenkilde, M, West, NP orcid.org/0000-0002-0346-6709 et al. (1 more author) (2019) Routine CT scan one year after surgery can be used to estimate the level of central ligation in colon cancer surgery. Acta Oncologica, 58 (4). pp. 469-471. ISSN 0284-186X

https://doi.org/10.1080/0284186X.2019.1566770

Letter to Editor

Title:

Routine CT scan one year after surgery can be used to estimate the level of central ligation in colon cancer surgery

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Disclosure of interest:

Authors report no conflicts of interest

Word count:

Text: 1472

Key words:

Colon cancer, surgery, complete mesocolic excision, radiology, quality control

Introduction

In recent years there has been an increasing focus on improving the quality of colon cancer surgery according to the principle of complete mesocolic excision (CME)[1]. CME surgery provides a standardised approach with the intention of reducing the rate of recurrence and improving survival.

One of the key principles of CME is central ligation of the tumour feeding artery at its origin with removal of the central lymph nodes.

Along with the increased uptake of CME, a pathological evaluation method was developed in order to evaluate the quality of surgical specimens and to give feedback [2].. The level of division of the tumour feeding artery is often assessed by pathologists through measuring the distance between the tumour and the artery ligation on the specimen. In a recent study we measured the residual arterial stump left behind on a CT-scan performed two days after colon cancer surgery [3]. We found no statistically significant correlation between the pathological measurment on the specimen and the radiological measurment of the arterial stump. Even though a CT scan two days after surgery may be technically feasible to the measure the level of arterial division, this will not be acceptable in routine clinical practice due to the increased costs and patient radiation exposure.

Therefore, the aim of this study was to clarify whether a routine CT-scan performed one year after colon cancer surgery could be used to identify and measure the residual arterial stump and thereby give an objective measure of the level of central division.

Materials and methods

Patients:

The patient cohort has been described in our previous study [5] but is summarised here in brief. During the period between May 2014 and June 2015, 52 patients underwent surgery for primary colon cancer at Randers Regional Hospital. These included either right sided (caecum and ascending colon) or left sided (descending colon and sigmoid colon) cancers. All patients underwent an additional CT-scan two days after surgery following informed consent, specifically to identify the residual stump of the tumour feeding artery. 14 patients had the arterial ligation marked with a metal clip. One year after surgery all patients were offered a further abdominal CT-scan as a part of their routine follow up to detect tumour recurrence.

Measurement of the arteries

The available images included scans undertaken prior to surgery, two days after surgery and approximately one year after surgery. The study radiologist first assessed the images taken one year after surgery in order to identify the residual arterial stump and measure its length. If this was not possible, the pre-operative CT-scan was used for identification. Afterwards, the CT-scan performed two days after surgery was used as a control. On the right side only, the ileocolic artery was measured from its origin at the superior mesenteric artery to the ligation. On the left side only, the inferior mesenteric artery was measured from its origin at the aorta to the ligation. The arterial stumps were

classified as: a normal vessel (Fig. 1a), thrombosed (visible thrombosis within the vessel, fig 1b), a fibrotic line (mostly degenerated, fig. 1c) and not visible.

Statistics

Statistical analyses were performed with Stata IC 12 using the student *t*-test in univariate analyses, Wilcoxon signed-rank test, Mann Whitney U test, and Fishers exact test as appropriate. P values less than 0.05 were considered statistically significant.

Ethics

The study was approved by The Central Denmark Region Committees on Health Research Ethics (J.nr. 1-10-72-333-13).

Results

In total 52 patients underwent a CT-scan two days after colon cancer surgery and in all cases we were able to identify and measure the residual arterial stumps. Of these, 47 underwent a subsequent routine CT-scan one year after surgery

Identification of the vessels on the one-year post-operative CT scan

In 38 of 47 cases (81 %) it was possible to identify and measure the residual arterial stump one year after surgery and there was no significant difference between cases with or without metal clips (P=0.4). Of the identifiable vessels we found that 25 (66 %) were categorized as a normal vessel, 8 (21 %) as a fibrotic line, and 5 (13 %) were

thrombosed. In 8 (21 %) cases the radiologist had to use the images taken pre-operatively in order to identify the correct vessel. According to the subjective opinion of the radiologist, the identification of the tumour feeding vessel was easier if the artery was marked by a metal clip.

Comparison of the arterial length at day two and one year

The measured length of the residual arterial stumps one year after surgery ranged from 4 mm to 106 mm. There were no significant differences between the lengths two days after surgery and at one year (mean difference -1.7 mm; 95% CI (-3.8 to 0.5 mm), P=0.53). Vessels categorized as thrombosed or a fibrotic line were slightly shorter after one year (mean difference -4.5 mm; 95% CI (-8.9 to -0.1 mm), Table 1). In this group the length was reduced by approximately 13 %.

Discussion

In this study we confirmed that it is possible to identify the residual arterial stump on CT images taken at the routine one year follow up scan in the majority of cases. In 81 % we identified the tumour feeding artery (including normal, thrombosed and fibrotic lines) and overall we found no significant shrinkage compared to measurements

performed two days after surgery. Approximately one third of the residual vessels were categorized as showing thrombosis or a fibrotic line and these patterns were approximately 13% shorter than on the two day post-operative measurements.

Until now, measurement of the level of division of the tumour feeding artery has been based on pathological measurements performed on the resected specimen. We have recently shown that this method may be inadequate on an individual patient basis due to variations in anatomy across a population,. Our study showed that CT-scans are a valid way of measuring the level of the vascular division [3] and we believe these are potentially more useful than a photograph of the operative field taken during surgery as we are able to accurately measure the length of the residual vessel. An additional CT-scan performed on day two is impossible to implement due to cost and increased radiation exposure, hence the routine CT-scan performed at one year in all patients offers a viable alternative. . In this study we have shown that the one year CT-scan can be used to evaluate of the level artery division after colon cancer surgery.

The concept of CME introduced standardised colon cancer surgery with resection in the mesocolic plane and central ligation of the tumour feeding vessel [1]. In recent years there has been significant debate about the clinical benefit of CME surgery and specifically mandatory division of the tumor feeding artery remains controversial [4–6].

Quality control of the planes of surgery by pathologists on colon cancer specimens is recommended as it facilitates feedback in order to optimise surgery. We believe that in addition the post-operative CT-scan is a valuable measure of the level of vascular division. With this study we have demonstrated that it is possible to reliably identify and

measure the arterial stump one year after surgery on a routine CT-scan, and that this measure is an estimate of the level of vessel ligation during surgery.

As some arterial stumps degenerate over one year, it will not be possible to identify and measure them in all cases. In addition, it can be very difficult to determine a true central ligation from a degenerate vessel one year after surgery. Our study shows that if central ligation is not performed, a radiologist will be able to find the residual vessel in 80% of cases.

It has previously been shown that it is possible to identify the residual arterial stump on a CT-scan performed shortly after surgery [7] and also after a significant delay [8]. The current study is unique as we were able to measure the length of the arterial stump on a CT-scan two days after surgery and again one year later in the same patient cohort. Our results demonstrate that an arterial stump without any sign of alteration (thrombosis or fibrotic line) identified on a CT-scan one year after surgery is statistically the same length as when measured on a scan two days after surgery.

The strengths of our study include the matched patient cohort and the strict methodology. The same specialist gastrointestinal radiologist undertook the measurements at both time points and we have previously validated the standard of her work [5]. The main weakness is the relatively limited number of patients included in the study.

In conclusion we have demonstrated that the routine one-year post-operative CT-scan documents a reliable measure of the level of arterial division performed during colon cancer surgery and can be used as a marker of specimen quality control.

Acknowledgements

NPW is funded by Yorkshire Cancer Research

References

[1] Hohenberger W, Weber K, Matzel K, et al. Standardized surgery for colonic cancer: complete mesocolic excision and central ligation--technical notes and outcome. Colorectal Dis. 2009;11:354–355.

[2] West NP, Morris EJA, Rotimi O, et al. Pathology grading of colon cancer surgical resection and its association with survival: a retrospective observational study. Lancet. Oncol. 2008;9:857–865.

[3] Munkedal DLE, Rosenkilde M, Nielsen DT, et al. Radiological and pathological evaluation of the level of arterial division after colon cancer surgery. Colorectal Dis. 2017;19:O238–O245.

[4] Emmanuel A, Haji A. Complete mesocolic excision and extended (D3) lymphadenectomy for colonic cancer: is it worth that extra effort? A review of the literature. Int. J. Colorectal Dis. 2016;31:797–804.

[5] Willaert W, Ceelen W. Extent of surgery in cancer of the colon: is more better? World J. Gastroenterol. 2015;21:132–138.

[6] Nesgaard JM, Stimec B V, Soulie P, et al. Defining minimal clearances for adequate lymphatic resection relevant to right colectomy for cancer: a post-mortem study. Surg. Endosc. 2018;32:3806–3812.

[7] Spasojevic M, Stimec B V, Gronvold LB, et al. The anatomical and surgical consequences of right colectomy for cancer. Dis. Colon Rectum. 2011;54:1503–1509.

[8] Kaye TL, West NP, Jayne DG, et al. CT assessment of right colonic arterial

anatomy pre and post cancer resection - a potential marker for quality and extent of surgery? Acta Radiol. 2016;57:394–400.