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Original Research

Regional and inter-hospital differences in the utilisation of liver surgery for patients with synchronous colorectal liver metastases in the Netherlands

J. 't Lam-Boer [a,*], E.P. van der Stok [b], J. Huiskens [c], R.H.A. Verhoeven [d], C.J.A. Punt [e], M.A.G. Elferink [d], J.H. de Wilt [a], C. Verhoef [b] on behalf of the CAIRO5/CHARISMA Group[1]

[a] *Department of Surgery, Radboud University Medical Center, Nijmegen, The Netherlands*
[b] *Division of Surgical Oncology, Erasmus MC Cancer Institute, Rotterdam, The Netherlands*
[c] *Department of Surgery, Academic Medical Center, Amsterdam, The Netherlands*
[d] *Netherlands Comprehensive Cancer Organisation, Utrecht, The Netherlands*
[e] *Department of Medical Oncology, Academic Medical Center, Amsterdam, The Netherlands*

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Abstract ***Background:*** The objective of this study was to map referral patterns in patients with synchronous colorectal liver metastases (SCLM) and to investigate if type, volume and location of the hospital of diagnosis are associated with whether or not patients underwent liver resection.

Methods: This population-based study includes all patients diagnosed with SCLM between 2008 and 2012, based on the Netherlands Cancer Registry. To study inter-hospital variation, the proportion of patients undergoing liver surgery was calculated per hospital of diagnosis. Multivariable multilevel logistic regression analysis was used to investigate the association between hospital characteristics and liver resection.

Results: Of 10,520 patients with SCLM, 12% (n = 1259) underwent liver surgery. Of these patients, 58% (n = 733) were referred to another hospital to undergo liver surgery. In 53% of the patients (n = 647), liver resection was performed in a university hospital, in 39% (n = 482) in a dedicated liver centre and in 8% (n = 102) in a general hospital. There was a large inter-

* *Corresponding author*: Department of Surgery, Radboud University Medical Center, PO Box 9101, 6500 HB Nijmegen, The Netherlands. Fax: +31 24 36 103 68.
E-mail address: Jorine.tLam-Boer@radboudumc.nl (J. 't Lam-Boer).

[1] Other members of the CAIRO5/CHARISMA group who collaborated on this study: Dejong CHC (Maastricht University Medical Center, Maastricht), Grunhagen D (Erasmus MC Cancer Institute, Rotterdam), van Gulik TM (Academic Medical Center, Amsterdam), de Jong KP (University Medical Center Groningen, University of Groningen, Groningen), Kazemier G (VU University Medical Centre, Amsterdam), Molenaar IQ (University Medical Center Utrecht, Utrecht), Ruers TM (Antoni van Leeuwenhoek Hospital, Amsterdam).

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hospital variation in the proportion of patients undergoing liver resection (2–26%). In a multilevel logistic regression model, the odds of undergoing liver surgery were higher when patients were diagnosed in hospitals where liver surgery was performed compared with the general hospitals (dedicated liver centre: odds ratio 1.36 [95% confidence intervals 1.08–1.70], university hospital: odds ratio 1.69 [95% confidence intervals 1.22–2.34]).

Conclusion: There is a large inter-hospital and inter-regional variation in the utilisation of liver resection. Patients diagnosed with SCLM in expert centres had a higher chance of undergoing liver resection.

1. Introduction

Colorectal cancer (CRC) is the third most common type of cancer worldwide. In 2014, more than 15,000 patients were diagnosed with CRC in the Netherlands. Metastases occur in a substantial number of patients, depending on the histological subtype of colorectal cancer (i.e. mucinous, signet ring cell or adenocarcinoma) [1]. Approximately, 20% of patients present with synchronous distant metastases (stage IV disease), and another 20% of patients develop metastases during follow-up (metachronous metastases) [2,3]. Colorectal liver metastases (CLMs) are present in three out of four patients with stage IV disease and in the majority no extrahepatic metastases are found [3,4].

Surgical resection of the primary tumour and all metastases offers a potential cure for patients with CLM; in particular for patients without extrahepatic metastases [5]. The five-year survival rates for patients undergoing liver resection are nowadays between 20% and 60%, depending on clinical risk factors [5–8]. As the criteria for resectability are evolving, the proportion of patients undergoing liver resection is increasing [9]. At present, metastasectomy is considered for patients with colorectal liver metastases if the patient is fit for surgery, if there is an expected remnant liver of at least 20–30% of the preoperative volume, if liver resection is anatomically possible with regard to vascular and biliary structures, and if no unresectable extrahepatic metastases are present [10,11].

In the Netherlands, inter-hospital variation in the proportion of patients undergoing curative treatment has been demonstrated for various types of cancer [12–14]. A survey among surgeons showed a wide variety in the diagnostics and therapeutic work-up for patients with metastatic CRC [15]. Recently, a regional study demonstrated variation in the utilisation of liver resection in the south of the Netherlands [8]. This implies that substantial differences in the utilisation of liver surgery might exist on a national level as well. Previous research has demonstrated that involvement of a hepatobiliary surgeon in the multidisciplinary colorectal cancer team improves overall survival [16–18]. Therefore, we hypothesise that patients with CLM diagnosed in a dedicated liver centre more often undergo liver surgery.

The objective of this study was to determine the variation between hospitals in the proportion of patients with CLM undergoing liver resection, using the Netherlands Cancer Registry (NCR). Because only synchronous metastases can be identified by the NCR, we focused on stage IV patients only. Moreover, we analysed referral patterns for liver surgery and investigated if type, volume and region of the hospital of diagnosis were associated with the probability that a patient will undergo liver resection.

2. Methods

2.1. Netherlands Cancer Registry

Nationwide population-based data were extracted from the NCR. This database registers all newly diagnosed cancers since 1989. Identification of patients is primarily based on notification by the national automated pathology archive and hospital discharge notes [19]. Patient, tumour and treatment characteristics were retrieved from patient files by specially trained registration employees of the Netherlands Comprehensive Cancer Organisation. Classification of tumour characteristics occurs according to the current versions of the TNM Classification of Malignant Tumours [20] and the International Classification of Diseases for Oncology [21]. Information on metachronous metastases is not registered in the NCR. Follow-up of vital status is obtained by annually linking the Registry to the Municipal Personal Records Database, which contains information on vital status of all Dutch inhabitants.

2.2. Data selection

All adult patients (18 years or older) who presented with SCLM between 2008 and 2012 were selected for this study. Patients diagnosed with SCLM during autopsy were excluded. Synchronous metastases were defined as metastases detected before the start of initial treatment and/or during surgical exploration. The extracted data included patient, tumour and treatment characteristics, as