



Review

High tie versus low tie of the inferior mesenteric artery in colorectal cancer: A meta-analysis



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ABSTRACT

Background: Colorectal cancer surgery includes “high tie” and “low tie” of the inferior mesenteric artery (IMA). However, different ligation level is closely related to the blood supply of anastomosis, which may increase the leakage rate, and it is unclear which technique confers a lower anastomotic leakage rate (AL) and survival advantage.

Objective: To compare the effectiveness and impact of inferior mesenteric artery (IMA) high ligation versus IMA low ligation on anastomotic leakage, lymph nodes yield rates and 5-year survival.

Methods: A list of these studies, published in English from 1990 to 2017, was obtained independently by two reviewers from databases such as PubMed, Medline, ScienceDirect and Web of Science. Anastomotic leakage rate, the yield of lymph nodes and 5-year survival were compared using Review Manager 5.3.

Results: There was no significant difference in anastomotic leakage, number of lymph nodes retrieved and 5-year survival rate for both techniques.

Conclusions: Neither the high tie nor the low tie strategy has an evidence in terms of anastomotic leakage rate, harvested lymph nodes, and the 5-year survival rate. Further RCT is needed.

1. Introduction

Colorectal cancer is the third leading cause of cancer-related death, with age-adjusted rates of 26.6/100,000/year in females and 40.0/100,000/year in males [1]. Left colonic and rectal cancers represent under two thirds of all colorectal malignancies [2]. The mainstay of treatment is surgery, with removal of the tumor, adjacent bowel, and lymph nodes along its blood supply [2].

In rectal cancer surgery, it is unclear whether the inferior mesenteric artery (IMA) should be ligated either low or high. According to the Consensus Statement of Definitions for Anorectal Physiology and Rectal Cancer of the American Society of Colon and Rectal Surgeons (ASCRS) (Washington, D.C., May 1, 1999), a low tie of the IMA is meant as a ligation below the origin of the left colic artery, while the high tie is the ligation of the IMA at its aortic origin [3,4].

High ligation of the IMA for rectal and left colonic cancers can improve lymph nodes yield rate, thus facilitating more accurate tumor staging and better disease prognosis [5]. It has been reported that there is no significant difference in survival rates between the two techniques [5–10]. The high ligation enables free-tension anastomosis to be performed during low anterior resection. But studies showed that 80% of

cases were not necessary to perform high ligation, as sufficient length was gained with low ligation [11]. In contrast, the low-ligation technique allows for adequate blood supply to the colon proximal to the anastomotic stoma during low anterior resection [7,11–13]. There is also little or no risk of injury of the hypogastric nerve plexus and its possible consequence of ejaculation disorder [14–16]. However, High ligation was not found to be positively correlated with increased anastomotic leakage or impaired genito-urinary function [17].

Based on previous researches, ligation level of the IMA remains controversial. A meta-analysis was conducted to compare the existing data about the effectiveness and safety of high versus low ligation of IMA by evaluating 3 outcome data: 1) The incidence of anastomotic leakage, 2) Lymph nodes retrieval rate, and 3) The 5-year survival rate.

2. Materials and methods

2.1. Literature search

All studies that reported different ligation level of inferior mesenteric artery (IMA) for colorectal cancer patients were identified by comprehensive computer-based searches of PubMed, Medline,

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Abbreviations

CRC	colorectal cancer
AL	anastomotic leakage
IMA	inferior mesenteric artery
LCA	left colic artery
SRA	superior rectal artery
ST	sigmoid trunk

ScienceDirect and Web of Science. These computer searches were limited to English language articles published before 2017. The following fields were used for the search: “colorectal”, “cancer” or “tumor”, “high ligation” or “high tie” and “low ligation” or “low tie”.

2.2. Inclusion and exclusion criteria

Studies published in English that fulfilled the following criteria were included: (1) studies that were retrospective cohort studies, (2) studies that compared high tie with low tie of the IMA for sigmoid or rectal cancer surgery, (3) studies that included quantitative outcome data about anastomotic leakage, harvested lymph nodes, and the 5-year survival rate. Studies were excluded from analysis when (1) it was not possible to extract data from the published results, (2) the reported appropriate outcomes were excluded, or (3) the studies contained re-published data, and (4) publications are editorials, comments, letters, review articles.

2.3. Data extraction

Two authors (YF Y and JL H) independently extracted primary relevant data from the studies. The extracted data included the following: the basic characteristics of the study, including authors, year, sample size and type of study, quality assessment; the basic patient characteristics, including TNM stage, diagnosis and treatment; comparative outcomes, including rate of AL, 5-year survival rate and mean number of lymph nodes harvested on different ligation level of IMA. Disagreement was resolved by reaching a consensus.

2.4. Quality assessment

Two reviewers (YF Y and JL H) independently evaluated the quality of each included study using the modified Newcastle-Ottawa scale (available at http://www.ohri.ca/programs/clinical_epidemiology/oxford.asp), which is widely used for observational cohort study assessment. The quality assessment consisted of three major categories: patient selection, comparability between high and low tie of the IMA, and results assessment. The details of this quality assessment are provided in Table 1. Any disagreement was resolved via discussion among the authors.

2.5. Statistical analysis

We performed statistical analysis using Revman software, version 5.3(Cochrane Collaboration, The Nordic Cochrane Centre, Copenhagen). Continuous and dichotomous variables were analyzed by odds ratios (OR) and mean differences (MD), respectively. A 95% confidence interval (CI) was recorded. Heterogeneity was evaluated by χ^2 and I^2 tests, with an I^2 of 25–50, 50–75 or > 75% that were considered with low, moderate or high heterogeneity [18]. Studies with values of $P < 0.10$ and $I^2 > 25\%$ indicated substantial heterogeneity. If heterogeneity existed with $I^2 > 25\%$, the random effects model was used to estimate the pooled OR or MD (DerSimonian and Laird method) [19]. Otherwise, the fixed effects model was adopted (Mantel-Haenszel method or Inverse variance method) [20]. The Z test was used to

Table 1
Basic characteristics of the included studies.

Trials	Type of study	Years of the study	n. patients		Diagnosis	Surgery	AL(%)		Lymph nodes harvested (mean)		5-year survival (%)		NOS score
			High tie	Low tie			High tie	Low tie	High tie	Low tie	High tie	Low tie	
(Zedan, 2016)	Retrospective cohort	2007.1–2011.12	38	76	rectal cancer	NA	7.9	5.3	21	18	79.7	78.2	5
(Hinoi and Okajima et al., 2013)	Retrospective cohort	1994.5–2006.2	256	155	middle and low rectal cancer	Laparoscopic AR	14.5	7.1	19.0	18.9	NA	NA	8
(Charan and Kapoor et al., 2015)	Retrospective cohort	2007.1–2008.12	44	16	left-sided colorectal cancer	NA	NA	NA	31.5	25	NA	NA	8
(Yasuda and Kawai et al., 2016)	Retrospective cohort	1997.1–2007.3	42	147	sigmoid colon cancer or rectal cancer	NA	4.76	2.04	15.5	13	82.4	80.3	7
(Boström and Haapamäki et al., 2015)	Retrospective cohort	2007–2010	334	388	rectal cancer	AR	41	41	NA	NA	NA	NA	8
(Huang and Zhou et al., 2016)	Retrospective cohort	2007.1–2009.12	818	1101	rectal cancer	AR	41.3	55.1	15	14	NA	NA	8
(Adachi and Inomata et al., 1998)	Retrospective cohort	1984.4–1996.6	134	38	Adenocarcinoma of sigmoid colon and rectum	curative resection	83.6	92.1	NA	NA	NA	NA	7
(Rutegård and Hemmingsson et al., 2012)	Retrospective cohort	2012.1–2014.12	87	29	local advanced rectal cancer	laparoscopic resection	8.0	3.4	NA	NA	NA	NA	8

AR = anterior resection, NA = not available.

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