



To go high, or to go low: the never-ending debate of inferior mesenteric artery ligation

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Inferior mesenteric artery (IMA) ligation is a key procedure in low anterior resection for effective lymph node dissection (LND) and further mobilization of the colon. Adequate LND is crucial in colorectal cancer surgery, as insufficient LND is a known risk factor for recurrence [1]. There have been extensive debates on whether low ligation of the IMA provides adequate LN retrieval, with some arguing that it is oncologically suboptimal. Conversely, others contend that the incidence of nodal metastasis at the root of the IMA is relatively low, suggesting that routine high ligation may be unnecessary [2]. Furthermore, as surgery is the only treatment option for operable patients, the significance of surgical expertise and the reduction of surgical complications cannot be overstated. Nonetheless, concerns have been raised about the potential complications associated with high ligation of the IMA, such as anastomotic leakage and nerve injury [3]. The recent study by Lee et al. [4] has addressed these issues, evaluating the long-term clinical outcomes of high versus low IMA ligation in patients with rectal cancer.

Nakamura et al. [5] conducted a propensity score matching analysis to compare the outcomes of high versus low IMA ligation in a cohort of 455 patients, focusing on overall survival (OS) and recurrence-free survival (RFS). Their findings indicated a poorer 5-year RFS in the low ligation group ($P=0.039$). Additionally, they observed a significant increase in lung metastases in the low ligation group, but no difference in IMA recurrence between the high and low ligation groups. In the high ligation group, 3 patients

experienced IMA recurrences, all located at the superior left side of the IMA root. In contrast, the 3 IMA recurrences in the low ligation group were located at the bifurcation of the left colic artery. The high ligation group also had a significantly higher number of lymph nodes retrieved (17 vs. 14, $P=0.001$). Given the recurrence locations in the low ligation group, the authors proposed that high ligation might be a safer oncological procedure. However, Lee et al. [4] reported no differences in 5-year OS and RFS between the high and low IMA ligation groups in their recent study. Other research has similarly failed to demonstrate oncological benefits associated with high ligation of the IMA. A few studies have been initiated to conduct prospective trials with larger sample sizes, aiming to provide clearer evidence on whether the level of IMA ligation impacts oncological outcomes (ClinicalTrials.gov identifiers: NCT00701012, NCT03498885, NCT01979029).

The risk of surgical complications is a critical point of debate. Proponents of low IMA ligation contend that marginal arteries are often inadequate for ensuring sufficient perfusion to the anastomosis following high ligation. Insufficient perfusion can lead to anastomotic leakage (AL) or stricture formation. The latest meta-analysis [6], which included 6 randomized controlled trials (RCTs) and 11 retrospective cohort studies, indicated a lower incidence of AL (risk ratio, 1.58; 95% confidence interval, 1.20–2.08) and a shorter time to first flatus in the low ligation group. However, no significant differences were observed between the groups in terms of the number of harvested LNs, LN metastasis, 5-year mortality

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rate, 5-year disease-free survival rate, duration of surgery, intraoperative blood loss, or postoperative ileus. Lee et al. [4] also reported no difference in AL rates between high and low ligation; similarly, an RCT by Fujii et al. [7] involving 331 patients found no differences in AL rates between the 2 ligation techniques. Since AL is a potentially life-threatening surgical complication, a larger, multicenter RCT is essential to resolve these conflicting findings.

Although many surgeons suspect that damaging the autonomic nerve plexus during high ligation of the IMA may negatively impact genitourinary and bowel function, there has been limited research on this topic. Lee et al. [4] explored the impact on defecatory function and found that the Fecal Incontinence Severity Index scores were better in the group that underwent low ligation. Similarly, Koda et al. [8] examined the effects of high versus low IMA ligation on defecatory disorders following low anterior resection for rectal cancer. Their study observed spastic waves in the neorectum of the high ligation group ($P < 0.05$), which they suggested could lead to incomplete fecal evacuation and subsequent defecatory dysfunction. Overall, there appears to be a trend toward improved defecatory function in patients who have undergone low ligation, but further research is necessary to accurately assess defecatory functional outcomes.

Current studies have not resolved the ongoing debate about whether the IMA should be ligated high or low. Instead, meta-analyses and RCTs continue to provide conflicting results as further research is conducted on the oncological and surgical outcomes of high versus low IMA ligation. Some research even suggests that IMA ligation may need to be customized based on lymph node involvement and underlying conditions such as diabetes mellitus and atherosclerosis, which could lead to relatively subjective decision-making [9, 10]. In this context of conflicting findings, the study by Lee et al. [4], which includes 545 patients, contributes significantly to the existing literature.

ARTICLE INFORMATION

Conflict of interest

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