Robotic low ligation in rectal cancer: How we do it?

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Abstract

Introduction
High versus low ligation of the inferior mesenteric artery is a controversial issue in the literature. However, low ligation is revealed to be technically demanding, particularly in minimal invasive surgery. Here we provide technical tips to facilitate safe inferior mesenteric artery skeletonization and low ligation at the level of the superior rectal artery.

Methodology
The robotic approach to vascular ligation possesses many advantages over the laparoscopic approach; however, due to the lack of haptic feedback, technical skills are necessary to achieve low ligation and vascular skeletonization.

Conclusion
Ligation of the inferior mesenteric artery is easier than low ligation. However, if procedures are followed, then low ligation can be easy.

Introduction
A debate arises when high versus low inferior mesenteric artery (IMA) ligation is discussed. Low ligation, in which the IMA is ligated caudal to the origin of the left colic artery, has been reported to have several advantages. These include preservation of the autonomic nerve at the IMA origin, increased blood supply to the left colon and anastomosis with a subsequent decrease in anastomotic leakage. Despite these benefits, oncological safety and tension-free anastomosis remain debatable and are considered drawbacks to this technique by some authors.

Over the past six years, we have performed over 600 robotic colorectal procedures, mainly for cancer resection. We found that low ligation in minimal invasive technique is technically demanding, and we can provide our experience on that part.

If low ligation is preferred, careful dissection of the lymph node around the IMA route is performed, and the specimen is sent for histopathological examination to determine the possibility of improving the lymph node count. To perform this procedure, anatomical orientation and technical skills are required because the robotic system possesses many technical advantages over other systems. Our aim was to provide anatomical orientation and vascular dissection using full advantages of the robotic system. In this review, we discuss the method of performing low ligation of the superior rectal artery (SRA) in a cancer patient.

Methodology
We provide our technical tips for robotic IMA anatomical landmarks—skeletonization and low ligation—which were performed at the Yonsei University College of Medicine in South Korea. Photographs were acquired during an operative robotic procedure performed in November 2012.

Technique
The da Vinci Si system was used for a patient diagnosed with rectal cancer.
We used a single docking technique published by Lee et al. from our institution with a predominant third arm on the right hand (Figure 1).

Our goal in the present study was to achieve IMA dissection and low ligation respective of the dissection being performed medially to laterally or laterally to medially.

The third robotic arm was used to retract the SRA as high as possible. The assistant grasped the inferior mesenteric vein (IMV) and elevated it as high as possible using a laparoscopic grasper instrument. Using this method, an ‘eagle sign’ would be observed (Figure 2). This manoeuvre reduces the chance of nerve injury at the IMA root.

With the advantages of endowrist movement and tremor filtration, we grasped the tissue at the root of the IMA and dissected it from the IMA by touching the attachments, not the vessel itself. Lowering the Bovies setting to 30 Mhz may reduce the risk of vascular injury. The direction of dissection began at the root of the IMA and moved obliquely parallel to the vessel (Figure 3A, B).

Next, we grasped the tissue over the SRA and cut it transversely toward the IMV (Figure 4). This tissue could be sent for histopathological analysis for additional lymph node identification. A triangular zone was observed between the left colic artery, sigmoid vein and SRA (Figure 5). We continued the dissection at this zone to identify each vessel clearly, and we applied a hemlock clip for the SRA and sigmoid vein (Figures 6 and 7).

The variability of the vessels originating from the IMA should be considered during dissection. The sigmoid artery and SRA may originate separately from the IMA; if so, both should be ligated. After ligation of

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Figure 2: Eagle sign: The third robotic arm retracts the SRA, and the assistant grasper retracts the IMA and L.C. artery. SRA: superior rectal artery; IMA: inferior mesenteric artery; IMV: inferior mesenteric vein; L.C.: left colic.

Figure 3: A: Tissue dissection around IMA. NOTE: The ureter posterior. B: Dissection moves parallel and obliquely over IMA and SRA. Arm 3: Holding the SRA. Arm 2: Retracting the peri-vascular tissue.
Methodology

Figure 4: Transverse dissection of the peri-vascular tissue parallel to the left colic artery. This tissue was sent for histopathological examination.

Figure 5: Triangular vascular zone formed by the SRA, sigmoid vein and left colic artery.

Figure 6: A: SRA dissection using the endowrist function of the scissors. IMA: inferior mesenteric artery. B: Hemlock clip was applied to the SRA, and the scissors were used for division.

Discussion

The authors have referenced some of their own studies in this review. These referenced studies have been conducted in accordance with the Declaration of Helsinki (1964) and the protocols of these studies have been approved by the relevant ethics committees related to the institution in which they were performed.

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Methodology

Figure 7: A: Sigmoid vein dissection using the endowrist function of the robotic scissors. B: Hemlock clip applied over the sigmoid vein.

Figure 8: A and B: The method of IMA vascular pedicle elongation by dissection lateral to the left colic artery and vein.

All human subjects, in these referenced studies, gave informed consent to participate in these studies.

The advantages of a robotic system have been demonstrated by several systematic reviews and meta-analyses. Technically, this system provides high-definition three-dimensional vision, filters physiological tremor, provides a human wrist-like motion and offers stable camera control with better ergonomics.

Low versus high ligation remains a controversial issue in the literature, and no consensus yet exists. For oncologic purposes, many surgeons...
apply high arterial ligation. Other strategy includes ligation at the level of the SRA, immediately caudal to the origin of the left colic artery (low ligation). However, Nicholls et al. found that high ligation did not improve the 5-year survival in patients with sigmoid or rectal cancer. Lange et al. systematically reviewed publications concerning the level of ligation in rectal cancer surgery. They included 23 articles that evaluated oncologic outcome (n=14), anastomotic circulation (n=5), autonomic innervation (n=5) and tension on the anastomosis/anastomotic leakage (n=2). They concluded that insufficient evidence exists to support high ligation as the technique of choice. Furthermore, high ligation has been confirmed to decrease perfusion and innervation of the proximal limb. Consequently, in rectal cancer surgery, a low tie should be the preferred method.

Conclusion
Ligation of the IMA is easier than low ligation; however, low ligation is technically demanding. With the advantages of robotic instruments, performance of low ligation will be simplified if procedures are carefully followed.

References