

# A new stage of surgical treatment: super minimally invasive surgery

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## Introduction

The application of video-assisted thoracoscopy, laparoscopy, and Da Vinci robotic surgery allows surgical treatment to enter the stage of minimally invasive surgery (MIS).<sup>[1-3]</sup> Compared with traditional open surgery, MIS is less invasive with a shorter hospital stay.<sup>[4,5]</sup> However, both MIS and traditional open surgery fail to maintain the integrity of organs while resecting the lesions. To date, MIS does not change the treatment mode used in traditional open surgery, namely, “resect not only lesions but also partial or complete selected organ,” leading to loss of some organs and anatomical reconstruction of remaining organs. Every organ in the human body has its own function and plays an important role in the normal metabolism of our body; thus, no organ is redundant. Moreover, we know much less about the interaction between organs than the function of special organs. If one organ was partially or completely resected, the remaining organ might not function as well as it did before the resection. The functions of other organs might be affected by the loss or partial removal of this organ. Patients often suffer from complications related to the loss of organs. For example, patients who underwent proximal gastrectomy often suffered from reflux post-operation, resulting in a decline in their sleep quality. Patients often lived with dyspepsia, innutrition, diarrhea, and anemia after total gastrectomy.

Human organ reconstruction that accomplishes the creation of organs that are the same as those we are born with remains far from possible. The highest expectation of the disease treatment method is to remove lesions and retain organs without inducing additional discomfort. It is better not to break the normal structure or affect survival. With the development of endoscopy, it has become possible to treat more lesions by endoscopy without changing the anatomical structure of our body. Considering that more and more lesions might be diagnosed in their

early stage with the development of medicine, a new treatment method, namely, super minimally invasive surgery (SMIS) was initially reported by Linghu in 2016.<sup>[6]</sup> SMIS is believed to achieve a therapeutic effect similar to that of surgical treatment without damaging organ structure and function.

## Definition

SMIS is defined as “curing the disease while preserving the integrity of human organ anatomy.” The purpose of SMIS is to cure diseases without damaging organ structure and function, together with ensuring a normal survival time and post-operative quality of life (QoL). The treatment modes of traditional open surgery, MIS, and SMIS are shown in Supplementary Figure 1, <http://links.lww.com/CM9/A585>. Surgical treatments, such as endoscopic mucosal resection, endoscopic submucosal dissection (ESD), and endoscopic submucosal tunnel dissection, could be regarded as SMIS because they can be applied to resect early gastrointestinal cancer without injuring the integrity of the gastrointestinal duct.

Not all endoscopic operations are classified as SMIS, whereas laparoscopy and thoracoscopy are classified as MIS. Some operations under laparoscopy and thoracoscopy did not affect the anatomical structure of organs and should also be regarded as SMIS, such as video-assisted thoracoscopic enucleation, which only resected lesions. Surgical operations, no matter whether endoscopy or video-assisted thoracoscopy, should be regarded as SMIS if they did not affect the anatomical structure of organs while curing disease.

## Comparison Between SMIS and MIS

To better understand the difference between SMIS and MIS, we compared the use of these methods in the treatment of the same type of disease. Anastomosis and

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gastric retention could occur after traditional open surgery [Supplementary Figure 2A–C, <http://links.lww.com/CM9/A586>] and MIS [Supplementary Figure 2D and 2E, <http://links.lww.com/CM9/A586>] for the treatment of early gastric cancer that, consequent to partial loss of stomach, has necessitated reconstruction of stomach and small intestine. Scars of the gastric tract wall were noted in the post-operative endoscopic views after SMIS for the treatment of early gastric cancer, and the anatomical structure of the stomach was free from damage [Supplementary Figure 2F and 2G, <http://links.lww.com/CM9/A586>]. When treating suppurative appendicitis, MIS is used for an appendectomy [Supplementary Figure 3A and 3B, <http://links.lww.com/CM9/A587>], whereas SMIS successfully cures the lesion by endoscopic drainage [Supplementary Figure 3C–E, <http://links.lww.com/CM9/A587>].

Laparoscopy- and thoracoscopy-assisted endoscopic surgery have been reported as methods to overcome the limitation of the relatively significant invasive nature of MIS and make endoscopic resection less challenging.<sup>[7-9]</sup> When treating early cancer with lymph node metastasis, cancer can be resected under endoscopy, whereas lymph nodes can be resected by laparoscopy. This cooperative application of endoscopy and laparoscopy should be regarded as SMIS. Although MIS is well developed and regarded as the main surgical operation, it cannot completely replace traditional open surgery. Similarly, SMIS is the main surgical method; however, it might not completely replace MIS in the near future. It provides us with a new treatment method and a development direction for medicine in the future.

### Applications of SMIS

Taking gastrointestinal diseases as an example, SMIS can be mainly applied to obstruction relief and lesion resection. Obstruction relief treatments mainly include foreign body removal, stenosis relief, pus drainage, necrosis drainage, and bile duct obstruction removal. Lesion resection treatments mainly include the resection of early gastrointestinal cancer, submucosal tumors, polyps, and neuroendocrine tumors. The digestive endoscopic tunnel technique (DETT), which was first proposed by Linghu in 2009,<sup>[10]</sup> played a landmark role in the development of SMIS. DETT divided the gastrointestinal tract wall into two layers by establishing a tunnel between the mucosal and muscularis propria, making endoscopic treatment of diseases that used to be treated by surgery possible. DETT broke the boundary between gastrointestinal internal medicine and surgery, promoting the development of SMIS.

For most benign lesions, SMIS is believed to achieve a therapeutic effect similar to that of surgical treatment. For malignant lesions, SMIS is mainly applied to those in the early stage. For lesions in the advanced stage, traditional open surgery and MIS are still regarded as the optimum resection methods. The applications of SMIS are affected not only by the development of techniques and equipment but also by the characteristics and the stage of the disease. However, diseases are increasingly diagnosed in their early stage with the

development of medicine. More and more diseases are indicated for SMIS.

### Nomenclature of SMIS

When SMIS is performed to treat a disease, the type, location and stage of the lesion, and the treatment method should be demonstrated. The SMIS should be described as “location + disease + SMIS (type).” Taking ESD for early esophageal cancer as an example, the standard demonstration should be “esophageal early cancer (T1aN0M0) SMIS (ESD).”

### Advantages of SMIS

SMIS does not affect the QoL and expectancy of patients because it can not only cure the disease but also make no changes to the anatomical structure of organs.

SMIS also has the advantages of less invasion, shorter operation time, shorter hospital stay, and less expense than MIS and traditional open surgery. For example, when SMIS was applied to resect early rectal cancer close to the anus, the anatomical structures of the rectum and anus were maintained. The defecation method after the operation was similar to that before surgery. The QoL and life expectancy were not affected.

Compared with open surgery, MIS was reported to improve QoL outcomes when treating early gastric cancer.<sup>[11]</sup> However, when making a comparison between SMIS and MIS, MIS showed a worse QoL due to the loss of organs.<sup>[12,13]</sup>

### Perspectives

Both traditional open surgery and MIS fail to maintain the integrity of organs, while resecting the lesions. The treatment method, namely, “resect not only lesions but also partial or complete selected organ” has not been changed. Being different from traditional open surgery and MIS, SMIS is intended to cure the disease while preserving the integrity of human organ anatomy. SMIS provides a new treatment mode for medicine and specifies the development direction for medicine. With more and more diseases diagnosed in their early stage, SMIS will be widely used and is expected to be the leading method of surgery in the future. Surgery that fails to maintain the integrity of organs will be eliminated.

SMIS is still at the preliminary stage of development; however, it shows promise for application in obstruction relief and lesion resection. Experts in World Endoscopy Organization (WEO) also believe that SMIS will play an important role in the development of medicine and an *ad hoc* committee named “super minimally invasive interventions” belonging to WEO has been established this year.

The treatment of digestive diseases simply belongs to a branch application of SMIS. SMIS can also be applied to diseases of other systems. Similar to MIS, SMIS is a type of treatment method and theory suitable for different

diseases, such as urinary system diseases and respiratory diseases, and mediastinal surgery.

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### Conflicts of interest

None.

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