Preliminary application experiences of a multi-disciplinary teamwork (MDT) pattern using in the robotic-assisted gynaecological surgery

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Abstract

Abstract: Objective Patients' demographics, perioperative data and reasons of using MDT pattern were all analyzed to report preliminary application experiences of an MDT pattern using in the robotic-assisted gynaecological surgery at a single institution. Design Retrospective and descriptive study. Setting Tertiary referral center with one surgical team. Population All the 39 patients who have undergone robotic-assisted MDT gynaecological surgeries from 2018 to 2021 in Chinese PLA General Hospital. Methods Various types of robotic-assisted MDT gynaecological surgeries were carried out by the Da Vinci SI Surgical System. Patients' demographics, perioperative data and reasons of applying MDT surgeries were described. Main Outcome Measures Patients' demographics, perioperative data and reasons of applying MDT surgeries. Results Most patients undergone robotic-assisted MDT gynaecological surgeries have at least one abdominal surgery before. The operation cost and hospital expense were higher than common laparoscopy. Hospital stays ranged from 7 to 42 days. General surgery department and urological surgery department were the top two familiar departments involved in robotic-assisted MDT gynaecological surgeries. Only 4 cases appeared intraoperative complications in these surgeries. However, postoperative infection needed to be closely monitored. Conclusions It was indicated that robotic-assisted MDT gynaecological surgeries applied in severe diseases could provide both safety and precision, and the pattern was proved to demonstrate the concept of patient-centered and holistic treatment. Simultaneously, the MDT pattern could cultivate teamwork in various departments in the hospital, thus it was beneficial to both patients and hospitals. Keywords Multi-Disciplinary Teamwork; Robotic-Assisted Surgery; Minimally Invasive Surgery; Gynaecology

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Running title Experience of robotic MDT gynecology surgery

Objective

Patients' demographics, perioperative data and reasons of using MDT pattern were all analyzed to report preliminary application experiences of an MDT pattern using in the robotic-assisted gynaecological surgery at a single institution.

Design

Retrospective and descriptive study.

Setting

Tertiary referral center with one surgical team.

Population

All the 39 patients who have undergone robotic-assisted MDT gynaecological surgeries from 2018 to 2021 in Chinese PLA General Hospital.

Methods

Various types of robotic-assisted MDT gynaecological surgeries were carried out by the Da Vinci SI Surgical System. Patients' demographics, perioperative data and reasons of applying MDT surgeries were described.

Main Outcome Measures

Patients' demographics, perioperative data and reasons of applying MDT surgeries.

Results

Most patients undergone robotic-assisted MDT gynaecological surgeries have at least one abdominal surgery before. The operation cost and hospital expense were higher than common laparoscopy. Hospital stays ranged from 7 to 42 days. General surgery department and urological surgery department were the top two familiar departments involved in robotic-assisted MDT gynaecological surgeries. Only 4 cases appeared intraoperative complications in these surgeries. However, postoperative infection needed to be closely monitored.

Conclusions

It was indicated that robotic-assisted MDT gynaecological surgeries applied in severe diseases could provide both safety and precision, and the pattern was proved to demonstrate the concept of patient-centered and holistic treatment. Simultaneously, the MDT pattern could cultivate teamwork in various departments in the hospital, thus it was beneficial to both patients and hospitals.

Keywords

Multi-Disciplinary Teamwork; Robotic-Assisted Surgery; Minimally Invasive Surgery; Gynaecology

Tweetable abstract

An MDT pattern using in the robotic-assisted gynaecological surgery could help accomplish complicated operations. Therefore, it has great application value.

Introduction

Robotic-assisted surgery, which was originated in 1994, has become one of the favorite surgical approaches adopted by surgeons. Da Vinci Surgical System (Intuitive Surgical Inc.), which was classified as a masterslave surgical system, was approved by the United States Food and Drug Administration (FDA) in 2000 for general laparoscopic surgery and in 2005 for selected gynaecologic procedures¹. After that, Da Vinci surgical system rapidly developed its application areas in gynaecologic surgeries, and even created single-site form². It was indicated that the most common indications for robotic-assisted surgeries consisted of intricate hysterectomy, sacrocolpopexy, bladder and ureter injuries repair, deep infiltrating endometriosis, gynaecologic cancer staging surgeries and recurrent pelvic tumors resections³⁻⁵. In addition, Da Vinci system could provide 3D vision, distinct amplified view, flexible endo-wrist facilities, visual immersion tremor filtration and appropriate ergonomic design^{3, 6}. So that blood loss, intraoperative and postoperative complications, operation and recovery time could be reduced significantly, especially in obese or elderly patients^{7, 8}. It was no exaggeration to say that robotic-assisted surgery has brought tremendous revolutions to minimally invasive therapy, especially in gynaecology.

A multi-disciplinary team (always abbreviated as MDT) is a patient-centered medical service pattern. It is a process in which senior experts from multiple disciplines formulate a personalized diagnosis and treatment plan for specific patients through joint discussions or cooperative operation, and it is especially suitable for the diagnosis and treatment of complex diseases such as tumors, severe systemic trauma, and multiple organ failure. MDT is a creative diagnosis and treatment pattern widely respected in the modern international medical field^{9, 10}. It not only improves the quality of medical treatment, but also effectively forms the collaboration while breaking the barriers between disciplines, and realize the improvement of doctors, departments and hospitals. More and more literature linked the quality of teamwork with the quality and safety of medical services. And the MDT pattern has also been widely used in obstetrics and gynaecology.

A British research institute conducted MDT assessment on 200 patients with ovarian tumors, and found that the sensitivity of discovering ovarian cancer increased to $98.4\%^{11}$. Researchers from University of Manchester in the United Kingdom also carried out an MDT pattern for 41 patients with advanced ovarian cancer, and believed that the four key parts of the MDT implementation were: clinical presentation, patient factors, chair's direction, and input from other specialties¹². MDT pattern shows advantages in the diagnosis and management of intractable diseases. At the same time, MDT could also play a certain role in the formation of personalized surgical treatment. Some researchers have found that the combination of laparoscopic score and MDT pattern can complete more satisfactory tumor cytoreductive surgery for recurrent ovarian cancer. for the survival time is significantly better than those with chemotherapy alone or with cytoreductive surgery that has not been evaluated and performed by MDT¹³. Scholars from Taiwan have also found that patients with peritoneal cancer could have greater opportunities to achieve thorough operation due to the use of tumor cytoreductive surgery and intraperitoneal hyperthermic perfusion combined with the MDT pattern¹⁴. It was also reported a case of a 73-year-old woman suffering from cervical clear cell carcinoma using the MDT pattern to develop a diagnosis and treatment plan¹⁵. In fact, MDT is not only used for gynaecological malignant tumors, but also for non-malignant diseases in obstetrics and gynaecology. Some evidence revealed that MDT could be used in disseminated uterine leiomyomas, severe placental implantation and the management of hyperthyroidism during pregnancy¹⁶⁻¹⁸. Besides, MDT was often associated with deep infiltrating endometriosis^{19, 20}. Therefore, the MDT pattern was expected to be applied to all aspects of the diagnosis and treatment in obstetrics and gynaecology. However, it was still difficult to find some research that shared the experiences of using the MDT pattern in the robotic-assisted gynaecological surgery.

Since 2006, DaVinci Surgical System has been introduced to Chinese PLA General Hospital and has created a new era of precise surgeries. There are several professors from different disciplines who can accomplish robotic-assisted laparoscopic surgery perfectly, so that chances of organizing MDT operations were gradually increasing. Our research will summarize the characteristics of the patients who have undergone roboticassisted MDT gynaecological surgeries in Chinese PLA General Hospital from 2018 to 2021 to discuss the details of this pattern.

Methods

Study design and data collection

The retrospective analysis was based on the clinical data of robotic-assisted MDT gynaecological surgeries in Chinese PLA General Hospital from January 2018 to December 2021. All procedures were performed by Da Vinci SI Surgical System (Intuitive Surgical Inc.). The MDT team mainly included Prof. Meng Yuanguang majored in gynaecological oncology, Prof. Ma Xin and Prof. Liu Hongyi from urology surgery department and general surgery department respectively. 39 patients' clinical information was collected in the following items: age, body mass index (BMI), final diagnosis, characteristic of disease (benign or malignant), frequency of abdominal surgeries before, frequency of gynaecological surgeries before, concomitant diseases (hypertension and diabetes), family history, preoperative days, postoperative days, total hospital stay, operation cost, hospitalization expense, details of cooperative departments, operation time, blood loss volume, blood transfusion volume, intraoperative complications, postoperative complications, length of ICU stay, 30 days admission, 30 days intervention, 30 days reoperation. All the information was collected under the supervision of PLA General Hospital Ethics Committee. And no privacy was leaked in this procession. All data were properly stored and data analysis was performed using the SPSS 25.0.0 software (IBM Corporation, USA).

Surgical technique

The patient was placed in the lithotomy position. The abdominal surgery area was sterilized with Aner's iodine, and the vulva and vagina were sterilized with iodophor. The surgical area was covered with operation towels routinely. We chose the position where about 3-4cm above the umbilicus as the approach location of the robotic camera port, and the camera port used a 12mm Trocar puncture cannula. An 8mm puncture cannula was placed through the intersection of the vertical line along the body axis along the left anterior superior iliac ridge and the horizontal line through the umbilicus, which served as the robotic arm 2 approach. The symmetrical point on the right side served as the robotic arm 3 approach. The middle point of the camera port and the arm 3 puncture position was the arm 1 entry port, and an 8mm puncture cannula was used. Similarly, we set a puncture approach used by a surgical assistant (Asst.) between the camera port and the arm 2 puncture port, which also used a 12mm cannula (Fig. 1C). Monopolar Curved Scissors were often used in arm 1, Fenestrated Bipolar Forceps in arm 2, and ProGrasp Forceps in arm 3. The assistant used atraumatic grasping forceps, curved forceps, or aspirator according to intraoperative needs. And the puncture positions of other departments were carried out based on their surgical habits (Fig. 1C, D, E, F). The number of puncture ports and surgical body position may change because of intraoperative needs (Fig. 1B).

On the basis of the patient's primary diagnosis, the surgical procedures were performed according to surgical principles in NCCN guidelines and other medical standards. For example, for cervical cancer patients, radical hysterectomy with bilateral pelvic lymph node dissection were performed. And endometriosis patients were performed with endometriosis lesions excision. If metastases or complications occurred, the related non-gynaecological organs should be partially removed or completely repaired.

Results

Population

The population consisted of 39 patients with an average age of 49.28 years (ranged 26-66 years), and 87.18% of the cases were middle-aged females. Their BMI values ranged from 19.15 to 33.87 kg/m², while the average value was 23.60. Two patients could be diagnosed with obesity. Thirty-four patients have undergone gynaecological procedures before, such as cesarean section, hysteroscopy, myomectomy, hysterectomy, and even primary debulking surgery for malignant gynaecological tumors. When it came to prior abdominal procedures history, the data showed that 84.62% of the patients have received abdominal surgeries including

cholecystectomy, appendectomy, and other gynaecological intraperitoneal surgeries. Several patients had other complications, for instance, hypertension and diabetes (Table 1). All of them had no history of smoking or drinking (data not shown).

The cases comprised 13 patients with benign disease and 26 patients with malignant disease. Benign diseases included the following types: deep infiltrating endometriosis, ureterovaginal fistula, huge uterine leiomyoma and angioleiomyoma. Meanwhile, malignant diseases consisted of ovarian cancer, cervical cancer, endometrial cancer and recurrent malignant gynaecological tumors. The average preoperative day of all patients was 10.36 days while average postoperative day was 12.64 days. The average of total hospital stay reached to 23 days, and fluctuated from 7 to 42 days. The reason why hospital stay values changed widely was that we didn't separate benign and malignant diseases. Simultaneously, operation cost seemed more expensive than common laparoscopy, mean operation cost was about 53,452 yuan. The condition of patients undergone MDT gynaecological surgery was usually complicated, so the hospitalization expense reached to a higher level, about 93,605 yuan. But a review predicted that the high expense of robotic surgeries may still be lower than open surgeries²¹. All the descriptive values were exhibited in Table 1.

Perioperative data

Mean operation time was 285.85 minutes (ranged 112-595 minutes, including robotic installation time). Blood loss volume varied greatly in MDT gynaecological surgeries. The median value was 200 ml. Blood transfusion volume ranged 0-2340 ml (Table 2).

Four departments always participated in robotic-assisted MDT gynaecological surgeries shown in Table 2. They were general surgery department, urological surgery department, hepatological surgery department and vascular surgery department, respectively. Among them general surgeons and urological surgeons were the most common partners to gynecologists. Twenty-one patients (53.85%) accepted the combined surgeries with gynaecological and general surgeons. The percentage of surgeries gathered gynaecological and urological surgeons was 38.46%. There were 4 patients needing hepatological surgeons. Occasionally vascular surgeons would appear when we needed vascular repair. A robotic-assisted MDT gynaecological surgery usually consisted of 2 to 3 departments.

After the surgery, all the patients discharged to home successfully. Eighteen patients were proved to return to the hospital in 30 days. Most of them came back for the follow-up treatment including chemotherapy or radiotherapy. Only 2 patients aimed to treat the complication. And one of them finally finished the double nephrostomy for vesicovaginal fistula, which we defined as the only one 30-day intervention. No one returned in 30 days for a reoperation in our study. Rafique et.al has discussed the outcomes of robot-assisted laparoscopic gynaecological surgeries (RA-LGS) that the lack of a trained team assisting in RA-LGS lead to poor outcomes²², which came to the similar conclusion with us.

Actually, only a little complication broke out in the robotic MDT gynaecological surgery. One patient had bladder wall damaged during the operation while another one had rectum damaged. Two patients suffered from vascular damage (one is left common iliac vein injury, the other is left external iliac artery injury). Two vascular injury cases and one difficult rectal resection and anastomosis conversed to open surgeries, others were all completed laparoscopically (Table 2). Three people transferred to ICU after the surgery, their ICU stay were 3,4 and 2 days respectively. That's because they had wider surgical area.

We found that 23.08% of the cases had postoperative infection (Table 2). Especially 10.3% of the cases undergone multi-site infection. Meanwhile, 3 cases (7.7%) only suffered from urinary tract infection (data not shown). Besides, two patients had intestinal obstruction. Two cases appeared vesicovaginal fistula and one case followed up with rectovaginal fistula.

MDT pattern in robotic-assisted gynaecological surgeries

As shown in Figure S1, the operation performed by surgeons from non-gynaecological departments was a crucial part in robotic-assisted MDT gynaecological surgeries. For general surgery department, surgeons repair intestinal damage and relieve severe intestinal adhesions. When the metastasis was deeply infiltrated

into the intestine, intestinal resection and anastomosis or enterostomy would be performed (Fig. S1A, B). Urological surgeons could help deal the metastasis on inferior vena cava (Fig. S1C). The ureters were the organs that required particular attention in gynaecological surgery. Urological surgeons resected ureteral lesions and completed the anastomosis because tumor metastasis or endometriosis tissue were often observed on the ureters (Fig. S1D). Meanwhile, partially liver resection often performed by hepatological surgeons to achieve R0 resection (Fig. S1E, F). Vascular damage needed surgical repair by vascular surgeons, but rapid and massive bleeding often lead to blurred vision so that they often transferred into open surgeries to accomplish vascular anastomosis (image not shown). Gynaecological surgeons carried out the major resection first and then other cooperative surgeons finished the procedures described above.

Reasons of MDT gynaecological operations

An analysis was completed on the reasons of MDT gynaecological operations described in Table 3. We judged the reasons through the description in the surgical record of 39 patients. As a result, six main reasons were summarized.

The most common situation was the diseases spread to other organs, especially in patients with malignant tumors and deep infiltrating endometriosis. There were 26 cases using MDT surgical pattern because of widespread metastasis to achieve the aim of complete resection. Surgical area included partial liver resection, sigmoid colon and rectum resection, bladder and ureter resection. All the tissues removed were proved to be the metastases of the primary disease by pathological result.

Other reasons were less common. Three patients received MDT gynaecological surgeries passively because vice-damage appeared during operation. Case 14 accepted a rectal repair as a result of rectum injury caused by separation of adhesions. Case 34 and case 38 received vascular repairs and both of them conversed to open surgeries. Three patients adopted robotic-assisted MDT gynaecological surgeries because they suffered from ureteral fistula or ureterovaginal fistula after radical hysterectomy. Only one patient needed MDT pattern to acquire intraoperative assistance in judging the condition of metastasis. An unexpected cystoscopy was used to rule out ureteral endometriosis for case 36. Due to the complexity of pelvic anatomy, it was advised to call for cooperation with other departments when separating severe adhesions. And we followed the rules during the surgeries of 3 patients. A small number of patients asked to solve their other non-gynaecological primary diseases in the operation. Case 11 received a right kidney tumor resection during the robotic-assisted pelvic and para-aortic lymph node dissection. A partial small intestine resection and anastomosis was accomplished for case 31 who was discovered small bowel diverticulum, while a cholecystectomy was carried out for case 35 who was diagnosed with cholecystitis.

Discussion

Main findings

A large number of patients achieved robotic-assisted MDT gynaecological surgeries have undergone at least one abdominal or gynaecological surgery before. The mean hospital stay reached to 23 days and the mean medical expense was about 93,605 yuan. Age, BMI value, medical complications (such as hypertension and diabetes) and the characteristic of gynaecological diseases seemed to have no relationship with whether to organize an MDT surgery.

It was investigated that mean MDT operation time was 285.85 min. At least half of the patients in our study had a blood loss volume of no more than 200 ml, while they didn't require blood transfusions. General surgeons and urological surgeons appeared in most cases. Follow-up chemotherapy and radiotherapy were the common reasons for patients who had a 30-day readmission. Only two cases came back for complication, and one of them adopted intervention.

According to the description in the surgical record, we summarized 6 main reasons for robotic-assisted MDT gynaecological surgeries above. Indication of the surgeries was based on the above conclusions.

Obviously, when aggressive diseases invaded to other non-gynaecological organs, it was a good choice to

organize a robotic-assisted MDT gynaecological surgery to accomplish the metastasis resection and avoid complications. Other indications consisted of intraoperative assistance for judging the metastasis, separating adhesions, and solving unexpected complications (ureteral and bladder injury, intestinal damage, vascular damage and so on). In addition, a robotic-assisted MDT gynaecological surgery could be used to cure complex gynaecological and non-gynaecological diseases at the same time. In fact, dealing with complications following with the last surgery was not an indispensable indication for robotic-assisted MDT gynaecological surgeries in our comments. There was no significant difference in the surgical skills between simple gynaecological robotic surgeries and robotic-assisted MDT gynaecological surgeries. What we need to focus on during the surgery was that pelvic anatomy should be distinguished clearly and vice-damage should be avoided.

After the robotic-assisted MDT gynaecological surgeries, surgeons must pay more attention on postoperative infection. It was reported in our research that up to 23.08% of the patients had different degrees of infection after surgery, most of whom suffered from multi-site infection.

Strengths and limitations

As far as we know, there were few investigations about robotic-assisted MDT gynaecological surgeries in the world. One reason was Da Vinci Surgical System actually hasn't distributed widely all over the world, the other was that not all the hospitals had proper multi-disciplinary teams. And most researches of gynaecological MDT treatments paid more attention on preoperative assessment and determination of final treatment. It seemed that we ignored cooperative MDT part in the operating rooms. Our research data could exactly provide some reference for gynaecological surgeons to perform a robotic-assisted MDT gynaecological surgery, and the surgical method truly provided both safety and precision.

It was a pity that only 39 qualified cases were collected in our research. The quantity of cases may not enough to help us get believable conclusions if we split the cases into several groups, so all the cases were mixed and analyzed the fundamental surgical index. We still had to collect more proper cases to prove the value of MDT pattern applied in robotic-assisted gynaecological surgeries.

Interpretation

Since Da Vinci Surgical System was imported into Chinese PLA General Hospital, the team leading by Prof. Meng has completed over 1,000 robotic-assisted gynaecological surgeries. As time went by, their surgical techniques have gradually been more mature. Owing to the balanced development of robotic-assisted surgery skills in most surgery departments, we have the opportunities to accomplish complicated gynaecological operations with other surgeons from general surgery department, urological surgery department and others from 2018 till now. Therefore, some difficult miscellaneous diseases (rare or recurrent diseases) could be solved by robotic-assisted MDT gynaecological surgeries.

Da Vinci Si Surgical System could provide clearer magnified views and the operative endo-wrists that hardly shake, so the intraoperative complications could be reduced to the great extent. Intraoperative complications occurred in approximately 10.26% of the robotic-assisted MDT gynaecological surgeries we studied. However, a German university hospital has focused on patient safety after 110 ordinary robotic-assisted gynaecological procedures, and discovered that no complications were recorded in 90 (81.8%) operations²³. The comparison of the two results implied the validity and safety of adding MDT pattern into robotic-assisted surgeries. Researchers from the First Affiliated Hospital of Zhengzhou University detected 16 patients (1.6%) undergone postoperative infection after robotic-assisted gynaecological surgeries²⁴. Banapour et.al collected 9858 patients undergone robotic surgeries in different departments and found that 4.8% of the patients appeared with wound infection while 5.7% emerged urinary tract infection²⁵. The results indicated that larger surgical areas caused by multidisciplinary cooperative surgery were often more prone to severe infection, so the early use of strong antibiotics was necessary for the patients receiving robotic-assisted MDT surgeries.

We found that 84.62% of the cases in the study have received at least one abdominal surgery. It is estimated that more than 90% of the patients who have undergone abdominal or pelvic surgeries would develop postoperative adhesions²⁶. Additionally, adhesions can cause increased complexity of subsequent intra-abdominal

operations. So, the MDT and robotic pattern applied in gynaecological procedures could be good for separating adhesions from different parts and making sure that operations went smoothly. It was indicated that the frequency of abdominal surgeries may be one of the predictors to adopt an MDT surgery. Potential indications of robotic-assisted MDT gynaecological surgeries were mentioned above. They could further guide the application of MDT pattern using in robotic-assisted surgeries.

If the patient really needed a robotic-assisted MDT gynaecological surgery, we recommended that a preoperative discussion meeting was necessary²⁷, and the MDT group could add more disciplines, such as pathology department, radiology department, ICU and others. A discussion checklist was also indispensable because it improved MDT ability to reach a decision from 82.2% to $92.7\%^{28}$.

The MDT pattern requires a high degree of cooperation and equal communication among team members. Therefore, its implementation was bound to promote the merge of various disciplines and improve our understanding of diseases. The MDT pattern was an evolution to precise and personalized treatment. It was believed to embody the ideal concept of patient-centered and holistic treatment.

Conclusion

In this retrospective and descriptive study, we pointed out that an MDT pattern using in gynaecological surgeries could be safe and precise, especially in severe gynaecological diseases such as recurrent tumors and deep infiltrating endometriosis. Therefore, the pattern could give some seriously ill patients the chances to achieve surgical treatments rather than only palliative treatments. The pattern was proved to demonstrate the concept of patient-centered and holistic treatment. Simultaneously, the MDT pattern could cultivate teamwork in various departments in the hospital.

Disclosure of interests

None declared.

Contribution to authorship

Y Meng, W Yang, J Xu and C Gu designed the study. Y Meng, W Fan and L Li performed the roboticassisted MDT gynaecological surgeries. Data collection was accomplished by N Zhang, M Ye and Z Li. C Gu, J Xu and X Jin finished statistical analysis. The manuscript was written by W Yang and J Xu, and was proofed by Y Meng, W Fan and L Li.

Details of ethics approval

The study was conducted in accordance with the principles of the Declaration of Helsinki. All the information was collected under the supervision of PLA General Hospital Ethics Committee. No privacy was leaked. Because of the retrospective and descriptive nature of the study, patient consent for inclusion was waived.

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Supporting Information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Figure S1. Scenes in robotic-assisted MDT gynaecological surgeries.

(A) Separation of adhesion between uterus and rectum. (B) Rectal anterior resection by proximate linear cutter and stapler for deep infiltrating endometriosis. (C) Resection of metastatic tumor of ovarian cancer on inferior vena cava. (D) Anastomosis of ureter after resection of endometriosis on ureter. (E) Partial liver resection for liver metastases of ovarian cancer. (F) Resection of liver metastasis in ovarian cancer.

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Figure legend

Figure 1. Puncture site location for different disciplines.

(A) Abdominal surgical area. (B) Actual puncture cannula position. (C) Theoretical gynaecological puncture site location (similar to lower urinary tract surgery puncture site location). (D) Theoretical general surgery puncture site location. (E) Theoretical hepatological surgery puncture site location. (F) All the potential puncture site location of different disciplines and probable area of gynaecological puncture site area.

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