**Medical
Research**

Analysis of Risk Factors for Subcutaneous Emphysema after Urology Department of Da Vinci Robotic Surgery and Risk Model Construction

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Abstract

This study aims to retrospectively analyze the incidence of postoperative subcutaneous emphysema in patients with Da Vinci robotic surgery, in order to clarify the influencing factors, and establish a risk prediction model, early prevention and early intervention treatment, so as to reduce the occurrence of subcutaneous emphysema and further development of harm to patients. By selecting 120 patients in our hospital and divided into control group and experimental group according to the requirements, the risk factors of subcutaneous emphysema were observed and analyzed. Finally, there were statistical differences in age, operation duration, repeated access into human tissue, and pneumoperitoneum pressure (P <0.05). Finally, by controlling the variable factors and effective postoperative care, reduce the occurrence of subcutaneous emphysema in urology robotic surgery.

Keywords: Urology; Da Vinci robotic surgery; subcutaneous emphysema

1.   INTRODUCTION

Progress in minimally invasive surgery at home and abroad Robot surgery system [1] is a set of medicine, robotics, mechanics, biomechanics, computer technology, and many other disciplines for the integration of cross research field, its birth to the surgeon provides another precise choice of minimally invasive surgery, relative to endoscopic surgery, its mechanical arm provides more natural dexterity and full range of fine operation, only through a small incision can provide beyond the limit of surgical accuracy and precision, can quickly and accurately complete anatomy and suture surgical operations such as [2]. Studies have shown that robot-assisted surgery is first applied to orthopedic surgery and neurosurgery [3]. The earliest report in the literature is the application of industrial robots as a surgical positioning

device for brain surgery [4] in 1985. In September 2001, Dr. Marescaux remotely operated the Zeus robotic surgical system in New York, USA, known as "Lindbergh" for patients in France, which is a landmark clinical application of the robotic surgical system [5].

The origin of the application of robotics in 1997. With the maturity and stability of the technology, some fields of Da Vinci technical surgery, such as cardiac surgery, general surgery and urology, have slowly kept up with the world's highest level. But da Vinci surgery as one of minimally invasive surgery, in addition to the advantages of medical technology, hemostasis, inevitably produce some complications, including clinical practice has proved that the complications of subcutaneous emphysema incidence is higher than laparoscopic surgery, this paper on the basis of the existing research, further explore the risk factors, for minimally invasive surgery into a new era, bring more Gospel for patients.

1.1   *Complications caused by minimally invasive surgical procedures- -subcutaneous emphysema*

Through reading a large number of literature, it can be seen that the occurrence of subcutaneous emphysema in previous minimally invasive surgery is typical. In 2000, Cynthia et al. 10 showed that the complication rate of subcutaneous emphysema in laparoscopic CO_2 was 2.3%, and that the operation time was more than 200 min, PET CO_2 greater than 50 mmHg, more incisions (6) and advanced age (65 years) were risk factors for this complication [6]. Domestic literature reported that the incidence of subcutaneous emphysema during pneumoperitoneum laparoscopic surgery was 2.7% [7]. Domestic studies by Zhou Cheng showed that the main risk factors for subcutaneous emphysema in laparoscopic surgery were body weight, subcutaneous fat thickness, surgical type, operation time and Trocar puncture, while the number of pneumoperitoneum needle puncture was eliminated [8] in multifactor analysis. According to the comprehensive domestic and foreign literature studies, the basic information of the patients, the puncture technique of the surgeon, the surgical complexity, the pulling out and replacement of repeated Trocar during the operation, and the operation habits of the doctors are the main causes of subcutaneous emphysema after laparoscopic surgery.

1.2   *Leonardo Da Vinci robotic minimally invasive surgery*

Da Vinci robot as a kind of minimally invasive surgery, the incidence of subcutaneous emphysema is higher, whether related to the laparoscopic factors, whether there are other factors, leading to the cause of higher incidence of subcutaneous emphysema, rarely reported at home and abroad, mostly designed to study Da Vinci robot as a new technology, in the new application and development of surgery, and no further study.

1.3   *Research purpose*

Da Vinci robot system should be used widely in urology surgery, and even some procedures have formed the fixed standard. After reviewing the literature, some studies have pointed out the incidence rate and risk factors of subcutaneous emphysema in minimally invasive laparoscopic surgery. In clinical practice, we found that the number of patients with subcutaneous emphysema after Da Vinci robotic surgery increased compared with other

minimally invasive procedures. Few studies at home and abroad have analyzed and compared the influencing factors of subcutaneous emphysema after Da Vinci robotic surgery. The purpose of this study is to retrospectively analyze the basic data of patients with Da Vinci robotic surgery and the incidence of postoperative subcutaneous emphysema, in order to clarify the influencing factors, and establish a risk prediction model, early prevention, early intervention treatment, so as to reduce the occurrence and further development of subcutaneous emphysema to bring harm to patients.

2.   RESULT

With the development of science and technology, network technology is also constantly applied in various medical fields, especially the application of minimally invasive technology in surgery in various departments. In the development of Da Vinci robot in urology surgery, some surgical methods have formed fixed standards, and studies show that the earlier laparoscopic complications are also reflected in the minimally invasive surgery of Da Vinci robot, and even some complications have higher rates. Most of the domestic and foreign studies of the development of Da Vinci surgery in various surgical fields, but ignore the other side of a large number of surgical operations. In this study, we investigated the risk factors for the occurrence of subcutaneous emphysema after urology surgery assisted by Da Vinci surgery, proposed preventive solution measures, established a risk prediction model for medical staff, guided the clinical work, and provided data support and evidence-based basis for the better clinical use of Da Vinci robot.

2.1   research contents

The study subjects selected robot-assisted urology patients from December 2021 to May 2023 in the urology department of a Grade A hospital in Shenzhen in strict accordance with the inclusion and exclusion criteria. The ASA was classified from grades I to II, with no severe cardiopulmonary disease, no neurological disease, no alcohol addiction, and no history of drug use. The patient has completed the preoperative blood, urine routine, electrocardiogram and other examinations. Patients with subcutaneous emphysema after surgery were selected as the study object, and patients with the same hospitalization period of the urology department, the same disease and no subcutaneous emphysema after urology surgery were randomly selected and included in the control group. Through electronic medical records, complete clinical data such as general patient data, subcutaneous emphysema related data, and preoperative laboratory examination were collected for retrospective analysis.

Inclusion criteria for the observation group: The patient was admitted to the Department of Urology of a Grade A hospital in Shenzhen, and underwent minimally invasive treatment assisted by Da Vinci robot after diagnosis, and met the following conditions:(1) The patient's basic information, general basic data, clinical history, pre-operation experimental examination indicators, relevant intraoperative data, postoperative diagnosis of subcutaneous emphysema data are complete and can be checked;2All kinds of surgeries have clear surgical indication and are performed with the assistance of Da Vinci robot. (3) The patient and their family members sign the informed consent form

Exclusion criteria for the observation group:(1) Patients with fatty liver and respiratory failure before surgery (2) intraoperative patients are transferred to open patients for various reasons (3) Patients with incomplete clinical data

Inclusion criteria for the clinical control group:The patient was admitted to the Department of Urology of a Grade A hospital in Shenzhen, and underwent minimally invasive treatment assisted by Da Vinci robot after diagnosis, and met the following conditions: The patient's basic information, general basic data, clinical history, pre-operation experimental examination indicators, relevant intraoperative data, postoperative diagnosis of subcutaneous emphysema data are complete, can be checked;1The patient and the family members signed the informed consent form (2) According to the ratio of 1:2 of the same disease and the same operation type.

Exclusion criteria for the clinical control group: (1) Patients whose patients turn to open during surgery (2) Patients with incomplete clinical data 4.2 Diagnostic criteria for postoperative subcutaneous emphysema With the chest and neck as the standard, by the same group of itinerant nurses and doctors to confirm, subcutaneous twist pronunciation can be issued

Retrospective analysis from December 2021 to May 2023 in Shenzhen a 3 armour hospital urology robot assisted urology after subcutaneous emphysema patients, and random in the urology stay the same time, the same disease, urology patients after no subcutaneous emphysema, its column according to 1:2. Relevant data were collected to explore the independent risk factors of subcutaneous emphysema after Da Vinci's operation, and the highly correlated factors were identified, so as to guide medical staff to prevent the occurrence of subcutaneous emphysema in the perioperative period and reduce the incidence of postoperative subcutaneous emphysema in patients. After statistical analysis, the prediction model can be constructed: Logit (P) =a * factor 1 + b * factor 2 + c * factor 3... + constant, and verify the effectiveness of the model. Finally, according to the prediction results of the risk model, the patients undergoing Da Vinci robot-assisted urology surgery underwent early perioperative prevention, early detection and timely treatment, so as to reduce the pain and danger caused by postoperative complications.

2.2   *Statistical method*

The data recording tool used a fixed computer in the operation room, and the relevant study data were recorded at EXCEl. Statistical analyses were performed using the IBM Corporation SPSS25.0 statistical software. For univariate analysis, if the normality, homogeneity of variance and independent test of measurement data are met, we used independent sample t-test to compare the statistical difference between two groups, and if the Mann-WhitneyU test of non-parametric test method is not met. The counting data were analyzed using the chi-square test or Fisher's exact test to compare the statistical differences between the two groups. Using multivariate Logsitic regression analysis, the factors statistically different between the two groups were analyzed, and the main results, OR value, significance test results (P-value), 95% confidence interval and parameter estimate, were obtained. Explore the independent risk factors affecting postoperative complicated subcutaneous emphysema and develop a prediction model. We used the Horsmer-Lemeisaw (Hosmer-Lemeshow) test

to draw the ROC curve, verify the sensitivity, and comprehensively evaluate the predictive value of the model, in order to expect more prone risk factors to guide clinical practice. Test level: a=0.05, P <0.05 was considered statistically significant.

Da Vinci assisted urology surgery, all by the same group of chief physician, one help, two help; The itinerant nurses and hand washing nurses cooperating with the operation are all centralized training. The training teachers are doctors and high qualified nurses who have been qualified for the Da Vinci robot training operation and obtained the certificate. Subcutaneous emphysema is judged by the circuit nurse and chief doctor to confirm the patient's chest, neck, can issue twist pronunciation. Data collection and collation were checked and entered by the doctor or nurse who performed the operation to ensure that the data and information were correct and to ensure the objectivity, authenticity and validity of the study.

3.   CONCLUSION

A total of 120 patients were included in this study. Our analysis of patient general data showed that there were statistical differences in age, operation duration, repeated puncture device into human tissue, size of robot special puncture device, and pneumoperitoneum pressure (P <0.05).

4.   DISCUSSION

When the patient is old, the subcutaneous tissue is loose, so the adipose tissue is weak. When CO_2 enters the human body, the resistance received is relatively small, so it is easy to cause subcutaneous emphysema. It can stick to the chest and wear elastic socks of the patient to remind the anesthesiologist in a reasonable range; observe the disappearance of subcutaneous emphysema of the patient at any time after surgery, and take appropriate nursing measures. The time of urinary robot surgery is generally determined by the complexity of the condition. Doctors, nurses and anesthesia groups cooperate to provide safe, effective and rapid surgery for patients, so as to reduce the increase in the incidence of subcutaneous emphysema. Urology robot surgery, due to the continuous replacement of instruments, lens and other reasons, resulting in the puncture device Frequent extraction and insertion, easy to damage to the abdominal wall tissue, leading to CO_2 into the subcutaneous tissue, causing subcutaneous emphysema. During the operation, the surgeon is recommended that the surgeon control the role of each robot arm, reduce frequent replacement of instruments, or pay attention to the fixation of the troer when replacing, and minimize friction to damage the abdominal wall tissue and cause CO_2 retention. Due to the difference between the puncture device used by the 4-generation robot and the ordinary laparoscopic surgery, its diameter is larger than the ordinary puncture device, which damages the abdominal wall incision. Therefore, the doctor should correctly grasp the size of the puncture incision to prevent the large incision and the gas from entering the subcutaneous tissue along the pipeline, resulting in subcutaneous emphysema. The pressure into the abdominal cavity is generally 12–15 mmHg. Because the length of the robotic arm is larger than that of general laparoscopic instruments, the space required is also larger than that of ordinary endoscopic surgery, and the main surgeon generally requires that the pneumoperitoneum pressure is greater

than the guiding value. Therefore, when performing urological surgery, doctors need to establish pneumoperitoneum in strict accordance with the clinical guidance value, from low to high, flow gradually increase, until the stable value, to prevent excessive pressure of pneumoperitoneum, resulting in a large number of $CO2$ into the pneumoperitoneum.

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