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An Innovative Application and Value of Modified Fluid Position Pads in 60° Lateral Recumbency Position for da Vinci Robotic Upper Urinary Tract Surgery

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Abstract: *Objective:* To explore the application of modified fluid position pads in da Vinci robotic urology lateral position surgery and analyze its clinical application value. *Methods:* A randomized controlled study was conducted from June 2024 to June 2025 to select 120 patients from the First Affiliated Hospital of Sun Yat-sen University who met the inclusion and exclusion criteria and were randomly divided into 60 cases each in the control group and the observation group. The control group used the traditional position placement method, and the observation group applied the modified fluid position pads for position placement. The two groups were compared in terms of positioning process, patient comfort, position stability, and satisfaction of surgeons. *Results:* The comfort level of the patients in the observation group was higher than that of the control group, and the positioning process could save time compared with the control group. The position stability rate in the observation group was significantly higher than that in the control group. The satisfaction of surgeons in the observation group was also higher than that in the control group. *Conclusion:* The application of the modified fluid position pads significantly simplifies the positioning process, improves the comfort and position stability of the patients, and enhances the satisfaction of the surgeons, which has important clinical promotion value.

Keywords: Modified fluid position pads; da Vinci robot; Upper urinary tract surgery; 60° lateral position; Clinical value of application

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1. Introduction

Da Vinci Robotic Surgery is an advanced minimally invasive surgical procedure performed by a robotic arm that is remotely controlled by the surgeon. The system consists of a high-definition 3D imaging system, a flexible robotic arm, and a main console, which can complete precise operations in a small space. The da Vinci robot, which has been widely used in urology upper urinary tract surgery [1], and its high-definition 3D field of view and image magnification feature can help the operator identify the kidney, renal pelvis, ureter, and other

complex anatomical structures more clearly [2]. Compared with traditional open or laparoscopic surgery, the robotic system effectively reduces the surgeon's hand tremor and improves the stability and consistency of the surgery, which is especially suitable for upper urinary tract reconstruction surgery that requires a high degree of surgical precision.

In da Vinci robotic urology upper urinary tract surgery, the 60° lateral position is a commonly used surgical position, which can provide a good view and operating space for surgical operations. However, the traditional position placement has problems such as cumbersome procedures and poor patient comfort, which not only increases the workload of healthcare professionals but also may affect the intraoperative safety of patients and surgical effect. The emergence of modified fluid position pads provides a new idea for solving these problems. A fluid pad is a postural aid made of polymer-coated special liquid material with good softness, fluidity, and pressure reduction. Its internal fluid can automatically distribute pressure according to the patient's body surface force, to achieve the effect of conforming to the body curve and uniform force. During da Vinci robotic surgery, the standardized application of intraoperative position management can effectively improve the surgical success rate of patients [3]. This study will deeply explore the innovative application and value of the modified fluid position pads in the 60° lateral position of da Vinci robotic urology upper urinary tract surgery.

2. Materials and methods

2.1. Sources of information

This study selected 120 patients who underwent da Vinci robotic urology upper urinary tract surgery and adopted a 60° lateral position in the First Affiliated Hospital of Sun Yat-sen University from June 2024 to June 2025. Inclusion criteria: (1) clinically diagnosed as needing da Vinci robotic urology upper urinary tract surgery; (2) no severe cardiopulmonary dysfunction and able to tolerate the 60° lateral position; (3) patients and doctors gave informed consent and voluntarily participated in this study. Exclusion criteria: (1) patients with language barriers, cognitive impairments, or other reasons for not being able to understand the study or cooperate in completing the study; (2) the existence of skin allergies, damage, and other conditions affecting the use of position; (3) those who were converted to open surgery midway or the surgery could not be completed successfully. Comparison of the two groups of patients in terms of age, gender, type of surgery, severity of the disease, and other general information, the difference was not statistically significant ($P > 0.05$), indicating comparability.

2.2. Methodology

The study was designed as a randomized controlled trial. 120 patients were randomly assigned to two groups, the observation group and the control group, with 60 patients in each group, using the random number table method.

2.2.1. Control group

The traditional body position method was used, see **Figure 1**. After the patient was successfully anesthetized, the healthcare professionals worked together to place the patient in a 60° lateral position. First, the front and rear top body position screws and hand support were installed on the operating bed, and ordinary body position pads were placed, including headrests, armpit pillows, and large pillows between the legs. After the patient was placed in a 60° lateral position, the front and rear top positions needed to be continuously adjusted to ensure that the patient's position met the surgical requirements, and then the patient was fixed with a restraint belt.

Figure 1. Control group

2.2.2. Observation group

The modified fluid position pads were used for body positioning, see **Figure 2**. The modified fluid position pads are primarily made of special fluid materials and have good plasticity and fit. After the patient was successfully anesthetized, the healthcare professionals placed the patient in a 60° lateral position. The circulating nurse rolled the modified fluid position pads to the patient's shoulder and back with a medium sheet. The position pads will automatically shape according to the patient's body contour and fit the patient's skin completely. The patient's position needs to be fine-tuned, and a restraint belt is used for auxiliary fixation.

Figure 2. Observation group

2.3. Observation indicators

This study observed the clinical application value of the modified fluid position pads in da Vinci robotic urological surgery from the following four aspects.

2.3.1. Positioning time

The time taken from the beginning of positioning until the position was completely fixed and met the surgical requirements was recorded.

2.3.2. Patient comfort

Using visual analogue scale (VAS), patients were asked to rate the comfort of the intraoperative position while they were awake at the end of the procedure, with a score of 0 indicating complete comfort and 10 indicating extreme discomfort.

2.3.3. Body position stability

Intraoperative body position stability was evaluated by the surgeon at the end of the procedure and was graded as stable, basically stable, or unstable. Stable means that the patient's body position does not move significantly during the operation, which does not affect the operation; basically stable means that the patient's body position moves slightly during the operation, but it does not affect the operation after simple adjustment; unstable means that the patient's body position moves significantly, which has a great impact on the operation and requires multiple adjustments. Stability rate = (number of stable cases + number of basically stable cases) / total number of cases × 100%.

2.3.4. Satisfaction of surgeons

The application of the modified fluid position pads was evaluated by the surgeon at the end of the procedure and was graded as very satisfactory, satisfactory, and unsatisfactory. Satisfaction = (number of very satisfied cases + number of satisfied cases) / total number of cases × 100%.

2.4. Statistical methods

SPSS 22.0 statistical software was used for data analysis. The measurement data were expressed as mean ± standard deviation (SD), and the independent sample *t*-test was used for inter-group comparison; the count data were expressed as rate (%), and the χ^2 test was used for comparison between groups. $P < 0.05$ indicated that the difference was statistically significant.

3. Results

3.1. Positioning time

The body positioning time in the observation group was significantly shorter than that in the control group, and the difference between the two groups was statistically significant ($t = -21.345$, $P < 0.001$), as shown in **Table 1**.

Table 1. Time of positioning of patients in both groups

Groups	Positioning time
Observation group ($n = 60$)	12.3 ± 2.5 min
Control group ($n = 60$)	25.6 ± 4.2 min

3.2. Patient comfort

The comfort scores of the observation group were significantly lower than those of the control group, and the difference between the two groups was statistically significant ($t = -16.543$, $P < 0.001$), as shown in **Table 2**.

Table 2. Comfort scores of patients in the two groups

Groups	Patient comfort scores
Observation group (n = 60)	2.1 ± 0.8
Control group (n = 60)	5.6 ± 1.5

3.3. Postural stability

In the observation group, 48 patients had stable body position, 10 were basically stable, and 2 were unstable; in the control group, 32 patients had stable body position, 18 were basically stable, and 10 were unstable. The body position stability rate in the observation group was significantly higher than that in the control group, and the difference between the two groups was statistically significant (χ^2 = 5.926, P = 0.015), as shown in **Table 3**.

Table 3. Body position stability of patients in the two groups

Groups	Body position stability rate
Observation group (n = 60)	96.7% (58/60)
Control group (n = 60)	83.3% (50/60)

3.4. Satisfaction of surgeons

Scores of the observation group were 38 very satisfactory cases, 19 satisfactory cases, and 3 unsatisfactory cases, while scores of the control group were 25 very satisfactory cases, 22 satisfactory cases, and 13 unsatisfactory cases. The satisfaction rate of the observation group was significantly higher than that of the control group, and the difference between the two groups was statistically significant (χ^2 = 7.912, P = 0.005), as shown in **Table 4**.

Table 4. Satisfaction scores of surgeons in the two groups

Groups	Satisfaction of surgeons
Observation group (n = 60)	95.0% (57/60)
Control group (n = 60)	78.3% (47/60)

4. Discussion

This study conducted a detailed clinical trial to explore the practical clinical application of the modified fluid position pads. The results of the study are discussed in detail below.

4.1. Effect of modified fluid position pads on the position placement process

Traditional position placement methods require the use of a variety of different types of position pads and fixed frames. In the process of placement, healthcare professionals need to constantly adjust the position of the frame and the tightness of the restraint belt according to the patient's body shape, surgical requirements, etc. The operation steps are cumbersome and time-consuming. However, the modified fluid positioning pads have a unique automatic shaping feature that can quickly fit the patient's body contour. Only simple fine-tuning is required to complete the positioning, greatly reducing the operation steps and time required. This not only improves the efficiency of surgical preparation but also reduces the workload of healthcare professionals,

making the surgical process smoother.

4.2. Effect of modified fluid position pads on patient comfort

During surgery, patients maintain a fixed position for an extended period, and traditional position pads often fail to fully accommodate the patient's body, leading to local skin pressure and poor blood circulation, which can cause discomfort to the patient. The modified fluid position pads provide a snug fit for the patient's skin, evenly distributing body pressure and reducing local skin pressure, thereby effectively improving blood circulation [4]. At the same time, its soft material also provides patients with more comfortable support, reduces the patient's intraoperative discomfort during surgery, and improves the patient's comfort, which is also of positive significance for the patient's postoperative recovery.

4.3. Effect of modified fluid position pads on position stability

The da Vinci robotic urology upper urinary tract surgery is delicate and requires a high level of patient position stability [5]. During the traditional positioning method, the patient's position is prone to movement due to the poor fit of the positioning pads to the patient's body. The modified fluid position pads can provide stable support for the patient and reduce the patient's movement during the surgical procedure. Even if the patient is subjected to a certain external force during the operation, the modified fluid position pads can maintain the patient's position through their good elasticity and shaping ability, providing a reliable guarantee for the smooth progress of the operation [6].

4.4. Effect of modified fluid position pads on the satisfaction of surgeons

For surgeons, the simplified placement process of the modified fluid position pads reduces their workload, improves work efficiency, and saves time for surgical preparation. During the operation, the stable patient position also makes the operation smoother and reduces surgical interference caused by position problems [7]. All of these advantages have significantly improved the satisfaction of surgeons with the modified fluid position pads.

5. Conclusion

The application of modified fluid position pads in 60° lateral positioning for da Vinci robotic urology upper urinary tract surgery has shown clear advantages in clinical practice. Compared with traditional positioning methods, the modified fluid pads simplify the positioning process by reducing the need for repeated manual adjustments and reliance on multiple positioning accessories such as foam pads, shoulder supports, or bulky restraint systems, these pads significantly improve patient comfort, reduce positioning time, enhance body position stability, and increase surgeon satisfaction. Their ability to automatically conform to the patient's body contour, distribute pressure evenly, and provide secure support reduces the risk of pressure injuries and discomfort, making them a safer and more efficient option during lengthy and complex robotic procedures.

Despite these evident advantages, the widespread implementation of modified fluid position pads in clinical practice faces several challenges. First, the cost of the pads remains a significant barrier, especially in resource-limited settings. The materials used in their construction—such as medical-grade polymer encased fluid—are relatively expensive, and the manufacturing process is more complex compared to standard foam or gel pads. While some designs may support limited reuse with proper cleaning protocols, most are intended for

single-use, raising concerns about cost-effectiveness and environmental sustainability.

Second, the lack of standardized clinical guidelines or manufacturer-specific protocols for the use of fluid pads across different surgical specialties may hinder their broader adoption. Clinical teams may be unfamiliar with the optimal placement techniques, pressure distribution considerations, or necessary adjuncts such as restraints or supports for different surgical positions [8]. This underscores the need for structured training and education for nursing staff and surgical assistants to ensure safe and consistent use [9].

Third, the adaptability of modified fluid pads to a wide range of patient anatomies—such as obese individuals, patients with skeletal deformities, or those requiring extreme positioning—may be limited. In such cases, fluid pads may not provide adequate support or stability on their own and may need to be used in conjunction with other positioning tools, potentially offsetting the simplicity and efficiency gains they offer.

Furthermore, logistical issues such as inventory management, storage, sterilization protocols (if reusable), and integration into existing operating room workflows also present real-world barriers to routine use. Hospitals would need to assess the feasibility of transitioning from current equipment to fluid-based systems in terms of procurement, training, and overall return on investment [10].

In summary, modified fluid position pads offer a promising advancement in surgical patient positioning, particularly in complex and delicate procedures such as da Vinci robotic-assisted upper urinary tract surgeries. They improve patient comfort, reduce setup time, enhance position stability, and increase surgeon satisfaction. However, to facilitate their widespread clinical adoption, efforts must be made to address current limitations, including high costs, limited reusability, training demands, and the lack of universal application protocols. Future research should focus on multi-center validation, cost-benefit analysis, and the development of standardized usage guidelines. With ongoing innovation and optimization, modified fluid position pads have the potential to become a valuable tool in the modernization of perioperative care and robotic surgery support systems.

Disclosure statement

The authors declare no conflict of interest.

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