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Complications of open versus laparoscopic renal surgery among adult patients with primary pelvi-ureteric junction obstruction: What to expect?

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Abstract
Ureteropelvic junction obstruction (UPJO) is a widely acknowledged medical condition that causes a blockage in the flow of urine from the renal pelvis to the ureter. If not identified and treated correctly, it can lead to the total loss of the affected kidney. Open pyeloplasty has been widely accepted as the most effective method for repairing Ureteropelvic Junction Obstruction (UPJO) since the first successful reconstruction of an obstructed UPJO was achieved. It consistently achieves success rates of over 90%. Laparoscopic dismembered pyeloplasty is a less invasive option to the traditional open Anderson-Hynes technique, which has a similar rate of success but without the associated complications. Laparoscopic pyeloplasty has resulted in a decrease in the morbidity rate compared to open pyeloplasty, as evidenced by shorter hospital stays and reduced reliance on narcotics. Thus, the combination of versatility and certainty establishes laparoscopic pyeloplasty as the superior method of treatment.

Keywords: Open pyeloplasty, laparoscopic dismembered pyeloplasty, pelvi-ureteric junction obstruction

Introduction
Ureteropelvic junction obstruction (UPJO) can be caused by either congenital or acquired factors, with congenital being the more common of the two. A male-to-female ratio of up to 2:1 indicates that UPJO is more prevalent in males than it is in females. Two times as many cases of the condition are reported on the left side as on the right side. It accounts for approximately 80% of all cases of hydronephrosis detected before birth [1]. The estimated incidence of UPJO is approximately 1 in 1000 to 1500. The efficacy of non-operative management for UPJO in adults remains largely unexplored, with a surprising scarcity of clinical trials investigating conservative treatment options [2, 3]. General anesthesia is necessary for laparoscopic renal surgery. The patient's pulmonary and cardiac function must be able to withstand this method; the presence of pneumo-peritoneum can potentially hinder breathing and impede venous blood flow [4].

UPJO has traditionally been treated with open pyeloplasty, which is considered to be the established method. Dismembered repair, which Anderson and Hynes popularized in the middle of the 20th century, is the method that has gained the most widespread acceptance over the course of its history. This procedure can be utilized in a variety of situations involving UPJO, including obstructions that are accompanied by significant reductions in renal function and renal calculi. The procedure involves the total elimination of the abnormal ureteropelvic junction and can be utilized in any situation across the board [5].

UPJO has been the subject of debate for more than a century, and researchers have investigated the effectiveness of various procedures in order to determine the most effective treatment for the condition. In addition to open pyeloplasty, the management strategies for UPJO have evolved over the past two decades to include a variety of procedures. These procedures include endopyelotomy, balloon dilatation, and laparoscopic pyeloplasty. There are also other procedures that have been included. As a result of developments in technology, laparoscopic procedures have gained a growing amount of popularity in the field of urology.

The transperitoneal or retroperitoneal approach is one of the two methods that can be utilized to carry out these techniques. However, it has been observed that procedures such as anterograde and retrograde endopyelotomies have shown poorer outcomes and a higher risk of bleeding when compared to laparoscopic procedures. This is the case because Laparoscopic procedures are more invasive [6].

Laparoscopic dismembered pyeloplasty

Schuessler et al. [7] first Laparoscopic pyeloplasty (LP) is a highly reliable and effective procedure performed by skilled laparoscopic surgeons. It has been proven to be a safe technique with a success rate ranging from 93% to 100%, which is comparable to the outcomes of open pyeloplasty. Previous studies have shown that Laparoscopic Pyeloplasty (LP) has resulted in a lower morbidity rate compared to open pyeloplasty. This includes shorter hospital stays and reduced use of narcotic medications.

Complications of laparoscopic renal surgery

Risk Factors

1. Individuals who have previously undergone abdominal or pelvic surgery, experience significant swelling of the intestines, have large masses in the abdomen or pelvis, and/or have hernias in the diaphragm.
2. Patients with poor cardiopulmonary reserve [8].

Complications

Complications from laparoscopic surgery are associated with abdominal access and trocar placement, insufflation, tissue dissection, hemostasis, and patient positioning. The rate of serious complications is low, and severe complications with significant morbidity and mortality are generally related to vascular injury and bowel perforation. About half of serious complications happen at the time of abdominal access, though these occur in less than 1% of cases. The most common cause of death related to laparoscopic surgery is a complication from anesthesia, followed by vascular injury and then bowel perforation [9].

While previous surgery does not prevent laparoscopic renal surgery, it does require careful attention due to the presence of intra-abdominal adhesions and the higher risk of bowel injury during insufflation, trocar placement, or dissection. Timely identification and suitable intervention can frequently mitigate the adverse outcomes of complications [10].

Problems with Insufflation

1. **Subcutaneous Emphysema**
   Subcutaneous emphysema is generally harmless and resolves spontaneously, though can cause alarm if it is present in the torso, neck, and face [11].
2. **Pneumothorax**
   Pneumothorax can occur due to diaphragm defects or as a result of barotrauma caused by excessive positive-pressure ventilation. Typically, it can be managed conservatively, but in some cases, needle aspiration or chest tube insertion may be necessary [12].
3. **Pneumo-mediastinum / Pneumo-pericardium**
   Pneumomediastinum/pneumopericardium can be indicated by the presence of subcutaneous emphysema or pneumothorax [13].
4. **Gas Embolus**
   Gas embolization has been documented to occur during laparoscopy, leading to cardiovascular collapse and pulmonary edema [14].
5. **Hypercarbia**
   Hypercarbia commonly leads to the occurrence of cardiac arrhythmia. [15].

Vascular Complications

Vascular injuries are the predominant complication observed in urologic laparoscopic surgery. The occurrence of major vascular injuries during laparoscopic surgery is infrequent, with an incidence rate of less than 1 in 1000 [16].

If an arterial injury is detected, sufficient control of bleeding can be accomplished through the application of clips, sutures, cautery, or vascular techniques. By employing this approach, laparoscopic suturing or transitioning to open surgery can be executed with precise control. [17].

It is important to check the abdominal cavity for bleeding after surgery. Lowering the intraperitoneal insufflation pressures can reveal hidden venous bleeding [18].

Urinary Complications

Urinary incontinence is a possible complication of renal surgery that involves damage to the pelvicalyceal system [19].

Visceral and Bowel Complications

An important and serious complication of laparoscopic surgery is the occurrence of bowel injury that goes unnoticed, resulting in a mortality rate of approximately 3%. The prevalence of bowel injury in the urologic literature ranges from 0.1% to 0.8%. Bowel injuries have the potential to occur at any stage of the procedure, with access being affected in 32% of cases.

Using thermal energy near the bowel is the main reason why injuries often go unnoticed, accounting for almost half of all cases [20].

The incidence of splenic and pancreatic injury during laparoscopic left renal surgery varies from 0 to 0.5%. Splenic injuries are most commonly caused by vigorous traction on splenic ligaments [21-23].

Dehiscence

Risk factors associated with dehiscence include older age, male gender, ascites, chronic pulmonary disease, postoperative coughing, anemia, emergency surgery, surgery type, wound infection, malignancy, obesity, poor nutrition, sepsis, chronic steroid use, and longer incisions [24].

Open pyeloplasty

When it comes to treating UPJO, open pyeloplasty has traditionally been considered to be the primary method of treatment. Dismembered repair, which Anderson and Hynes popularized in the middle of the 20th century, is the method that has gained the most widespread acceptance over the course of its history. Additionally, this procedure has the potential to be utilized on a global scale for a variety of cases of UPJO, which involve obstruction that is made worse by renal function loss and renal calculi. In this procedure, the abnormal ureteropelvic junction is completely removed from the digestive tract (Figure 1) [5].

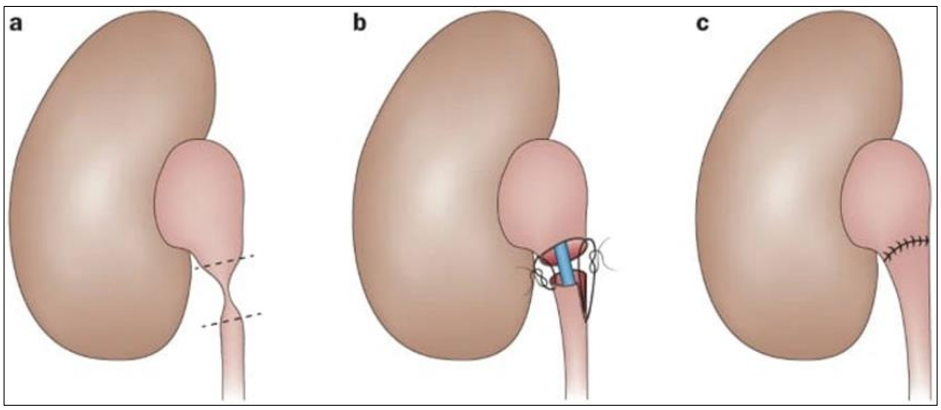

Fig 1: a | Stitches are positioned on the renal pelvis above the area of obstruction and on the side of the proximal ureter below the level of the obstruction. b | The tissue at the ureteropelvic junction is removed and a connection is made using small absorbable sutures, either in an interrupted or continuous manner. c | The sutures are placed securely over an internal ureteral stent to ensure it remains in place and prevents any leakage [5].

In cases of congenital UPJO caused by high insertion of the ureter, a non-dismembered Y-V Foley pyeloplasty may be employed. However, the use of this procedure is restricted to specific situations, such as when there is a proximal ureteral stricture, lower pole vessels that need to be repositioned, or when there is a need to reduce the size of a dilated renal pelvis (Figure 2) [5].

Spiral CulpDeWeerd flap and vertical (Scardino–Prince) flap pyeloplasties are suggested for cases where there is a large, excessive extrarenal pelvis or a long, narrow proximal ureter, respectively. The main reasons for using spiral flap repair are a widened extrarenal pelvis and a prolonged obstruction of the proximal ureter (Figure 3).

Vertical flap repairs are primarily of historical significance and are used in cases where there is a blockage with a ureteropelvic junction located on the inner edge of a pelvis outside the kidney. The vertical flap repair technique lacks the same level of length and adaptability as the spiral flap technique (Figure 4) [25].

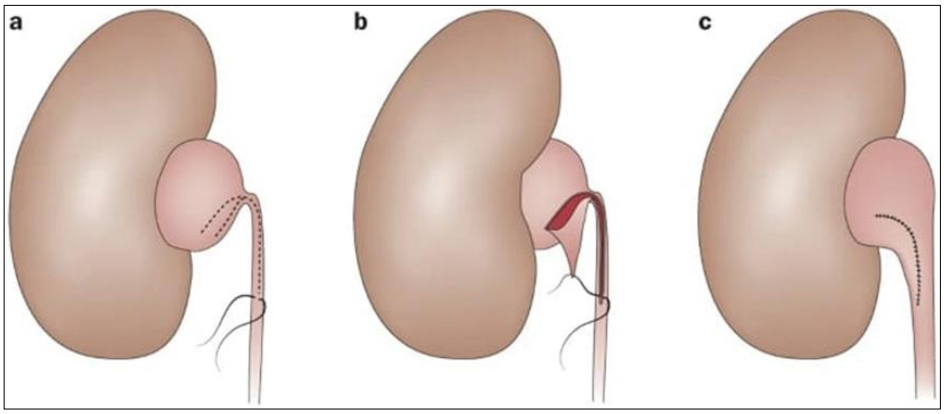

Fig 2: a | A stitch is used to exert traction on the ureter while a Y-shaped cut is made in both the renal pelvis and the ureter. b | A V-shaped incision is made in the tissue at the ureteropelvic junction. c | The V-shaped flap is stitched to the highest point of the ureteral incision using small interrupted or continuous absorbable sutures [26]

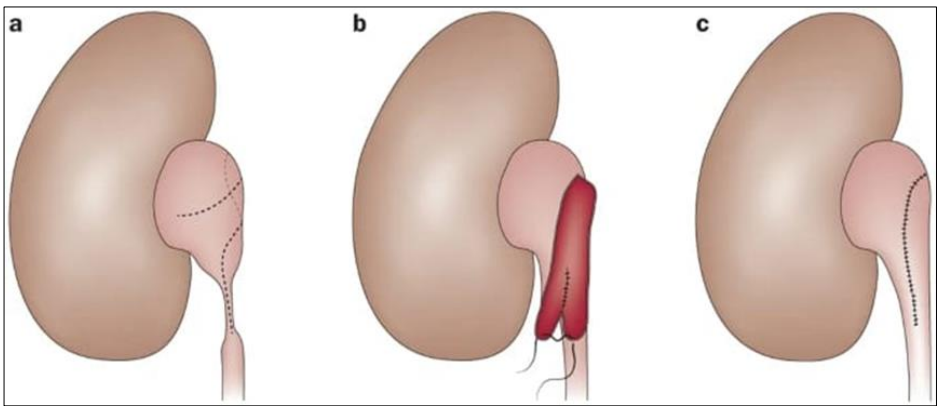

Fig 3: a | A spiral cut is created in the enlarged renal pelvis and extended an equal distance into the ureter. b | The tissue flap is folded over and sutured to the neighboring ureter. The flap is secured using either interrupted or continuous absorbable sutures [26]

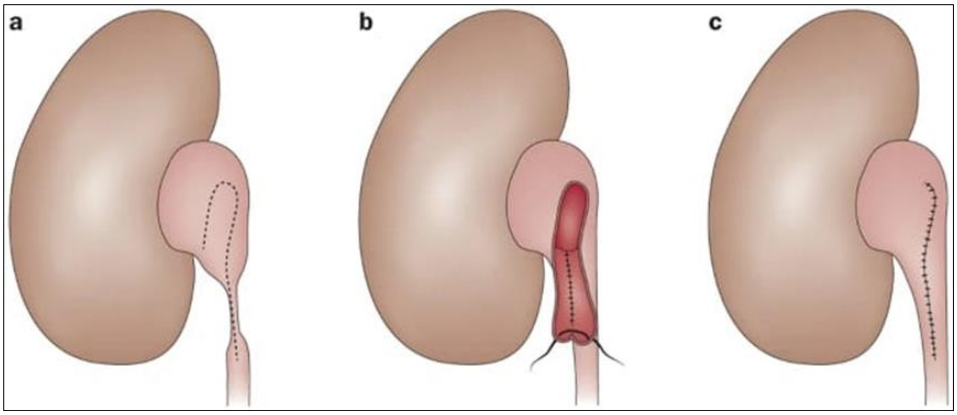

Fig 4: a | A vertical cut is created in the renal pelvis and ureter. b | The vertical fold of tissue at the junction between the ureter and the pelvis is folded downwards and stitched to the ureter. The renal pelvis is sealed using either fine interrupted or continuous absorbable sutures [26]

Complications

Noted complications consist of the reappearance of strictures, loss of blood supply, leakage of urine, formation of abnormal connections (fistulas), and ongoing obstructions [27]. The prevalence of persistent obstruction or anastomotic stricture is reported to range from 2 to 6% [28, 29].

Another serious complication is the formation of urinoma caused by an ongoing leakage at the location where the ureter is surgically connected. Urine leaks result in a strong inflammatory response, which significantly raises the likelihood of the repair breaking down or developing fibrosis [29].

In addition, this procedure is linked to a substantial flank incision, which inevitably leads to prolonged pain, recovery, and unsatisfactory cosmetic outcomes. Minimally invasive procedures have the potential to overcome these drawbacks [30].

Lee et al. assessed long-term complications such as deteriorating renal function, hypertension, and proteinuria. The authors suggested assessing for indications of functional renal impairment annually for a decade after the surgery, followed by evaluations every five years until reaching the age of 20 [31].

The investigation of long-term complications in relation to the specific type of surgical repair has not been conducted.

Outcomes

As of now, no comparative studies have been conducted to assess the different techniques used in open pyeloplasty and their respective outcomes. A comprehensive study involving a significant number of cases of retroperitoneal Anderson-Hynes dismembered repair demonstrates a notably high success rate ranging from 80% to 98%. Gogus et al. conducted a study on the Anderson-Hynes pyeloplasty procedure in 180 adult patients, with a follow-up period of 10 years. This study is the largest of its kind. The overall success rate was 91.1%, and it was found that patients with grade IV hydronephrosis had a success rate of 62.5%, indicating an inverse relationship between the degree of hydronephrosis and the success rate.

A study involving 24 patients who underwent the Anderson-Hynes pyeloplasty procedure was conducted. The patients were followed up for an average of 10.6 years. The study found that there was a significant improvement of 96% in drainage and a 79% improvement in renal function after the surgery [32].

The high level of visibility of the ureteropelvic junction during open pyeloplasty, which allows for precise repair using well-known anatomical structures, is a key factor in the procedure's high success rate.

Conclusion

Ureteropelvic junction obstruction (UPJO) primarily affects males more than females, with congenital factors being the most common cause. Despite the effectiveness of traditional open pyeloplasty, advancements in laparoscopic techniques offer promising alternatives with comparable success rates and lower morbidity. Complications from laparoscopic surgery, such as vascular injuries and bowel perforations, though rare, require careful management. Minimally invasive procedures are gaining popularity due to shorter recovery times and better cosmetic outcomes. However, open pyeloplasty remains a reliable option, especially for complex cases. Continued research and clinical trials are necessary to explore non-operative management and further improve surgical outcomes for UPJO.

Conflict of Interest

Not available

Financial Support

Not available

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