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Megaureter-Advanced Techniques for Surgical Management: An Updated Review Article.

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Abstract:

Background: Megaureter, characterized by the dilation of the ureter often exceeding 7-8 mm, is a common condition diagnosed in pediatric patients, typically through ultrasound imaging. Identifying the underlying cause of megaureter is crucial to determine whether conservative management or surgical intervention is needed. King's classification is a key tool for categorizing megaureters based on the presence of obstruction and vesicoureteral reflux (VUR). Surgical strategies aim to restore normal ureteral function by addressing obstruction or reflux. The rise of minimally invasive techniques, such as endoscopic balloon dilation (EBD) and laparoscopic ureteroneocystostomy (UNC), reflects the evolving trends in pediatric urology.

Aim: This article reviews the current advances in surgical management techniques for megaureter, focusing on the evolution of surgical interventions, particularly minimally invasive methods.

Methods: The review synthesizes various studies and clinical approaches, evaluating traditional and contemporary surgical interventions, including open ureteral reimplantation (UNC), endoscopic balloon dilation (EBD), and robotic-assisted techniques. Diagnostic criteria such as voiding cystourethrogram (VCUG), diuretic renograms (DR), and ultrasonography are also discussed.

Results: Minimally invasive procedures like EBD have gained popularity due to their non-invasive nature and high success rates, ranging from 60-100%. The article highlights the challenges of these procedures, such as the risk of introducing VUR, but also emphasizes their potential to replace traditional open

surgeries. The review presents the advantages of EBD, such as reduced morbidity, shorter recovery times, and fewer complications compared to open reimplantation.

Conclusion: Advances in the surgical management of megaureter, especially with minimally invasive techniques, provide significant benefits, including improved outcomes, reduced complication rates, and faster recovery times. Despite the promising results of endoscopic procedures, further prospective studies are required to refine surgical indications and outcomes across diverse patient populations.

Key Words: Megaureter, Ureteral Reimplantation, Endoscopic Balloon Dilation, Pediatric Urology, Minimally Invasive Surgery, Vesicoureteral Reflux, Ureteroneocystostomy.

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Introduction:

The most common method of detecting megaureter in pediatric patients is ultrasound imaging. Megaureter is defined by the expansion of the ureter, which usually exceeds 7 or 8 mm in diameter [1, 2, 3]. It is crucial to remember that megaureter is an imaging finding, and that figuring out the underlying cause is crucial to choose the best course of action, be it medicine or surgical. A well-established paradigm for classifying megaureters is provided by King's classification, which uses a two-by-two grid that takes blockage and vesicoureteral reflux (VUR) into account [4]. Primary obstructed (non-refluxing) megaureter (POM) and refluxing (non-obstructed) megaureter (dilating VUR) are the main categories that arise from this classification, along with less prevalent subtypes such obstructed refluxing megaureter (ORM) and non-obstructive non-refluxing megaureter. Although close surveillance and no surgery are typically required for the management of megaureters, both the choice to have surgery and the methods used to do so have changed over time. The goal of surgical care for megaureters is to maintain normal ureteral shape and function by either removing obstruction or treating reflux. In order to enable antegrade urine flow, which permits efficient peristalsis through opposing wall coaptation, it is necessary to maintain a sufficient ureteral diameter [5]. In order to prevent reflux, an intramural submucosal tunnel that functions as an effective valve mechanism is created [6], and an adequately shaped ureteral orifice is also created [7, 8]. With the increasing use of endoscopic, laparoscopic, and robotic techniques to treat megaureters, such as endoscopic balloon dilation and laparoscopic/robotic ureteroneocystostomy (UNC), which has historically been a very successful open surgical procedure, advancements in pediatric urology reflect a trend towards minimally invasive approaches.

Understanding the progress of megaureter management in the literature requires knowing the type of megaureter and defining the criteria for surgical intervention, both of which are crucial aspects of clinical practice. The voiding cystourethrogram (VCUG) is usually the first step in the routine evaluation procedure for megaureters. It is strongly advised that an obstructive process be present when reflux is absent, especially if ultrasound results show significant ureteral dilatation, tortuosity, and/or intraluminal debris. Since blockage is typically linked to higher morbidity than reflux and may necessitate surgical intervention, such as excising the obstructive segment during reimplantation, the main objective of this evaluation is to identify whether an obstruction is present. Before starting treatment for a primary megaureter, it is crucial to rule out secondary megaureters, such as those brought on by neurogenic bladder or posterior urethral valves, which can be done with the aid of VCUG and ultrasonography. The next diagnostic procedure performed to check for obstruction is usually a diuretic renogram (DR), which offers information on renal function and the efficacy of ureteral washout. The management strategy for POM is often conservative, even when blockage is established. In most cases (around 72%), observation is the best course of action because many cases will resolve or improve on their own over time [9, 10]. A progressive improvement in dilatation from the proximal to the distal ureters is typically indicative of megaureter resolution [11]. Higher grades of hydronephrosis and larger ureteral diameters are factors that predict a decreased likelihood of resolution [12], with some studies suggesting that ureteral diameters greater than 13 mm and SFU hydronephrosis grades 3–4 are major markers for surgery [13]. In a more recent prospective research with 50 ureters, the cutoff diameter was set at 10 mm. Over a median of 9 years, the resolution rate for cases with diameters

under 10 mm was 76%, whereas the resolution rate for those with diameters of 10 mm or above was just 17% [14].

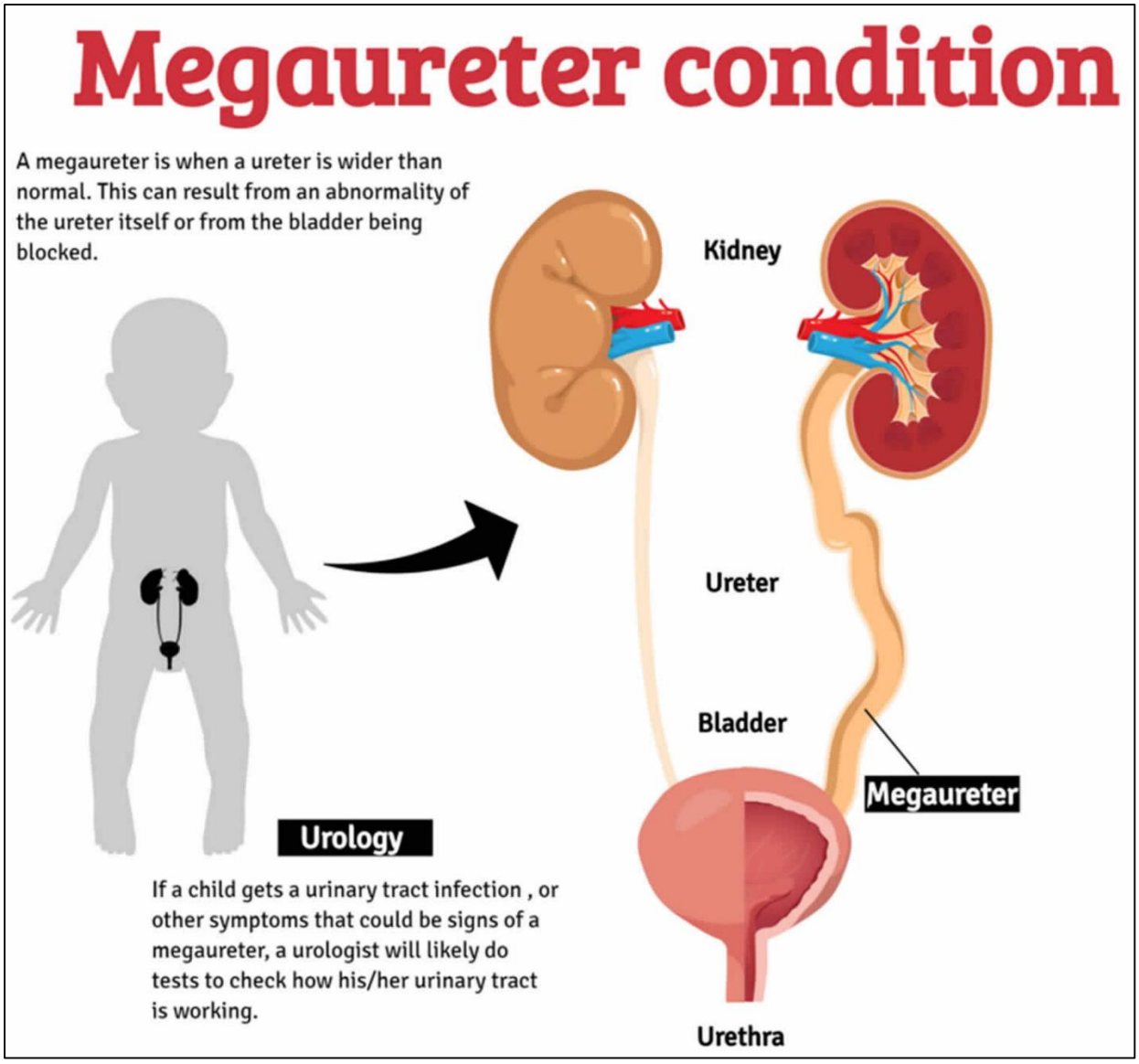

Figure 1: Megaureter.

POM studies commonly use the 2014 consensus recommendations of the British Association of Pediatric Urologists to determine surgical indications, emphasizing clinical considerations such discomfort, nephrolithiasis, urinary tract infections (UTIs), and progressive dilatation seen on ultrasound. To inform surgical choices, the recommendations, however, give greater weight to DR findings. In particular, in an asymptomatic patient with stable or improving dilatation, a prolonged T ½ (more than 20 minutes) or delayed washout curve is insufficient to justify surgery. Instead, a considerable loss of renal function is suggested by surgery if the initial differential renal function (DRF) is less than 40% or if repeated scans show a DRF decline of 5% or more. Since research on ureteropelvic and ureterovesical junction blockage has shown that kidneys with delayed washout can sustain normal growth, function, and even resolve their dilatation over time, delayed washout should not be regarded as the only surgical trigger. Furthermore, renography has minimal diagnostic relevance since megaureter washout curves are inherently inaccurate due to the presence of a dilated and frequently convoluted ureter. The operation is also linked to expenses, radiation exposure, and the requirement for bladder catheterization and IV access. As a result, some

physicians choose to base their surgical decisions more on the clinical criteria listed above as well as serial ultrasound observations demonstrating significant increases in ureteral and pyelocaliceal dilatation.

Because diverse surgical indication criteria might induce heterogeneity in result comparisons, this technique is especially pertinent when assessing surgical outcomes across multiple studies. Focus will switch to primary obstructive megaureters in the next section, with a particular emphasis on the significance of ruling out obstruction before treating reflux in megaureter therapy. This brings up an important concern regarding obstructed refluxing megaureter (ORM), a disease that is frequently disregarded in clinical settings. The likelihood of blockage is not always eliminated when vesicoureteral reflux (VUR) is present in a VCUG. A normal or narrow caliber ureter at its distal 1–2 cm, along with significant proximal ureterectasis, initial diluted contrast filling in the dilated ureter, or poor contrast drainage from the ureter into the bladder during late imaging are indicators that point to both an obstructive and refluxing component [17]. The idea of ORM is mostly explained in situations after endoscopic injections of dextranomer/hyaluronic acid for VUR [18,19,20]. Given that an obstructive component has been found in a significant number of patients in recent years, this should act as a reminder to doctors thinking about endoscopic treatment of high-grade VUR to first determine whether it may be present [21].

The Evolution of Surgical Approaches for Primary Obstructive Megaureter (POM)

In the past, ureteral reimplantation (UNC), frequently combined with ureteral tapering, has been the gold standard for surgical intervention in POM. A cutaneous ureterostomy is made as a stopgap measure until the patient is older and reimplantation is possible in situations involving infants, where reimplantation of a dilated ureter into a small bladder poses significant challenges, or where immediate temporary drainage is necessary in the presence of an active infection. Notably, if a lengthy duration of ureterostomy drainage permits the progressive shrinkage of the megaureter, tapering is frequently not required. Alternative approaches have developed over time with the goal of achieving the same or better results as classic UNC while reducing the need for recurrent open operations or tapering procedures. One such strategy is the use of ureteral stents for internal drainage, which can act as a bridge until the patient reaches an age where reimplantation is easier or as a window for the megaureter to resolve spontaneously. According to research conducted in the early 2000s, ureteral stents for POM were fairly effective; after three to six months of stenting, about 50% of patients avoided further procedures. However, there were several drawbacks to this strategy, including the requirement for many newborns to have their stents placed openly and a higher risk of UTIs, stone formation, and stent migration [22,23,24]. While 40% of patients encountered difficulties during the stenting phase, including UTIs, hematuria, stones, and stent migration, 25% of patients did not require additional surgery, according to a more recent study that included 29 patients and had a longer follow-up duration of 6 years [25].
Another approach, made popular by Kaefer, was exchanging blockage for reflux by using a dismembered refluxing reimplant. Instead of diverting the pee externally by a ureterostomy, this technique acts as a temporary internal diversion. After a year, 18 of the 19 ureters treated in this manner underwent definitive surgery, with two receiving nephrectomy and the remaining 16 requiring reimplantation, 13 of which still required ureteral tapering, according to a study [26,27]. A non-dismembered side-to-side refluxing reimplant is an advancement of this procedure that has been suggested as a possible last resort, especially for circumcised boys who did not experience UTIs throughout the follow-up period [28].

Because endoscopic balloon dilatation (EBD) is a minimally invasive endoscopic treatment that frequently resolves the obstruction without causing new vesicoureteral reflux (VUR), it has become increasingly popular in recent decades for treating POM. In order to widen the distal ureter and ureterovesical junction, a high-pressure balloon is inflated under cystoscopic and fluoroscopic guidance [29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47]. Stenoses can be treated with additional instruments like a cutting balloon or laser if the obstruction is not amenable to dilatation alone [31, 37, 46, 48, 49, 50]. The technique was first described in Spain in 1998 [29] and has since spread over the world, with a limited number of research from the United States [31] and many small to medium-sized studies

coming from European nations, especially Spain, Italy, and France. Larger case series comprising 40 or more ureters [41, 45, 46] and even those involving more than 100 ureters [42] have been included in more recent studies. The main benefit of EBD, which has been emphasized repeatedly in systematic reviews, is that it is an entirely endoscopic procedure that frequently acts as definitive management, eliminating the need for ureteral reimplantation in the future. Success rates range from 60% to 100% and are characterized by either an improvement in imaging findings or the avoidance of standard surgery.

The possibility of introducing VUR during the process is one possible worry with EBD. Following ureter dilatation to 18 or 21 Fr, Garcia-Aparicio et al. reported a 27% risk of postoperative VUR, which was validated by follow-up VCUGs [38]. The majority of study procedures, however, only ask for a postoperative VCUG in the event that a febrile UTI develops during the follow-up period. These studies have documented a rate of clinically relevant VUR of about 8% [53]. Although there may be technical difficulties in EBD, especially when trying to intubate a stenotic orifice or place a stent in a tortuous ureteral system, most studies show that the procedure is usually doable on the first try, with few cases requiring repeat dilation or pre-stenting. Although fluoroscopy is still the most popular method, dilatation has occasionally even been accomplished successfully without the implantation of a stent [45] and without fluoroscopic supervision [42]. The use of tandem stents was noted in two U.S. research [31, 47], but the small number of U.S.-based studies indicates that EBD has not yet gained much traction in North America. However, the increasing number of worldwide studies on EBD suggests that this strategy is being used more widely, probably because it is superior to earlier treatment alternatives. According to a quality analysis by the European Society for Pediatric Urology (EAU/ESPU) and the European Association of Urology, a major drawback of EBD is that the majority of the research that supports the method is retrospective, single-center case series, which indicates a lower level of evidence. This emphasizes the need for prospective research to better define EBD's role in the surgical management of POM, especially studies that compare its outcomes with those of alternative treatment modalities.

Minimally Invasive Approaches in Ureteral Reconstruction

Surgical reconstruction is still required or preferred over endoscopic procedures in some patient populations. One significant development in recent years has been the replication of open ureteral reimplantation (UNC) using minimally invasive surgery (MIS) procedures. Various transvesicoscopic techniques, including the Cohen cross-trigonal and Glenn-Anderson techniques, or laparoscopic extravesical Lich-Gregoir reimplantation are the main methods used to do this. According to a systematic review, competent surgeons can attain similar success rates with laparoscopic extravesical and transvesicoscopic techniques [55]. However, because of the technological difficulties, only a few surgeons at specialist centers usually do transvesicoscopic procedures. In order to avoid the need for tapering, the largest series of transvesicoscopic procedures, performed by a single surgeon, involved 182 patients with 317 ureters. These patients were all chosen based on certain criteria, such as age greater than three years and less than grade 5 vesicoureteral reflux, or VUR [56]. Smaller sample sizes are reported in other series [57,58,59,60,61,62]. These laparoscopic procedures are still a good choice in some situations, even if they have not been widely used because of technical issues and worries that their benefits over open surgery would be negligible.

If the right resources are available, robotic-assisted laparoscopic techniques offer a viable substitute with the potential for wider use by addressing a number of technical issues with traditional laparoscopy, especially in suturing. Although the results of early research on robotic ureteral reimplantation for primary VUR were positive [63,64], further research revealed that the procedure was less effective and had more complications than open surgery [65,66,67]. However, more recent studies have shown increases in robotic success rates, which may be a reflection of the learning curve related to these sophisticated methods [68,69]. The effectiveness of open and robotic reimplantation techniques for VUR has been comparable, according to updated systematic reviews; robotic procedures usually result in a shorter hospital stay, although at the expense of longer operating durations [70,71,72]. Both robotic and laparoscopic procedures are currently recognized as viable options in terms of resolution and complication rates for VUR,

particularly in cases involving less dilated ureters, according to the European Association of Urology and European Society for Pediatric Urology (EAU/ESPU) recommendations [73].

Minimally invasive investigations have also been carried out when specifically addressing megaureters, especially in cases where the ureters are significantly dilated. In children with high-grade VUR (grades 4 and 5), a recent multi-institutional European study comparing open and robotic ureteral reimplantation indicated that the open group had a 94% success rate while the robotic group had a 98.5% success rate. Both groups included kids who did not require tapering. Notably, faster catheterization times and shorter hospital stays were among the better recovery results brought about by the robotic technique [74]. Numerous researchers have observed that older patients or those with severe anatomical problems benefit most from the robotic technique [75,76].

The majority of investigations have used an extravesical Lich-Gregoir treatment after the amputation of the obstructed ureter, with or without tapering. Laparoscopic and robotic approaches have also been investigated in the setting of primary obstructive megaureter (POM). After a median follow-up of two years, all patients in a large series on robotic Lich-Gregoir procedures, which included 18 children ages six months to fifteen years, showed improvement in hydronephrosis and no need for additional surgeries, with a 39% intracorporeal tapering rate [77]. Another study extended the tunnel length in comparison to a typical Lich-Gregoir by using a laparoscopic (and later robotic) extravesical cross-trigonal method. Similar success rates (94–97%) and minimal complication rates (2–4%) were seen in a comparison of 47 laparoscopic and 48 robotic patients from four different centers across median follow-ups of 8–12 months [81]. Although transvesicoscopic methods have been used for POM as well, they have drawbacks. For example, a comparison between laparoscopic single-site Lich-Gregoir reimplants and laparoscopic transvesicoscopic Cohen reimplants showed similar success and complication rates; however, the transvesicoscopic method necessitated longer hospital stays and operational periods [82]. In several instances, extracorporeal tapering has made extravesical laparoscopic treatment of a dilated, convoluted megaureter easier [82,83,84,85,86]. In a research using a robotic approach on 16 newborns, the Lich-Gregoir surgery was extended to the anterior bladder wall to lengthen the tunnel; 94% of the patients had success and 25% needed tapering [85]. A single-center Italian study comparing robotic and open POM reimplantation revealed equal success (91–92%) and complication (8–9%) rates, as well as comparable operating timeframes and shorter hospital stays for the robotic group [87].

All things considered, several surgeons and specialized facilities are progressively investigating laparoscopic and robotic methods for treating refluxing and clogged megaureters. The material now available, however, points to a high learning curve and a restricted widespread use of these methods. As endoscopic procedures like VUR injections and balloon dilatation for POM continue to gain popularity, as seen by an increasing number of reports in the literature, the time needed to become proficient may be further prolonged. Furthermore, although mentioned in the literature, transvesicoscopic procedures are still rarely used because of their inherent difficulties. These methods will probably continue to be less popular until more sophisticated, smaller robotic platforms—like miniature single-port systems—are made available.

To Taper or Not to Taper

The possible need for ureteral tapering or tailoring is a unique feature of megaureter reimplantation, which is usually used for obstructive rather than refluxing causes. However, for a number of reasons, the emphasis on tapering in modern practice seems to be less prominent now than it was in the past. First, blockage is still a bigger problem than reflux, according to the basic urological principle. This idea serves as the foundation for several surgical strategies for Primary Obstructive Megaureter (POM) that were previously discussed [26,27,28]. These strategies successfully give priority to removing obstruction over treating reflux because they believe it to be the lesser of two evils. Furthermore, pediatric urology has been increasingly lenient with regard to reflux, particularly when there is no infection. In recent decades, there has been a decrease in surgical treatments for vesicoureteral reflux (VUR), which is supported by the growing use of observational care [88,89,90]. Instead of actively trying to treat reflux, many management

techniques now rely on monitoring until clinical problems, like fever urinary tract infections (UTIs), occur. Additionally, routine follow-up voiding cystourethrograms (VCUG) are no longer used in contemporary surgical outcome studies for POM and VUR to determine radiologic success; instead, clinical outcomes are the primary focus, with VCUG investigations being reserved for clinically required situations, such as fever UTIs. However, because of incompetent tunnels or ureterovesical fistulas, ureteral tapering increases surgical complexity and the risk of complications, such as stricture, urine leakage, and VUR. In light of these considerations, the current trend suggests a decreased propensity to use tapering in the surgical treatment of megaureters when its necessity is questioned.

Although no particular study has yet to verify this change, ureteral tapering is probably carried out less frequently now than it was in the past. However, pertinent ideas that have emerged from the literature point to factors that surgeons should consider when determining if tapering is necessary following megaureter surgery. One such idea is that it might not always be required to achieve the whole 5:1 tunnel length to ureteral diameter ratio, as first suggested by Paquin [6] [91]. This ratio is frequently difficult to attain in megaureter instances, especially in small bladders. Shorter tunnels, less (or no) tapering, or both may result from a more accommodating approach to this ratio. Babu explained a "mini reimplantation" method for the megaureter in which intravesical reimplantation was carried out without tapering. He obtained a 2:1 tunnel ratio with only two cases of postoperative reflux in this group of 13 patients. Although the tapered cases had higher rates of blockage and a greater requirement for reoperation, this result was similar to that seen in 15 patients undergoing conventional Cohen reimplants with excisional tapering [92]. In a similar vein, Villanueva documented nine infants who needed surgery for obstructive megaureter; five of them had POM, and four had ectopic ureters. Regardless of the ureter's diameter, he employed a "mini" extravesical reimplantation with a 2–3 cm tunnel in place of a cutaneous ureterostomy. In five subsequent cases, he used "mini-tapering," which involves utilizing an adventitia-sparing excisional method as outlined by Ossandon [93] to trim the distal 2-3 cm of the ureter. After two of the initial four patients experienced postoperative reflux, the "mini-tapering" technique was modified for the other patients. Over the median follow-up period of 44 months, none of the last five patients developed clinically noticeable VUR [94].

Furthermore, the orifice's configuration may be just as important in preventing reflux as the tunnel's length-to-diameter ratio. The nipple valve is one such device that has lately been used in the surgical therapy of POM, particularly in situations when the newborn bladder has little room for tunneling. For the treatment of eleven POM patients between the ages of five and twenty-four months, Babu described a laparoscopic procedure in which the megaureter was fixed into the bladder using a 5 mm protruding portion in conjunction with a brief extravesical tube. At six-month follow-up VCUGs, no VUR cases were found in this cohort [98]. In order to achieve a 2:1 ratio of intravesical length to ureteral diameter, another group used a similar procedure for POM without tapering or tunneling. Instead, they anchored the megaureter that protruded into the bladder with the distal end everted circumferentially. Eleven of the thirteen instances were successful, whereas there was only one incidence of reflux and one of obstruction. A few of these individuals had cystoscopic follow-up and showed that the bladder's nipple-shaped opening was still there [99]. A study of 16 tapered and 22 non-tapered ureters with similar initial diameters compared the effectiveness of tapered and non-tapered reimplants for POM. The non-tapered group had a higher rate of hydronephrosis resolution (50% vs. 19%), and each group needed one reoperation (one non-tapered for VUR, one tapered ureter for stricture) [100]. These results demonstrate alternatives to tapering that are becoming more popular and reflect the current trend away from it.

The Path Forward and Conclusions

Megaureter surgical therapy is still developing and improving, with a critical focus on determining whether obstruction is there or not. Understanding that an obstructive component may remain even in the presence of reflux is crucial. Diuretic renography is still the mainstay for diagnosing obstruction, despite its drawbacks, indicating that there is significant space for improvement in both the testing procedures and the criteria used to define obstruction. Although MR urography [102] and modified Whitaker test [101] have been investigated, the perfect non-invasive, precise, and diagnostic test for ureteral obstruction has

not yet been found. Furthermore, the majority of research on the surgical treatment of megaureters is either retrospective or uses data from a single site. Planning prospective, multi-center studies with predetermined surgical criteria and follow-up protocols is crucial to the advancement of the field. This will be particularly important for assessing more recent methods, like endoscopic balloon dilation for POM, and the possible effects of newly developed, more advanced, and smaller robotic surgical platforms. As these technologies advance, megaureter surgery is expected to see substantial advancements in the future.

Role of the Anesthesiologist in Megaureter Reimplantation Surgery

The role of the anesthesiologist in megaureter reimplantation surgery is multifaceted, encompassing preoperative, intraoperative, and postoperative responsibilities. This complex urological procedure, often performed to correct conditions such as primary obstructive megaureter (POM) or vesicoureteral reflux (VUR), requires meticulous planning and coordination to ensure optimal patient outcomes. Given the pediatric population typically undergoing this surgery, the anesthesiologist's expertise in managing these patients' unique physiological considerations is crucial. This paper will explore the anesthesiologist's role in this procedure, including preoperative assessment, intraoperative management, and postoperative care.

Preoperative Assessment

The preoperative role of the anesthesiologist is critical in ensuring the patient's readiness for surgery and identifying any potential anesthetic risks. For pediatric patients undergoing megaureter reimplantation, a thorough preoperative evaluation is necessary to assess medical history, including any comorbidities such as congenital anomalies, cardiovascular conditions, or previous surgeries. The anesthesiologist must evaluate the child's airway, assess for any signs of upper respiratory infections, and determine the appropriate anesthetic technique based on the patient's medical history and the complexity of the surgical procedure. An important aspect of the preoperative assessment involves reviewing the patient's hydration status and renal function. Many patients undergoing this surgery have a history of urinary tract infections (UTIs), kidney dysfunction, or urinary retention. Dehydration or electrolyte imbalances, particularly in cases of chronic obstructive megaureter, should be addressed before surgery to avoid complications during the operation. In some cases, fluid resuscitation may be required to optimize the patient's volume status. Furthermore, laboratory tests, such as renal function tests (serum creatinine and blood urea nitrogen), and imaging studies, such as ultrasound or CT scans, are essential in evaluating the condition of the urinary system and ensuring that the surgical intervention addresses the appropriate pathology. Given the potential for fluid imbalances, a careful review of the patient's fluid and electrolyte status is essential. Anesthesiologists must ensure that the child is optimally hydrated and that any abnormalities in electrolytes are corrected. Additionally, patients who have been on long-term antibiotic therapy or those with a history of recurrent UTIs may require a review of their antibiotic regimen to prevent surgical site infections. The anesthesiologist's ability to identify and address these concerns prior to surgery is vital for minimizing intraoperative and postoperative complications.

Intraoperative Management

Intraoperatively, the anesthesiologist plays a critical role in monitoring and managing anesthesia, fluid balance, and vital signs. Megaureter reimplantation is generally performed under general anesthesia, which allows for optimal control of the airway and adequate muscle relaxation during the procedure. The anesthesiologist is responsible for selecting an appropriate anesthetic agent that provides deep sedation while maintaining hemodynamic stability. Pediatric patients, particularly infants and young children, have a higher sensitivity to anesthetic agents, necessitating precise dosing and close monitoring. Airway management is a crucial component of intraoperative care, as pediatric patients may present with challenges such as smaller airways and a higher risk of aspiration. The anesthesiologist must ensure that endotracheal intubation is performed correctly, considering the patient's size and age, to maintain airway patency throughout the surgery. The use of appropriate monitoring devices, such as capnography, pulse oximetry, and electrocardiography, is essential for continuously assessing the patient's respiratory and cardiac status. In addition, the anesthesiologist must be vigilant for any signs of hypoxia or hypercapnia,

which can arise from ventilation issues during surgery. Anesthesia management during megaureter reimplantation also involves the careful titration of intravenous fluids and electrolytes to prevent both dehydration and fluid overload. Given the long duration of the procedure and the potential for significant fluid loss, the anesthesiologist is responsible for monitoring the patient's fluid status closely. This includes adjusting the rate of fluid administration based on urine output and the patient's clinical condition. In some cases, blood products may be required, particularly if there is significant blood loss during the surgery. The anesthesiologist must be prepared to respond to any hemodynamic instability that may arise during the procedure. Pain management is another critical aspect of intraoperative care. Megaureter reimplantation is a major surgical procedure that can result in significant postoperative discomfort. Anesthesia plans should include provisions for perioperative analgesia, such as the use of regional anesthesia (e.g., caudal block) in addition to general anesthesia, to minimize postoperative pain and reduce the need for systemic opioids. A multimodal approach to analgesia, incorporating both narcotic and non-narcotic agents, may be necessary to provide adequate pain relief while minimizing adverse effects.

Postoperative Care

The anesthesiologist's role extends into the postoperative period, where continued monitoring and management are vital to ensure a smooth recovery. Upon emergence from anesthesia, the anesthesiologist is responsible for ensuring that the patient regains spontaneous breathing, maintaining stable hemodynamics, and addressing any issues such as nausea or vomiting. Careful attention is required in pediatric patients, who may have a higher sensitivity to anesthetic agents, leading to delayed emergence or respiratory complications. Postoperative pain management is a major component of recovery. The anesthesiologist may continue to manage the patient's analgesia with oral or intravenous pain medications, considering the potential side effects, including sedation, nausea, and respiratory depression. The use of multimodal analgesia, such as local anesthetics, acetaminophen, and nonsteroidal anti-inflammatory drugs (NSAIDs), is encouraged to optimize pain control and minimize opioid consumption. The anesthesiologist must also monitor for any signs of complications, such as infections, bleeding, or fluid imbalances, that may arise after the procedure. Finally, the anesthesiologist must ensure that the patient is stable before discharge to the recovery room or intensive care unit (ICU) and that appropriate pain management and monitoring are continued in the postoperative setting. For pediatric patients, discharge planning must include appropriate instructions for caregivers regarding pain management, signs of infection, and follow-up appointments. The anesthesiologist plays a central role in the successful management of pediatric patients undergoing megaureter reimplantation surgery. From preoperative evaluation and optimization of fluid and electrolyte balance to intraoperative anesthesia management, airway protection, and postoperative care, the anesthesiologist is essential in ensuring the patient's safety and comfort throughout the entire surgical process. The complexities of managing pediatric patients, particularly those with congenital urological conditions, require a specialized approach that is tailored to the individual's needs. By providing expert care and coordinating with the surgical team, the anesthesiologist contributes significantly to the positive outcomes of this challenging procedure.

Conclusion:

The management of megaureter in pediatric patients has evolved considerably over recent decades, particularly with the introduction of minimally invasive techniques. Traditionally, surgical interventions for megaureter involved open procedures, with ureteral reimplantation (UNC) being the gold standard. However, advancements in diagnostic imaging and surgical techniques have provided more targeted and less invasive approaches, such as endoscopic balloon dilation (EBD) and robotic-assisted ureteroneocystostomy (UNC). These methods have transformed the landscape of pediatric urology, offering several advantages, including reduced morbidity, shorter hospital stays, and quicker recovery times. EBD, in particular, has emerged as a highly effective treatment for primary obstructed megaureter (POM), with success rates ranging from 60% to 100%, depending on the technique used and the severity of the condition. This minimally invasive approach has the added benefit of often eliminating the need for open surgery, which was previously associated with longer recovery periods and higher complication rates.

While concerns about the potential introduction of vesicoureteral reflux (VUR) during the procedure remain, the overall clinical relevance of this issue is relatively low, with the majority of studies reporting low rates of clinically significant VUR post-procedure. Moreover, EBD has been shown to be technically feasible even without fluoroscopic guidance or stent placement, making it a viable option in both primary and secondary care settings. The review also underscores the importance of a thorough diagnostic process, involving imaging modalities such as voiding cystourethrogram (VCUG) and diuretic renograms (DR), to accurately determine the underlying cause of megaureter. The management approach varies significantly depending on whether the megaureter is obstructive or refluxing, and precise classification plays a crucial role in guiding treatment decisions. While observation remains a viable option for many cases, surgical intervention is warranted when there is progressive dilation, renal function decline, or associated complications such as recurrent urinary tract infections (UTIs) or nephrolithiasis. While endoscopic techniques such as EBD offer promising outcomes, the need for further high-quality, prospective studies is evident. Larger, multi-center randomized controlled trials are essential to establish definitive guidelines regarding the best approach for managing the measurement in pediatric patients. These studies should aim to compare minimally invasive methods like EBD with traditional open surgery, considering long-term functional outcomes, potential complications, and overall patient satisfaction. Additionally, research into the role of robotic-assisted procedures and the refinement of surgical techniques will likely continue to advance the field and offer even more tailored solutions for individual patients. In conclusion, while the treatment of megaureter has been revolutionized by minimally invasive techniques, there remains a need for continued innovation and refinement in surgical management. As our understanding of the condition and available treatment options deepens, clinicians can expect even better outcomes for pediatric patients suffering from megaureter, with a focus on reducing invasiveness, improving efficiency, and optimizing long-term renal function.

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الحالب الكبير- تقنيات متقدمة لإدارة الجراحة: مراجعة محدثة.

الملخص:

الخلفية :يُعرَّف الحالب الكبير بتوسُّع الحالب، وغالبًا ما يتجاوز قطره 7-8 ملم، ويُعدّ حالة شائعة يتم تشخيصها في المرضى الأطفال من خلال التصوير بالموجات فوق الصوتية. يُعتبر تحديد السبب الكامن وراء الحالب الكبير أمرًا ضروريًا لتحديد ما إذا كان ينبغي اتباع الإدارة المحافظة أو التدخل الجراحي. تُعدّ تصنيفات كينج أداة رئيسية لتصنيف الحالب الكبير بناءً على وجود الانسداد أو الارتجاع المثاني الحالي .(VUR) تهدف الاستراتيجيات الجراحية إلى استعادة وظيفة الحالب الطبيعية من خلال معالجة الانسداد أو الارتجاع. شهدت تقنيات الجراحة طفرة كبيرة مع اعتماد تقنيات طفيفة التوغل مثل توسعة البالون بالمنظار (EBD) وإعادة غرس الحالب بالمنظار (UNC)، مما يعكس التطورات المستمرة في طب المسالك البولية لدى الأطفال.

الهدف :تهدف هذه المقالة إلى استعراض التقدم الحالي في تقنيات الإدارة الجراحية الحالب الكبير، مع التركيز على تطور التدخلات الجراحية، وخاصة الأساليب طفيفة التوغل.

الطرق :تستعرض المقالة مجموعة من الدراسات والأساليب السريرية، مع تقييم التدخلات الجراحية التقليدية والحديثة، بما في ذلك إعادة غرس الحالب المفتوحة (UNC)، وتوسعة البالون بالمنظار(EBD) ، والتقنيات بمساعدة الروبوت. كما تُناقش معايير التشخيص مثل تصوير المثانة والإحليل أثناء التبول(VCUG) ، والتصوير بالنظائر المشعة(DR) ، والموجات فوق الصوتية.

النتائج :اكتسبت الإجراءات طفيفة التوغل مثل EBD شعبية بفضل طبيعتها غير الجراحية ومعدلات نجاحها العالية التي تتراوح بين 60-100%. تُبرز المقالة التحديات التي تواجه هذه الإجراءات، مثل خطر حدوث الارتجاع المثاني الحاليVUR)) ، لكنها تؤكد أيضًا إمكاناتها في استبدال الجراحات المفتوحة التقليدية. كما تسلط الضوء على مزاياEBD ، مثل انخفاض معدلات الإصابة بالأمراض، وقصر فترات التعافي، وانخفاض معدل المضاعفات مقارنة بالجراحة المفتوحة.

الخلاصة :توفر التطورات في الإدارة الجراحية الحالب الكبير، خاصة مع التقنيات طفيفة التوغل، فوائد كبيرة تشمل تحسين النتائج، وتقليل معدلات المضاعفات، وتسريع فترات التعافي. ورغم النتائج الواعدة للإجراءات التنظيرية، فإن هناك حاجة إلى دراسات استشرافية إضافية لتحسين مؤشرات الجراحة ونتائجها عبر مجموعات متنوعة من المرضى.

الكلمات المفتاحية :الحالب الكبير، إعادة غرس الحالب، توسعة البالون بالمنظار، طب المسالك البولية للأطفال، الجراحة طفيفة التوغل، الارتجاع المثاني الحالبي، إعادة غرس الحالب بالمثانة.