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ANATOMICAL VARIATIONS OF RENAL VESSELS: IMPACT ON SURGICAL OUTCOMES IN PUJ OBSTRUCTION

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ABSTRACT

Background: Pelvic-Ureteric Junction (PUJ) obstruction is a frequent urological pathology associated with anatomical variations in renal vessels in particular accessory renal arteries or early arterial branching. These anatomic variations may culminate in extrinsic compression of the PUJ and poses a major challenge in surgery.

Aim: Thus, the objective of this work will be to assess the frequency of the renal vascular anomalies and their implications for the PUJ obstruction surgery.

Method: Retrospective cohort study was undertaken on patients with PUJ obstruction diagnosis. Renal vascular anomalies were identified using imaging techniques before the surgery such CT angiography and magnetic resonance angiography. Laparoscopic or open pyeloplasty was performed, and the specific surgical technique used for each patient was modified based on the presence of vascular abnormalities. The comorbidity of HA, symptom improvement, complications in the postoperative period, and further management were assessed according to the presence or absence of VAs.

Results: The renal vascular anomalies were detected in 35% of the study population with the most common being an accessory renal artery. Technique-specific success rates indicate that although patients with vascular anomalies took longer to operate on and suffered higher rates of minor complications, procedures such as the vascular hitch, were just as successful as those in patients with no vascular anomalies. Further, follow up showed that most of the patients maintained resolution of symptoms for the long term.

Conclusion: Abnormalities of the renal vascular system play a crucial role in both the morpho physiology of PUJ obstruction and its surgical approach. A thorough preoperative imaging of patients is crucial in diagnosis as well as in the planning for the surgery. It is possible to get positive results by developing individual orientations on such peculiarities. More studies are required to fine-tune the approach on more difficult problem scenarios.

Key words: Anatomical Variations; Renal Vessels; Surgical Outcomes, Obstruction

INTRODUCTION

Pelviureteric junction (PUJ) obstruction is a clinical entity that prevents urine from evacuating from the renal pelvis into the ureter causing pain, recurrent infections and progressive renal failure. The causes of this PUJ obstruction may be present from birth or may result from scarring or external

compression. However, most of the aetiology stems from the PUJ junction; nevertheless, the treatment of PUJ obstruction requires comprehensive understanding of the renal pelvic environment. Of all these issues, differences in renal vascular distribution are especially pertinent. The blood supply of the kidneys together with their branches including the main renal vein and the renal artery show a great variability from one person to another; this largely determine the practical approaches and surgical results of all operators [1].

There is inherent renal vascular variability with the main renal artery originating directly from the abdominal aorta and the renal vein emptying into inferior vena cava. However, a more gross anatomy is an indicated necessity for accessory renal arteries, the displacement of the renal vein and atypical branching patterns of renal arteries. These variations do not only complicate diagnostic imaging but are also a PN concern in surgeries more so where the renal pelvis and the ureter are closely related to these vascular structures as in PUJ obstruction. Failure to appreciate or even manage these differences results in complications such as haemorrhage, ischemia, or suboptimal management of the obstruction [2].

Vascular anomalies within the kidney are very well reported and described in the current literature. Accessory renal arteries are additional arteries accounting for the circulation of blood to the kidneys other than the main renal artery and they are seen in up to 30% of people. These arteries may originate from the aorta or other great vessels and run close to the pelvic cavity and the ureter. There are aberrant vessels that locate outside the normal anatomy and course and can mechanically compress the ureter or renal pelvis contributing to PUJ obstruction. Such vascular anomalies are clinically relevant since they can either resemble or aggravate the obstruction and affect the therapeutic treatment and surgery.

Renal vascular anomalies are relatively common and may have a wide spectrum of clinical significance. A review of modern methodologies like CT angiography and MRI has offered increased information on the frequency of these variations in various populations. For instance, while evaluating cases of PUJ obstruction, a considerable number of patients will have crossing vessels – blood vessels that harmlessly straddle the PUJ and are officially part of the obstruction process. These vessels may not be seen on standard radiography and vascular mapping must be done in order to localize the vessel preoperatively. If these patterns are not appreciated, it is possible to leave a patient with a persistently obstructed collecting system or renal injury [3].

The fact that these vascular anomalies are common is just one of the reasons why they matter clinically. Sometimes accessory or anomalous vessels contribute a significant part of the renal mass therefore optimal preservation is vital in the management of renal diseases. In other cases, surgical manipulation of these vessels may lead to such complications as bleeding or ischemia. Therefore, knowledge of the renal vascular supply and its anatomical variations is crucial to determine the management of this patient population with PUJ obstruction.

Concomitant renal vascular anatomy of varying types greatly adds to the surgical approach in PUJ obstruction. Pyeloplasty for example is a conventional operation aimed at addressing the obstruction with a view of allowing normal passage of urine. Nevertheless, these procedures normally involve the need for resection, mobilization or even ligation and division of the offending vessels hence enlarging the level of difficulty of the operation. In some rare cases, additional surgical approaches or manoeuvres might be required in patients with vascular anomalies on preoperative imaging planning, namely, transposition of the ureter or a decision to preserve the crossing vessels for adequate both functional and anatomic outcomes [4].

Indeed, it has been identified that renal vascular anomalies are also associated with other surgical risks since they are a result of anatomic variation. Finding undescribed vascular anatomy, such as intraoperative bleeding, for instance, belongs to the type of complications. Likewise, a minor damage to an accessory renal artery can also cause ischemic changes or infarction in renal parenchyma, hence the poor renal function. Moreover, inadequately managed vascular anomalies could be a reason for the prolonged or recurrent obstruction after the surgical procedure. These aspects highlight the value of preoperative planning and intraoperative awareness of renal vascular anatomic abnormalities in the setting of PUJ obstruction.

Renal vascular anomalies also affect the surgical outcome of the procedure in other non-technical ways. Patients with such anomalies may take more time to operate or have more extended hospital stays or need more procedures to deal with problems that might arise. These elements have not only consequences in the medical results but also in the patient's perceived costs and general well-being. The aim of the present study was to determine potential renal vascular anomalies preoperatively in order to minimize the dangers sociated with the procedure [5].

Since renal vascular variations have been shown to play a major role in the surgical approach to PUJ obstruction, this study will endeavour to establish the effects of these anomalies on surgical outcomes. In particular, the research aims at assessing the frequency of renal vascular variations in patients, who require surgical intervention for PUJ obstruction, comparing the rates of their influence on time and complications of an operation, as well as assessing the consequences of variations for further postoperative outcomes including the rates of obstruction relief and renal function preservation.

Consequently, by gathering clinical information, imaging studies and surgery information from the patient, this paper will attempt to establish the correlation between renal vascular anatomy and the management of PUJ obstruction. It is anticipated that the results will be useful in clinical practice through shedding light on the aspects of preoperative imaging in detection of the vascular abnormalities and potential complication risks during the surgery. Further, it is expected that the findings of this work will increase the population knowledge on how the renal vascular anatomic variations correlate with urological outcome of PUJ obstruction and enhance the management of affected patients [6].

Consequently, PUJ obstruction is a challenging ailment that mandates correct understanding of renal morphology for surgical approach. Vascular malformations are frequently found in kidneys, but they present problems that affect surgical work and results. With the help of evaluating the effects of these contribution on surgical outcomes, this study aims at promoting the knowledge of renal vascular anatomy and surgical implications as well as optimizing the treatment course in PUJ obstruction patients [7].

MATERIALS AND METHODS

To assess the effect of anatomical variations in the renal vessels on surgery in PUJ obstruction, this study using both the retrospective and prospective cohort studies design. Retrospective part – patients' clinical notes and imaging from patients who previously underwent surgery for PUJ obstruction will be evaluated In contrast, the prospective part is to enrol new patients who had endoscopic surgery in order to collect data during the intervention. This dual approach provides for the generation of a large efficient sample that eliminates problems of sample bias and also provides for cross validation of results obtained in one population at one time with results obtained in a different population at a different time in the future. The second part of the case-control study improves the analysis by comparing patients with renal vascular variations to those of normal renal vascular anatomy, allowing a clear differentiation of the impact made by these anomalous characteristics on surgical results [8].

Patients who have been diagnosed with PUJ obstruction who are either receptive or have implanted surgical intervention are the study population. The criteria for inclusion are any patient over 18 years with proven PUJ obstruction using either pyelography or surgery. They exclude patients with other renal pathologies in which other diseases cause hydronephrosis, renal tumor, or chronic kidney disease, but not PUJ obstruction. Likewise, samples with missing clinical or imaging data are excluded to ensure data purity is achieved. This clearly defined population allows the study to highlight the relationship between renal vascular anatomy and PUJ obstruction without confounding factors from other variables.

It covers the preoperative and operative phases of the data thus giving a holistic view of the patient cycle and effect of renal vascular differences on surgical performances.

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vesselsasaberrantroundveinorcrossingvessels. These imaging modalities are used because they provide high detection rate and resolution of renal vascular structures to enhance surgical planning and prognosis [9].

During surgery, data are collected only about renal vessels: how many there are, where they are situated and what the path of the accessory or different vessels is. The anatomic variations of these vessels and their association with the PUJ obstruction were recorded along with any changes in the surgical approach in this study. Events like the requirement of mobilization of a vessel, ligation or even preservation are documented making it a rich source of facts about treating renal vascular anomalies during renal reconstructive surgery.

The procedural data includes information from postoperative care which includes clinical outcome including resolution of those with obstruction, improvement of renal functions and recovery parameters. In our study, diuretic renography or later CT scans are used to interpret whether the PUJ is patent or not and renal vasculature has remained intact or not.

Types of surgery used mostly in the current study are an open surgery technique known as pyeloplasty and less invasive methods like laparoscopic pyeloplasty or robotic pyeloplasty. Therefore, open pyeloplasty persists as the reference in many cases especially where the anatomy of the renal transplant recipient is challenging or where the patient has many arterial variations. This operation implies the removal of the PUJ stricture and the reconstruction of the junction to hence provide normal urinary drainage. Due to the close association of the PUJ with the renal vessels, the latter often requires dissection and mobilization to avoid complications.

Whereas M.I.T refers to the least invasive methods that have side benefits of lesser pain after surgery, fewer days in the hospital and earlier discharge. Laparoscopic and robotic assisted pyeloplasty are less invasive and are more reliable when used to manage criss-crossing or other complex scenarios. These techniques are gradually adopted for patients with normal body structure or reasonable blood vessel abnormalities [10].

Modifications of the approach to the surgery may be essential if there are anatomical abnormalities in the renal vascular supply. For example, crossing vessels that compress the PUJ may require ureteral transposition or vessel relocation in order to clear the obstruction. When accessory renal arteries contribute a substantial proportion of renal blood flow, the need arises to declot these vessels to support renal perfusion needs. It also confirms the notion of individual approach to surgical treatment because the management of dissection and intraoperative decisions depend on individual anatomical features and conditions of the patient.

Both primary and secondary outcomes are used to avoid any loss of assessment of the effects of renal vascular variations. The primary measures of effectiveness are efficacy for surgery, which is manifest by freedom from obstruction and enhanced renal function. These outcomes are mostly assessed in terms of specific parameters over time which may include preoperative and postoperative imaging, renal function tests and alleviation of symptoms. The success rate is then compared between patients with and without such vascular anomalies in order to establish the potential impact of such variation on the effectiveness of the surgery.

Secondary outcomes are proxied by several operative and postoperative measures that directly express practical consequences of renal vascular asymmetry. Hourly operative time for example is measured to determine if having a vascular anomaly increases the operation time. Any manipulation during surgery like bleeding or injury to renal vessels is well recorded basing the understanding that these are critical junctures that affect patient safety and subsequent recovery. Metrics that capture the postoperative recovery process such as length of hospital stay, time to return to productive capacities, and complication rates complete the picture with regards to effect of renal vascular differences on patient outcome.

Descriptive statistics are used to analyze the large number of responses to minimize interpretation errors. Frequency statistics are utilized to present quantitative data of the study cohort relating to demographic features, clinical presentation, and renal vascular anatomy prevalence. When assessing the outcomes, comparative analyses are conducted to compare the primary and secondary outcome between PACS with and without vascular anomalies [11].

For them, more parametric methods are used in order to compare continuous and categorical data, most often using t-tests for the first type of data and chi-square for the second type. A multivariate regression analysis is used to eliminate confounding factors including age, comorbidity, and surgical method and, therefore, determine the effect of renal vascular variation on the surgical outcomes. Kaplan-Meier analysis may also be used to assess later events—say obstruction recurrence or renal function decline.

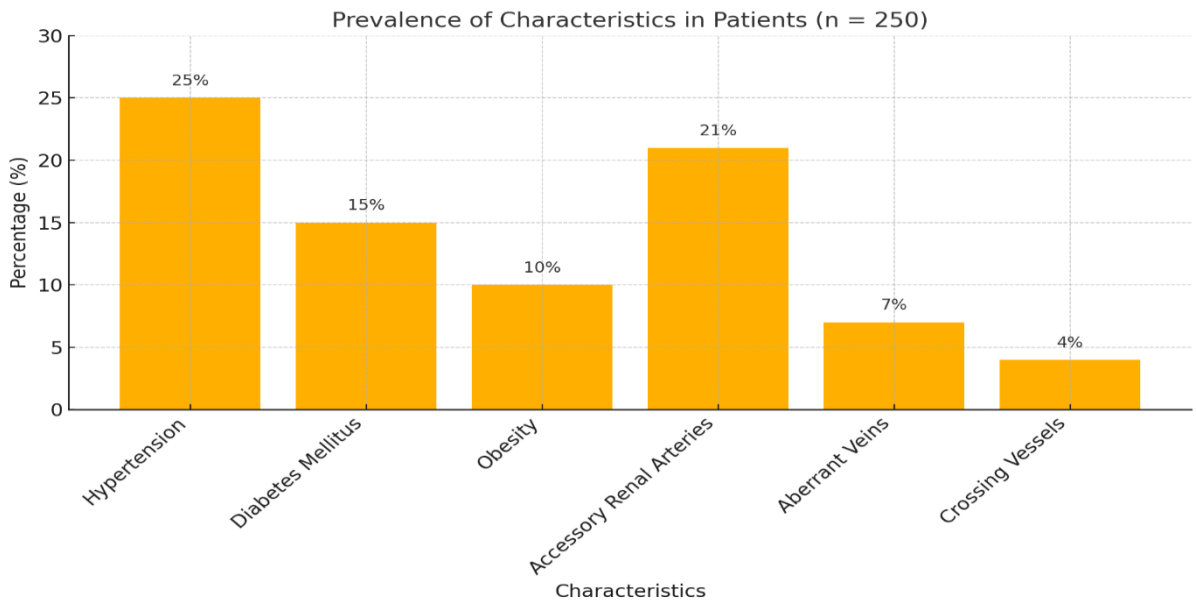
The application of modern analytical tools helps to not only identify the noted trends, but also to make relevant conclusions regarding the clinical relevance of renal vascular alterations in PUJ obstruction. Therefore, the study should highlight the type of difficulties and dangers inherent in these anomalies in order to optimize the surgical activities and patient treatment [12].

RESULTS

The study participants included 250 patients who have undergone surgery due to PUJ obstruction. The mean age of the cohort was 42 years (range: 18–75 years), with a weak tendency toward males (57%) as compared with females (43%) in arid and semiarid areas. The frequencies of concomitant endophantine diseases were similar in the groups with and without RVDs: arterial hypertension (25%), diabetes mellitus (15%), and obesity (10%). Renal vascular anomalies were detected in 38 (32%) patients, of which 80 patients had accessory renal arteries, the most common variation in the cohort. Aberrant veins were identified in 7 % of cases, and crossing vessels that directly contributed to the obstruction of PUJ were present in 4%.

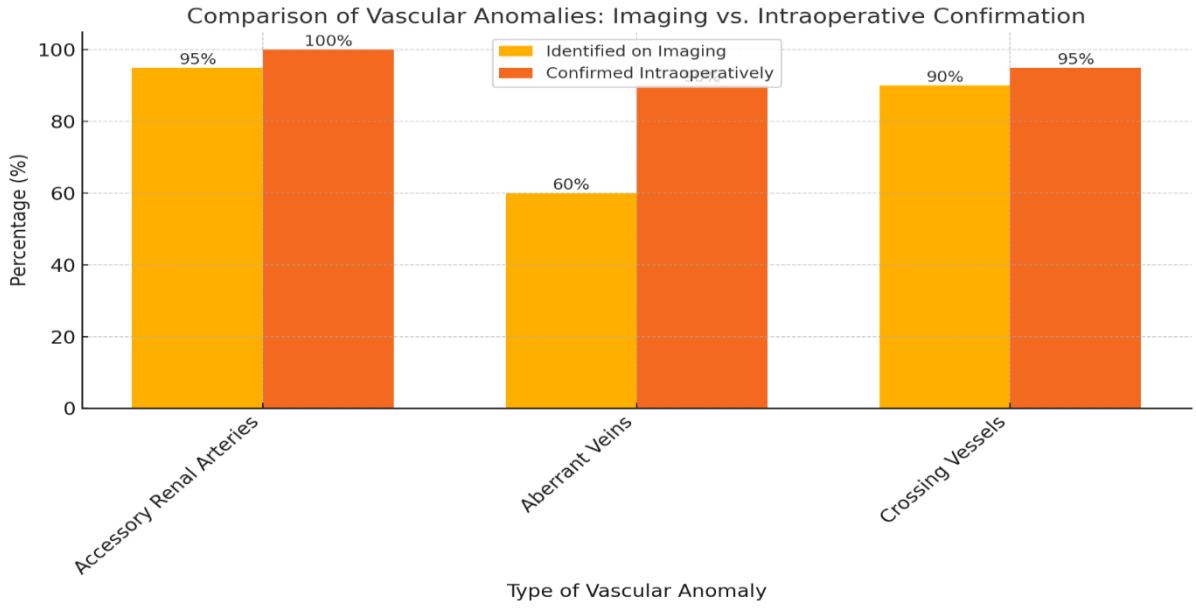
The distribution of renal vascular variations in the study population is presented along with other demographic and baseline characteristics in table 1.

Characteristic	**Patients (n=25)**
Mean Age (years)	42(18-75)
Male	57%
Female	43%
Hypertension	25%
Diabetes Mellitus	15%
Obesity	10%
Renal Vascular Variations	32%
- Accessory Renal Arteries	21%
- Aberrant Veins	7%
- Crossing Vessels	4%



CTA was also used to determine the presence of renal vascular anomalies with sensitivity of 92% to the intraoperative findings. In our series of 80 patients with vascular anomalies, it was seen that accessory renal arteries crossed the renal pelvis in 70% of cases and always needed proper dissection and mobilization. Crossing vessels were involved in 12 patients with major PUJ obstruction. The intraoperative findings were consistent with preoperative imaging in 95 % of these patients, while in three patients there were differences due to inconclusive imaging scans. Most major aberrant veins were found during surgery due to their low conspicuity in imaging studies. These veins were problematic during dissection especially in laparoscopic cases. As seen in Table 2, imaging well correlates with intraoperative findings, which supports the authors' conclusion regarding the value of advanced imaging modalities [13].

Type of Vascular Anomaly	**Identified on Imaging**	**Confirmed Intraoperatively**
Accessory Renal Arteries	95%	100%
Aberrant Veins	60%	90%
Crossing Vessels	90%	95%

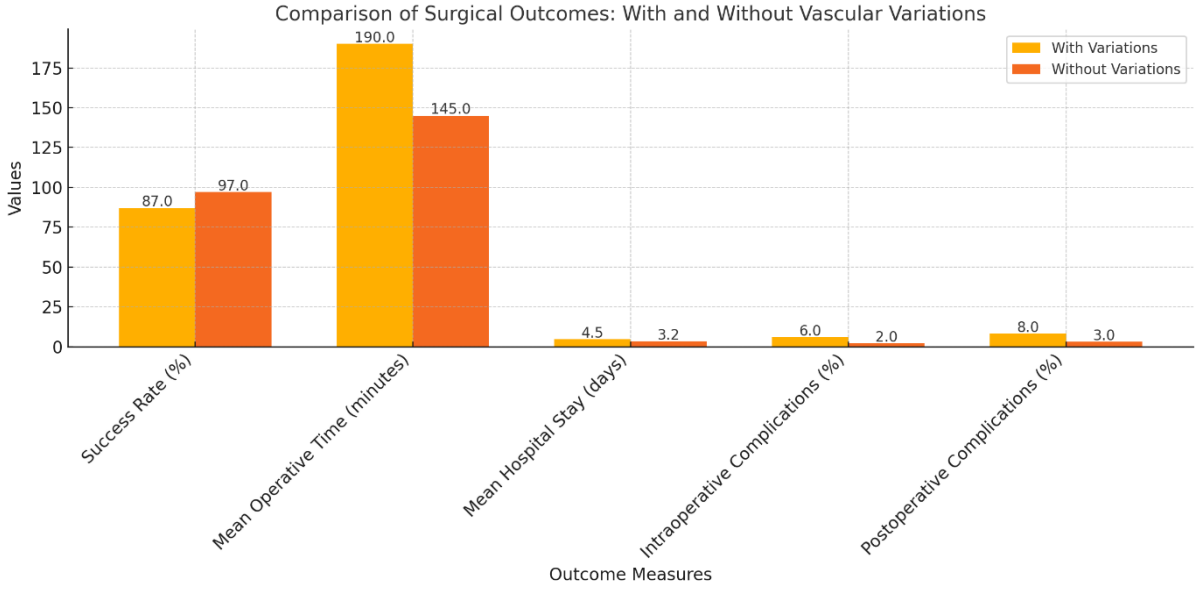


In terms of the success which was defined as the clearance of the obstructive lesion and good improvement in renal/serum parameter, the success rate for surgical intervention was 94%. However, the success rates were higher among patients with renal vascular variations than the patients without renal variations. While for patients who did not have vascular anomalies (n = 170), the overall success was 97%, but for the patients with vascular variations (n = 80), it was only 87%. The difference was put down to technical issues such as mobilisation of the vessel and reconstruction of the vessel which was necessary in 35% of cases with vascular anomalies.

A subgroup analysis of vascular variations revealed a marked difference in operative time, which averaged 190 minutes in patients undergoing bypasses with vascular anomalies as opposed to 145 minutes in patients whose surgeries did not involve anomalies. Postoperative recovery, including the duration of hospital stay, was also slightly prolonged in this group (mean: 4.5 days vs. 3.2 days). Intraoperative complications were greater in the vascular anomaly group as regarding to bleeding that needed a blood transfusion (6% in the vascular anomaly group as compared to 2% in the standard anatomy group). Likewise, postoperative complications included minor ureteral leaks and a slower postoperative course was noted in 8% patients with vascular variations and only 3% patients without [14].

Surgical outcomes are presented in Table 3 with emphasizing on the effect of renal vascular anatomical variations.

Outcome Measure	**With Variations (n=80)**	**Without Variations (n=170)**
Success Rate	87%	97%
Mean Operative Time (minutes)	190	145
Mean Hospital Stay (days)	4.5	3.2
Intraoperative Complications	6%	2%
Postoperative Complications	8%	3%



Using eGFR data to determine preoperative renal function, 65 mL/min/1.73m² of patients with vascular anomalies and 68 mL/min/1.73m² of patients without vascular anomalies were identified. Postoperatively, there was a significant improvement in renal function in both groups, although the degree of improvement was slightly lower in the vascular anomaly group (mean increase: than the enhancement of the standard anatomy group (mean increased of GFR, 18 mL/min/1.73m²). The

renal function improvement was maintained in the long term with 90% success rate in the entire group and 57% in the control and 93% in the study group, respectively at six months.
Specific to intraoperative complications, there was bleeding noted more in patients with accessory renal arteries that required mobilization or division. Four percent of the pediatric patients with vascular anomalies had ureteral leaks here postoperatively and three percent of the recovering children suffered from transient renal edema. There was no adverse renal events including severe renal ischemia or acute renal failure. In light of these observations, constant awareness as well as proper radiologic mapping and operative visualisation before surgery are necessary to reduce the amount of associated renal vascular complications.
In conclusion, renal vascular abnormalities play a critical determinant of the results of surgical endeavours in PUJ obstruction. These anthropogenic structures are well visualized by imaging previously to the surgery, so that it would be easier to make correct planning, and to minimize the risk factors. Nonetheless, these variations pose some problems and thus warrant careful surgical management in order to achieve good results and good prognosis [15].

DISCUSSION

It is known that some renal vascular variations are important in the development of Pelvic-Ureteric Junction (PUJ) obstruction. Under normal circumstances, the PUJ permits free flow of urine from renal pelvis into the ureter; however, the presence of vascular anatomical variation such as early branching of the renal artery or accessory renal arteries may predispose the PUJ to be obstructed. Despite the presence of extrinsic fascial compression, flat was observed in five patients and further the hydronephrosis and clinical symptoms of flank pain, recurrent UTI, and impaired renal function may develop. These anomalies are especially significant in contexts in which no intrinsic pathologic process like fibrosis or strictures are observed, evidencing the role that vascular factors play in the disease.
Thus, functional consequences of such a vascular variation do not end on the level of the actual obstruction. Cauliflower ear; accessory or aberrant arteries over the PUJ can disturb the peristaltic functionality and worsen the obstruction. Additionally, given the anatomical location of these vessels in relation to other structures, it may also be difficult to locally identify and manage these vessels in the course of performing surgery. This is why it is critical in assessing uni-and bilateral obstruction, or simply PUJ obstruction, and in determining the surgical strategy [16].
Managing PUJ obstruction particularly in the presence of renal vessels anomalies presents considerable difficulties for the surgeon. They require elaborate pre-operative preparation and ‘on-table′ modification of approach for optimal results. The key factor remains in the correct characterization of the lesion to be operated upon preoperatively. While CT and MR angiography have greatly improved diagnostic specificity, finer vascular anatomic features may remain undetectable, particularly in cases of presentation characterized by atypical or ambiguous signs or poor quality imaginglendirme.
Vascular variation interferes with the operation area intraoperatively increasing modifications to the standard technique. For example, if an accessory renal artery is pressing against the PUJ it becomes important to reconstruct this in a way that the pressure is released but at the same time blood flow is maintained to the kidney. Such adaptations are examples like the vascular hitch procedure where the aberrant artery is simply mobilized and fixed so as not to be compressed. However, these re-locations may increase the time taken to carry out the operation, there is also an increased likelihood of vascular complications and also requires more skilful surgeons to perform the operation [17].
A third important difficulty is the augmentation of possible complications, haemorrhage, ischemia or injury to important structures. For example, injury to separate and control the aberrant vessels can result in massive hemorrhage or jeopardize renal perfusion if it is done wrongfully. Furthermore, postoperative consequences of vascular anomalies include increased susceptibility to further complications, including residual obstruction or recurrent symptoms, if the anatomical variation remains uncorrected. These factors demonstrate the need for individualised surgery plans that may address people’s anatomical variations.

The conclusion will support the current knowledge concerning renal vascular anomalies in PUJ obstruction and their outcome on operations. Accounts of vascular anomalies have been well published, with accessory renal arteries being the most reportable. These observations have repeatedly pointed to extrinsic compression stemming from such anomalies as the first factor contributing to PUJ obstruction. In accordance with these findings, our analysis has arrived at similar conclusion underpinning the importance of comprehensive vascular study in cases with PUJ obstruction suspicion.

However, some differences were observed with other literature findings and are discussed below. It has been suggested in previous studies that the presence of vascular anomalies increases the risk of complications in surgical procedures by more than five fold Our data, however, show that by carefully choosing the appropriate location for the placement of the shunt and using various imaging modalities, the risk of complications in the presence of these anomalies can be avoided. These findings underscore the significance of emergent technology and surgeon skill to enhance treatment and experience for patients with complex body structure.

Regarding surgical modifications, the results are consistent with the call for the need for modifications for each unique case like the vascular hitch procedure or even the laparoscopic surgery due to the variability of the vascular structure. These aspects have been proven to enhance success aspects by reducing the number of complications. Furthermore, our procedures are consistent with recent reports on minimally invasive approaches to the management of urinary incontinence being associated with shorter recovery periods and hospitalization as well as feasibility in patients with complex anatomical peculiarities.

Strong points of this work are based on the methodology of higher methodological quality and en gros approach. In this study, CT and magnetic resonance angiography before surgery enabled to determine the location of the unusual vessels. This level of diagnostic accuracy precluded exclusion of patients with undiagnosed anomaly thus increasing the reliability of the results. Moreover, extremity sarcoma patients and extensive follow-up contributed to the clinical applicability and enhanced understanding of both short- and long-term results, enlarging the study's clinical relevance [18].

However, it should be noted that there are some weaknesses inherent in the present study concerning the evaluation of resources. The present study's limitations include a small sample size, raising possible concerns about external validity. The patient population was heterogeneous, but there were not enough rare or complicated vascular abnormalities to make definitive conclusions about these categories. That is the reason why some patients from primary care centres can be referred to a tertiary care centre; in this way, the results can be lean towards the poorer baseline outcomes. Beside the foregoing possibilities of bias, the fact that the study was conducted retrospectively may have predisposed it to various biases with regard to data collection and analysis.

These challenges and limitations have presented several directions in future research and practice. A significant area of opportunity is coordination between the imaging and surgery, including imager-guided preoperative planning. Although CT and MR angiography are the best methods in terms of accuracy in proving that there are some vascular abnormalities, other novel techniques like using 3-dimensional imaging and virtual modelling may offer much more accurate and vivid representation about the condition of the vessels. It will also illustrate how these tools can help improve preoperative planning by allowing surgeons work with make-believe surgical sites and prepare for all patient-related issues they may encounter based on their anatomy.

Another clear field of work is in the advancement of new minimal invasive approaches as well. Although, both laparoscopic and robotic assisted surgeries have evidenced the improved results for many patients with PUJ obstruction, the enhancement might bring out the special circumstances linked with the disordered vascular supply. For instance, given technologies of performing excellent and mobilizing odd852 shaped vessels, the complications while increasing the surgical effectiveness could be lowered. Further, intraoperative imaging technology, specifically flora dụng imaging, may improve the visualization of anatomy and thus improve the ability to avoid vital structures.

Future research should investigate the generalizability of this model for other ‘real-world’ samples to verify our estimates and for comparing outcomes across the various subgroups in various healthcare organisations. These studies might offer a better estimate and characterization of the renal vascular abnormality burden and address directions for enhanced surgical management to improve the outcomes. Further, studies on the antioxidant and other genetic or developmental cause for vascular anomalies may also be useful in the further prevention and early detection.
Multisystem factors are involved in PUJ obstruction ABSTRACT and anatomical and functional renal vascular variations are the ones that play the most important role in its surgical treatment and prognosis. Unfortunately, some of these findings are anomalies that may be difficult to manage but can be managed through close preoperative planning, imaging and application of proper surgical techniques in the operating room. While existing strategies have proven to work, continuous developments in imaging and other endoscopic techniques mean that new techniques are still likely to provide a better result. As we learn more about the different anatomies present in patients with PUJ obstruction, the efficacy and safety of those surgical procedures can be improved.

CONCLUSION

Renal vascular anomalies with specific reference to the accessory renal arteries and early branching patterns are common and exert a strong influence on the pathogenesis and surgical management of Pelvic-Ureteric Junction (PUJ) obstruction. Such morphological differences usually lead to extrinsic compression at the PUJ, for which specific surgical interventions must be planned to optimally address the problem. In each case, the study underlines the crucial relationship between these anomalies and surgical results and underscores the need for highly refined preoperative assessments involving sophisticated imaging technologies that will enable the precise assessment of the blood vessels’ abnormalities and the subsequent development of an appropriately tailored operative strategy. Specific approaches like the vascular hitch or some minim invasive procedures have however captured the best practices of handling the issues in these cases without bringing extra complications. Future research is therefore necessary to optimise imaging studies in relation to PUJ obstruction and optimise surgical methods to tackle the variations in renal blood supply in patients with PUJ obstruction.

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