

Original Research Article

ASSESSMENT OF SERUM CA 19-9 AS A BIOLOGICAL MARKER IN PAEDIATRIC PELVIURETERIC JUNCTION OBSTRUCTION: A STUDY OF UTILITY AND LIMITATIONS

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ABSTRACT

Background: Pelviureteric junction obstruction (PUJO) is a common cause of hydronephrosis in children. Serum carbohydrate antigen 19-9 (CA 19-9) has been investigated as a potential biomarker for urinary tract obstruction, including PUJO. This study aimed to evaluate the utility of serum CA 19-9 levels in assessing the severity of PUJO in paediatric patients. **Materials and Methods:** This prospective case-control study included 60 patients, 30 diagnosed with unilateral PUJO requiring surgery (Group A) and 30 with non-urological paediatric surgery (Group B). Serum CA 19-9 levels were measured preoperatively for both groups and at 3 and 9 months postoperatively for Group A. Anteroposterior diameter and differential renal function was assessed preoperatively and postoperatively using ultrasonography and DTPA scans. **Result:** Preoperative serum CA 19-9 levels showed no significant difference between PUJO patients (16.8 ± 6.6) and controls (17.2 ± 7.1 , $p=0.824$). In Group A, CA 19-9 levels significantly declined postoperatively at 3 months (16.2 ± 6.3 , $p=0.026$) and 9 months (16.0 ± 6.9 , $p=0.067$). For APD, the mean preoperative value was 2.43 ± 0.73 , which decreased to 2.13 ± 0.68 in the postoperative period ($p<0.0001$). Regarding DTPA clearance, the mean preoperative value was 27.10 ± 5.15 , which increased to 32.0 ± 5.95 in the postoperative period ($p<0.0001$). Additionally, serendipitous findings showed elevated CA 19-9 levels in pyonephrosis (585.3 U/ml) and PUJ calculi (286.6 U/ml). **Conclusion:** Serum CA 19-9 demonstrates no significant correlation with hydronephrosis in paediatric patients with PUJO. Despite normal preoperative and postoperative serum CA 19-9 levels, patients showed significant improvements in renal function and APD after surgery.

INTRODUCTION

Pelviureteric junction obstruction (PUJO) is the leading cause of hydronephrosis in children and infants, defined by obstructed flow of urine from the renal pelvis into the proximal ureter.^[1] PUJO most commonly involves males and is frequently diagnosed antenatally. Fever, urinary tract infections, and abdominal pain are clinical presentations.^[2] Other signs and symptoms are urinary tract infections, haematuria, and palpable abdominal masses. In infants, around 50% of intra-abdominal masses are renal in origin, and 40% of these are due to PUJ obstruction. Although most of these cases are self-limiting, around 20% need treatment.^[1] Treatment options range from conservative

management to surgical interventions like pyeloplasty or endourological procedures.^[3] Delayed diagnosis can lead to renal damage and loss, emphasising the importance of early detection and prompt treatment.^[2] Associated urogenital anomalies are common, with medullary cystic kidney disease being the most frequent.^[4]

PUJO is a major cause of hydronephrosis in children, and reliable biomarkers are needed for its diagnosis and prognosis in this population. One study using capillary electrophoresis with mass spectrometry identified 53 urinary biomarkers that could predict clinical outcomes in PUJO patients with 97% accuracy.⁵ Carbohydrate antigen 19-9 (CA 19-9) is a glycoprotein, a widely used tumour marker, primarily

associated with pancreatic cancer diagnosis and management.^[6]

Serum and urinary CA 19-9 levels have been investigated as potential biomarkers for urinary tract obstruction, including PUJO. A study showed that CA 19-9 concentrations increase in both urine and serum during ureteral obstruction and hydronephrosis.^[7] In cases of giant hydronephrosis due to ureteropelvic junction obstruction, preoperative serum and urinary CA 19-9 levels were significantly higher than in healthy individuals and inversely correlated with renal function.⁸ Postoperative decreases in CA 19-9 levels correlated with improved renal function, suggesting its potential as a non-invasive marker for diagnosis and follow-up in PUJO patients.^[8]

Various modalities of investigation for PUJO/hydronephrosis have been established to determine cases requiring follow-up or surgical intervention. However, certain equivocal cases that initially appear to necessitate only follow-up may ultimately require surgery due to a sudden loss of renal function. By the time surgery is performed, the lost nephron function may or may not be salvageable. Consequently, various biomarkers have been investigated, among which CA 19-9 has demonstrated potential. This study aimed to evaluate the potential role of serum CA 19-9 as a potential role in the management of PUJO.

Aim: This study aimed to evaluate the utility of serum CA 19-9 levels in assessing the severity of PUJO in paediatric patients.

MATERIALS AND METHODS

This prospective case-control study included 60 patients from the Department of Paediatric Surgery, Coimbatore Medical College Hospital. This study was approved by the Institutional Ethics Committee prior to its commencement, and informed consent was taken from all the patients prior to the study.

Inclusion and exclusion criteria

Patients with unilateral PUJO were included, whereas those with bilateral, duplex, or redo PUJO were excluded.

Methods: A total of 60 patients were included and categorised into Group A (n=30) (cases), all diagnosed with unilateral PUJO requiring surgery and managed for over one year. Group B (n=30) (controls) included patients undergoing non-urolurgical paediatric surgery managed over one year. Serum CA 19-9 levels were measured preoperatively in both groups.

In Group A, serum CA 19-9 levels were measured at 3 and 9 months postoperatively. The patients underwent preoperative and postoperative assessments, including anteroposterior diameter (APD) measurement using ultrasonography and differential renal function evaluation using a Diethylenetriamine Pentaacetate (DTPA) scan. APD was assessed preoperatively and postoperatively at 3 months using USG, while differential renal function was estimated using a DTPA scan at one year postoperatively.

All patients underwent standard Anderson-Hynes pyeloplasty with double-J (DJ) stent placement. The DJ stent was removed cystoscopically 4 months postoperatively.

Statistical analysis: Data were presented as mean, standard deviation, frequency, and percentage. Continuous variables were compared using the independent sample t-test, repeated measures analysis of variance (ANOVA) with post hoc analysis, and paired t-test. Categorical variables were compared using the Pearson chi-square test. Significance was defined by P values less than 0.05 using a two-tailed test. Data analysis was performed using IBM SPSS version 25.0.

RESULTS

In Group A, the mean preoperative CA 19-9 level was 16.8 ± 6.6 , and in Group B, was 17.2 ± 7.1 , showing no significant difference ($p=0.824$) [Table 1].

Table 1: Comparison of pre-op CA 19-9 between groups

	Mean $\pm$ SD		P value
	Group A	Group B	
Pre-op CA 19-9	16.8 ± 6.6	17.2 ± 7.1	0.824

In the preoperative period, the mean CA 19-9 level was 16.8 ± 6.6 , in the 3rd month was 16.2 ± 6.3 , and in

the 9th month, was 16.0 ± 6.9 , showing significant differences ($p=0.037$) [Table 2].

Table 2: Comparison of CA 19-9 levels at pre-op, 3rd month and 9th month in Group A

	CA 19-9 level (Mean $\pm$ SD)	P value
Pre-op	16.8 ± 6.6	0.037
3 months	16.2 ± 6.3	
9 months	16.0 ± 6.9	

The mean preoperative CA 19-9 levels of 16.8 ± 6.6 was decreased to 16.2 ± 6.3 at 3 months, with a mean difference of 0.617, showing a significant difference ($p=0.026$). When comparing the preoperative levels

to the 9-month levels, the levels further decreased to 16.0 ± 6.9 , with a mean difference of 0.78, showing no significant difference ($p=0.067$). The comparison between 3-month and 9-month shows a mean

difference of 0.163, with no significant differences (p=1.000) [Table 3].

Table 3: Post hoc analysis of CA 19-9 levels across periods in Group A

	CA 19-9 level		P value
	Mean±SD	Mean difference	
Pre-op	16.8±6.6	0.617	0.026
3 months	16.2±6.3		
Pre-op	16.8±6.6	0.78	0.067
9 months	16.0±6.9		
3 months	16.2±6.3	0.163	1.000
9 months	16.0±6.9		

For APD, the mean preoperative value was 2.43±0.73, which decreased to 2.13±0.68 in the postoperative period, showing a significant difference (p<0.0001). Regarding DTPA clearance,

the mean preoperative value was 27.10±5.15, which increased to 32.0±5.95 in the postoperative period, showing a significant difference (p<0.0001) [Table 4].

Table 4: Comparison of APD and DTPA between pre-op and post-op in Group A

		Mean±SD	P value
APD	Pre-op	2.43±0.73	<0.0001
	Post-op	2.13±0.68	
DTPA	Pre-op	27.10±5.15	<0.0001
	Post-op	32.0±5.95	

An 8-year-old male child was diagnosed with right pyonephrosis and had an elevated CA 19-9 value of 585.3 U/ml. Similarly, a 10-year-old male child was

diagnosed with right PUJ calculous and reported an elevated CA 19-9 value of 286.6 U/ml [Table 5].

Table 5: Serendipitous findings

	Age, gender	Diagnosis	CA 19-9
Serendipitous findings	8 years, MCH	Right pyonephrosis	585.3 U/ml
	10 years, MCH	Right PUJ calculous	286.6 U/ml

DISCUSSION

In our study, preoperative serum CA 19-9 levels did not significantly differ between PUJO patients and the control group, which aligns with the findings by Kajbafzadeh et al. showing preoperative serum CA 19-9 levels were significantly greater in children with ureteropelvic junction obstruction compared to controls and shows no significant differences.⁹ One article by Banerjee et al. indicated that preoperative serum and voided urine CA19-9 levels were significantly higher in the case group compared with controls, correlating inversely and significantly with preoperative percent renal function and glomerular filtration rate.^[8]

Atar et al. demonstrated higher diagnostic performance than serum CA 19-9 in discriminating between obstructive and non-obstructive cases, with a suggested cut-off value of 85.5 U/mL.^[10] Suzuki et al. identified elevated serum CA 19-9 in one-fourth of 68 patients (123 serum samples) with benign hydronephrosis. The inflammation and resultant damage of the urinary epithelium, blockage of the pathway of discharge of CA 19-9, and impairment of the organs metabolizing CA 19-9 lead to an increase in serum levels of CA 19-9.^[11]

In our study, CA 19-9 levels significantly decreased postoperatively in Group A, decreasing from preoperatively to 3 and 9 months, showing a significant difference. Post hoc analysis confirmed this reduction, with the mean difference (0.617)

between preoperative and 3-month levels, (0.78) between preoperative and 9-month levels, and (0.163) between the 3-month and 9-month levels. Banerjee et al. reported giant hydronephrosis due to UPJ obstruction, with preoperative serum and urinary CA19-9 levels significantly elevated compared to controls and postoperative decreases correlating with improved renal function.⁸ Amini et al. mentioned median urinary and serum CA19-9 levels as 34.0 and 15.0 in patients of group A and 16.1 and 5.3 in group B patients. Median level decreased to 12.5 and 4.5 after 8 weeks following TUL. Serum and urine CA 19-9 decreased significantly after the successful removal of ureteral stone by transurethral lithotripsy.^[12]

In our study, imaging assessments showed that the APD of the renal pelvis significantly decreased postoperatively, indicating a positive anatomical response to the surgical intervention. Additionally, differential renal function, as assessed by DTPA scan, showed significant improvement postoperatively, suggesting better functional outcomes after surgery. A study by Panicker et al. reported a postoperative decrease in anteroposterior pelvic diameter correlates with improved drainage on renogram, with positive surgical outcomes.^[13]

Li et al. identified that maximum parenchymal thickness and anteroposterior pelvic diameter to maximum parenchymal thickness ratio can be predictors of differential renal function improvement after pyeloplasty in cases of UJO and children with

UPJO resulted in better DRF in 29.5% of patients, with maximum parenchymal thickness and APD/PT ratio as predictors of improvement.^[14] A study by Nordenstrom et al. found that 27% of patients showed >5% improvement in DRF with antenatal diagnosis, high APD, and low preoperative DRF as predictive factors.^[15]

Immunohistochemical studies demonstrated that CA 19-9 was expressed in the renal tubular epithelium and the urothelium of the renal pelvis, whereas other cells were not positive for anti-CA 19-9 antibodies. Nevertheless, the pathophysiology of abnormal increases in serum CA 19-9 in benign hydronephrosis patients is unknown. Excessive secretion of CA 19-9 in the renal pelvic mucosa could be caused by prolonged chronic inflammation that is a result of hydronephrosis, or CA 19-9 could be produced in the renal pelvic membrane and secreted into the bloodstream as a result of increased internal pressure in the renal pelvis due to the hydronephrosis.^[11,16,17]

CONCLUSION

We concluded that serum CA 19-9 levels were not significantly correlated with hydronephrosis. Our findings indicate that patients who underwent surgical intervention demonstrated normal pre and postoperative serum CA 19-9 levels, along with substantial improvement in renal function and a reduction in APD. These results suggest that serum CA 19-9 has limited utility as a biomarker for detecting or monitoring PUJO.

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