



Contribution of Dynamic Renal Scintigraphy with ^{99m}Tc -DTPA in the Management of Pyeloureteral Junction Syndrome in Senegal: Study of 88 Cases in the Nuclear Medicine Department of Idrissa Pouye General Hospital (Dakar)

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Abstract

Introduction: Pyeloureteral junction syndrome is the most common of the congenital obstructive uropathies. Her annual impact is evaluated at 5 for 100,000 in the general population in Senegal. Its frequency ranged from 1 to 10 across 5000 births. Dynamic renal scintigraphy (DRS) with hyperdiuresis testing has two aims: to define the impact of urinary tract obstruction on renal function and to assess the severity of the obstruction and the flow of the urine. Our objective was to evaluate the role of dynamic renal scintigraphy in the management of ureteropelvic junction obstruction (UPJO) in Senegal. **Methods:** This was a retrospective study based on the records of patients with UPJO who underwent DRS with ^{99m}Tc -DTPA at the nuclear medicine service of HOGIP, from 2010 to 2017. **Results:** We had collected 88 files of obstructive uropathies, the UPJO were represented in 51 cases (57.96%). The average age of discovery was 37.5 years for adults and 5.5 years for children. Male predominance was also generally found among the children who lived in the house of the adults. The circumstances of discovery were represented by clinical signs in the large majority of cases, with a predominance of abdominal pain, followed by signs of urinary infection. The paraclinical exams most commonly used for the diagnosis, management, and monitoring of these pathologies include ultra-

sound of the urinary pathways, urinary tract tests, CT urography, and dynamic isotope scans. Ultrasound had a 78% permit to diagnose a UPJO in 43% of patients. The CT urogram revealed dilation of the calyceal cavities in 98.18% of patients. The intake Treatment was dominated by surgical intervention, taking into account the results by DRS. The data of their dynamic renal scintigraphy with ^{99m}Tc -DTPA yielded the following results: The Tmax was prolonged in 59.80%; the NORA had shown drainage partial drainage in 25.49% and poor drainage in 19.61%; the VFR of both kidneys was abnormal in 43.14% of which 50% are hypofunctional and 50% mute; the obstruction was of organic origin in 49.02%, of functional origin in 41.18% and normal in 9.80% after the post-void test. **Conclusion:** Renal scintigraphy with ^{99m}Tc -DTPA and a furosemide challenge has made it possible to overcome the limitations of morphological imaging techniques in distinguishing organic obstruction from functional impairment, thus contributing to a better grasp of charge therapy with a favorable dosimetric profile.

Subject Areas

Nuclear Physics

Keywords

Dynamic Renal Scintigraphy, Apparent Obstruction Organic, Apparent Obstruction Functional

1. Introduction

Obstructive uropathies are caused by an anatomical or functional obstruction to the normal urinary flow, sometimes even leading to obstructive nephropathy. They can affect either the kidney or the urinary tract (ureters, bladder, and urethra), or the genital organs [1].

Urological conditions, due to their multiple acquired and especially congenital malformations, are seen at all ages. However, the syndrome of junction pyeloureteral (UPJO) and the pathologies lithiasics occupy their first place by report, including compression tumorous, trauma, post-radiation stenosis, ureteral stenosis, megaureter, and the dilation congenital [1]-[3]. In children, they are mainly due to congenital malformations of the urinary [4].

In our days, he consists of many imaging techniques for exploring the urinary system. This mainly involves ultrasound, retrograde urethrography (RUG), retrograde ureteropyeloplasty (RUP), and the CT scan (CT scan) of MRI (magnetic resonance imaging) and of their scintigraphy [1] [5]-[7].

These techniques will most often allow us to confirm the diagnosis, assess the impact on renal function, guide treatment, allow her follow-up, and inform patients and/or parents about the prognosis and possible after-effects of the pathology.

Radioisotopic explorations provide functional and morphological information.

In the course of the main uro-nephrological syndromes [8]. Furosemide-sensitized dynamic renal scintigraphy (DRS) helps to make the difference between an organic or functional obstruction to urinary flow and simple dilation without underlying obstruction. In children, it requires certain methodological precautions related to the pediatric context [6] [9] [10].

These explorations radio isotopic are non-invasive, little irradiating, and constitute a tool essential in their role in charge of diagnostic and therapeutic of the uropathies obstructives.

Our objectives were:

- 1) To evaluate the role of dynamic renal scintigraphy in the management of pueloureteral junction syndrome (UPJO) in Senegal.
- 2) Describe the main socio-demographic, clinical, and radiological aspects of our patients.
- 3) To analyze the results of dynamic renal scintigraphy in our patients.
- 4) To evaluate the usefulness of dynamic renal scintigraphy in therapeutic decision-making and monitoring of UPJO in Senegal.
- 5) To assess the contribution of renal scintigraphy compared to morphological explorations in the management of UPJO.

2. Materials and Methods

The materials and methods of this study are as follows.

2.1. Study Framework

Our study was conducted in the nuclear medicine department of the General Hospital Idrissa Pouye (HOGIP).

Operational since June 2009, the HOGIP nuclear medicine department is the only reference service currently functioning in Senegal.

2.2. Study Types and Population

We conducted a retrospective, descriptive study, focusing on the records of patients with uropathy obstructive (UPJO and/or kidney stones) who benefited from a scintigraphy kidney dynamic at ^{99m}Tc -DTPA at the service of nuclear medicine of HOGIP, over the period from January 2010 to December 2017.

2.2.1. Inclusion Criteria

We included in our study all patients with UPJO syndrome who underwent ^{99m}Tc -DTPA radiotherapy, for whom most information was available.

2.2.2. Exclusion Criteria

The following were not included in our study:

- 1) Patients who have undergone DRS with DTPA for a reason other than UPJO.
- 2) Patients who received a DRS at DTPA but for whom the medical file was not available.
- 3) Patients who have benefited from DRS at MAG3.

2.3. Data Collection and Analysis

2.3.1. Data Collection

To collect the data, we used:

1) The physical records (clinical observation sheets) of each patient included in the study were in the nuclear medicine department and in the originating department.

2) All dynamic renal scintigraphy images recorded during the study period were viewed.

For each case, the data were transcribed onto the analysis sheet designed for the study.

2.3.2. Data Analysis

Data entry and processing were performed using Epi Info software under Windows 10.

The data from their kidney scintigraphy have been compared with clinical, para-clinical (ultrasound and uro-CT), therapeutic, and evolutionary aspects of our patients.

The figures and diagrams have been done with Microsoft Office Excel.

2.4. Variables Studied

2.4.1. Dependent Variables

The variables studied that depended on our study were the results of dynamic renal scintigraphy with ^{99m}Tc -DTPA.

2.4.2. Independent Variables

The variables studied that were not dependent on our study were:

- 1) Epidemiological data: age, sex.
- 2) The indication for renal scintigraphy.
- 3) The time between the diagnosis of obstructive uropathy and the performance of the renal scintigraphy.
- 4) The circumstances surrounding the discovery of the disease.
- 5) The results of the radiological assessment (abdominal ultrasound, urological CT scan).
- 6) The therapeutic approach adopted (abstention, medical and/or surgical treatment, and/or monitoring).

2.5. Examination Procedure Scintigraphy

The different phases of performing the scintigraphic examination are as follows.

2.5.1. Implementation Technique

All our patients benefited from a scintigraphy kidney dynamic at ^{99m}Tc -DTPA, done after intravenous injection, in a bolus of an activity average depending on weight and age.

The dynamic acquisition was conducted over a period of 31 minutes according to two phases:

- 1) A vascular phase (or angioscintigraphic), lasting 60 seconds with 60 sequential images of 1 second each, recorded with a 64×64 matrix, during which the first vascular passage of the radioactive embolus was recorded.

- 2) Nephroscintigraphic phase of 30 minutes with 60 sequential images of 20 seconds each, a matrix of 128×128 , during which the phenomena of accumulation (uptake) and then decrease of the tracer (washout) predominate.

Preparation for the examination consisted of adequate prior hydration of the patient. Urination has been requested when possible, just before the examination, to limit interference from bladder fullness. The patient was placed in decubitus dorsal, the detector in the lumbar region. A restraint has been used notably at the young child's house or when the child was agitated.

Exploration scintigraphy dynamic has been supplemented as needed by an acquisition static image of a one-minute post-void residual, in posterior view, providing information on the quality of bladder emptying (checking for any residual urine) post-micturition and especially assessing the presence or absence of any activity residual in the area of the two kidneys.

The test hyperdiuresis with furosemide has been practiced on all patients. Furosemide was injected into our patients according to the F + 20 protocol, that is, 20 minutes after injection of the radiotracer at a dose of 1 mg/kg (without exceeding a dose maximum of 20 mg).

After digitized processing of the sequential images recorded following the tracing manual of the kidney's kidneys and the BDF (Background Noise), the scintigraphy has been interpreted according to:

- 1) Qualitative criteria: based on a visual assessment of the intra- and extrarenal transit of the tracer.

- 2) Semi-quantitative criteria: based essentially on the study of the isotopic nephrograms obtained as well as their interpretation parameters, essentially: time to maximum activity (Tmax), and normalized residual activity (NORA).

- 3) Quantitative criteria: evaluating the relative contribution of each kidney to glomerular filtration function or separate renal function.

2.5.2. Production Materials

The scintigraphic examination was performed using a wide-field gamma camera equipped with a parallel collimator of weak energy and with high resolution (**Figure 1**).

The data of their scintigraphy kidney have been compared to clinical, paraclinical (ultrasound and uro-CT), therapeutic, and evolutionary aspects of our patients.

2.6. Ethical Considerations

All ethical requirements relating to health research were respected by the nuclear

medicine team led by Professor EHAL Bathily. Patient data were processed confidentially and in strict compliance with medical confidentiality. Record sheets were anonymized using an identification code. The confidentiality of the collected data was ensured.



Figure 1. Dual-head SPECT Gamma camera of the nuclear medicine department of HOGIP and the acquisition console.

3. Results

3.1. Characteristics Epidemiological

The epidemiological characteristics are as follows.

3.1.1. Distribution of the Patients According to Obstructive Uropathy

Of the 88 patients included in our study, 51 or 57.96% had presented with a UPJO (**Figure 2**).

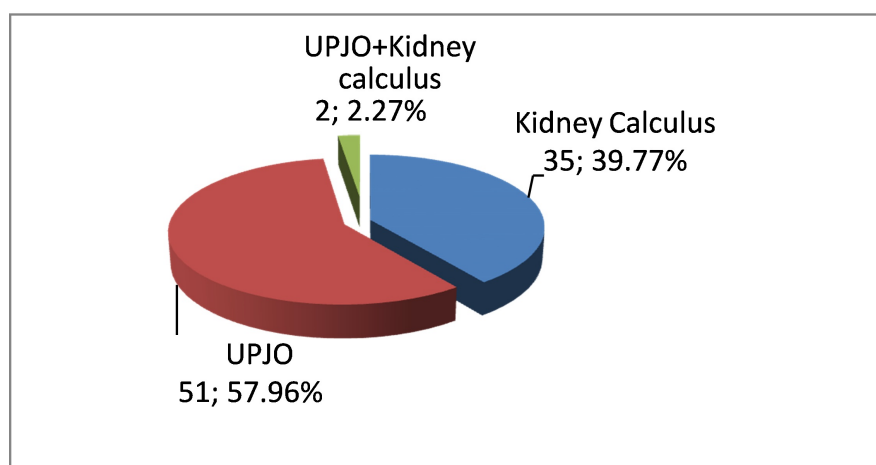


Figure 2. Distribution of the patients according to uropathy.

3.1.2. Age

The study population consisted of adults and children: 33 adults (64.70%) versus 18 children (35.29%).

1) At the house of the adults, the average age was 37.5 years, with an extreme of 19 years and 77 years old. The classes were aged in five-year periods; the most represented were [25 - 30 years old], [55 - 60 years old], and 60 years old and more.

2) Among children, the most represented age group was [2 - 11 years] with a percentage of 66.66%.

3.1.3. Sex

Their distribution of patients by sex showed, globally, a predominance of males. Note, thus, at the house of the child and adults, respectively, 55.56% and 58.33%.

3.2. Features Clinics of the UPJO

The clinical characteristics of UPJO are as follows.

3.2.1. The Circumstances of Discoveries of UPJO

The circumstances of discoveries (fixed-term contract) were dominated by the signs clinics at the house of 45 patients (88.24%), followed by prenatal discoveries with ultrasound at the house of 4 patients (7.84%).

3.2.2. The Data Clinics of UPJO

The most frequently observed clinical findings in UPJO were abdominal pain in 21 cases (46.67%), followed by signs of urinary tract infection in 13 cases (46.67%). 28.89% and their mass abdomen in 6 either case 13.33%.

3.3. Features Paraclinical

The characteristics of the relevant ancillary examinations are as follows.

3.3.1. Ultrasound Data Abdominal

The results of the ultrasound showed that abdominal hydronephrosis was found in 40 cases (78.43%), of which 26 cases (65.00%) were unilateral (15 cases or 37.50% on the left and 11 cases or 27.50% on the right) and 14 cases (35.00%) were bilateral.

3.3.2. The Uro-Scanner

The urinary scan made it possible to demonstrate dilation of the pyelocaliceal cavities in 54 patients (98.18%).

3.3.3. Dynamic Renal Scintigraphy with ^{99m}Tc -DTPA

The results of DRS were represented by:

1. The Activity of the Injected Radiotracer

The average activity injected at the house of our patients was:

1) In adults: 4.73 mci with extremes of 2.46 mci and 9.15 mci.

The intervals of dose of radiotracer 4 - 5 mci and 5 - 6 mci were the most common, with respectively 41.40% and 35.80% patients, respectively.

1) In children: 1.41 mci with extremes of 0.8 mci and 2.57 mci.

The interval of dose 1.5 - 2 mci was more frequent with 61.00% patient.

2. Correlation of the Activity of the Radiotracer Injected with the Weight (N = 6)

We had a small sample of 6 children in our study for whom weight data were available. We found that the injected activity, based on the child's weight, was lower than that calculated using the Card dosage (**Table 1**).

Table 1. Comparison of the activity of the radiotracer injected compared to that calculated according to the CARD dosage.

Weight (kg)	Activity Injected (mci)	Dosage CARD (mci)
19	1.05	2.04
27	1.6	3.07
20	1.2	2.6
30	1.45	3.35
17	1	2.32
21	2.57	2.64

3. Interpretation of the Results

The interpretation of the scintigraphy of the kidney dynamic was basically:

- 1) Time maximum (Tmax, peak capture): It must occur normally between the third and sixth minute.
- 2) Activity residual standardized (NORA): which must be less than 100% (normal drain), partial drain between 100% and 200%, and poor drain if greater than 200%.
- 3) Function kidney relative (FRR): there is a separate renal function, which is normal when between 43% and 57%.

There were visual parameters that allowed us to classify the results of our patients' isotopic nephrograms, as follows (N = 102 isotopic nephrograms).

- 1) Tmax was prolonged in 61NI (Isotopic Nephrograms) or 59.80%, and normal in 40.20% of cases.
- 2) NORA had shown good drainage on 56NI (54.90%), partial drainage on 26 NI (25.49%), and poor drainage on 20 NI (19.61%).
- 3) The VFR of the two kidneys was normal in 58 NI (56.86%) and abnormal in 44 NI (43.14%), including 22 cases (50%) of hypofunctional kidneys (3 cases, understood between 10% and 20%; 19 cases included between 20% and 43%), and 22 cases (50%) of non-functioning kidneys.

Their nature of stasis after the post-void test was:

- 1) Of organic appearance on 50 NI (49.02%) with a predominance right (16 cases or 32%), 14 cases (28%) on the left, and bilateral in 10 cases (20%) (**Figure 3** and **Figure 4**).
- 2) Of a functional or lasix-sensitive appearance on 42NI (41.18%) with a left predominance in 19 cases (45.24%) compared to 15 cases (35.72%) right and 4 bilateral cases (9.52%) (**Figure 3** and **Figure 5**).
- 3) The NI was normal in 10 cases, either 9.80% (**Figure 3**).

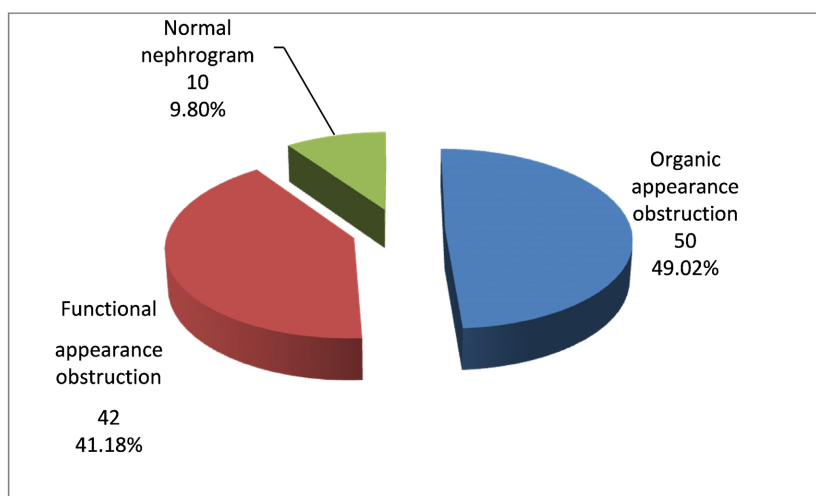


Figure 3. Distribution according to the shape of the isotopic nephrogram.

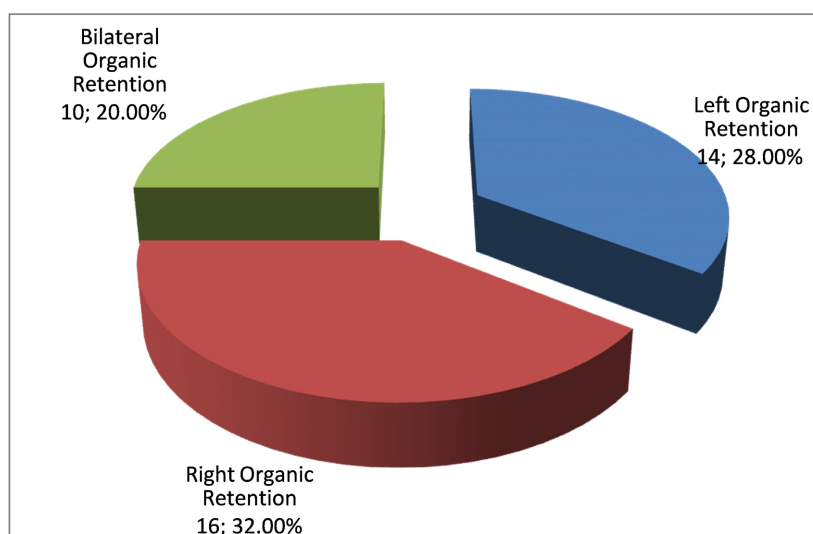


Figure 4. Distribution according to the location of organic-like retentions.

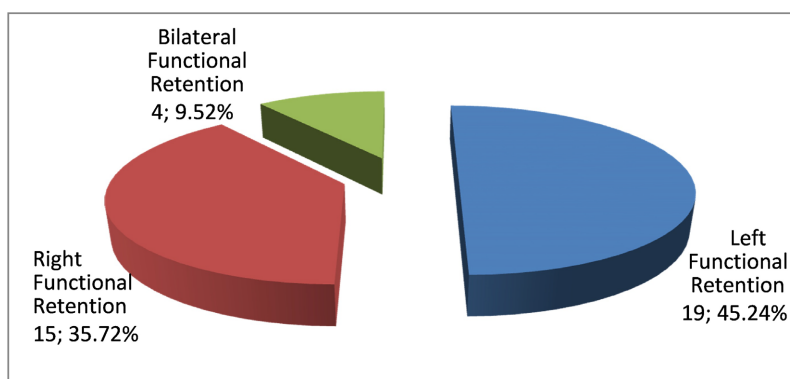


Figure 5. Distribution according to the location of functional-appearing retentions.

4. The Time Required to Perform the Scintigraphy

The average time between the date of diagnosis of obstructive uropathy and the date of realization of their scintigraphy kidney was 26 months 11 days, with extremes of 9 days and 28 years 4 months.

The delivery time class of less than [1 month -12 months] was the most represented, with 47.07% of the patients' follow-up, followed by the 3 - 4 years old with 11.76% and the 5 - 6 years old with 7.84%.

5. Scintigraphy Control

In our study, only 2 patients benefited from a scintigraphy of control: one showed a net improvement in glomerular filtration function, and the other showed results that were nearly identical to their first.

3.4. Aspects Therapeutics

In our study, the treatment received by the patients was:

- 1) 87 cases (98.86%), surgical treatment.
- 2) 1 case (1.14%), therapeutic abstention with monitoring.

The kind treatment the surgeon received was:

- 1) A double JJ probe was used in 22 cases (78.57%).
- 2) Nephrectomy in 6 cases (42.86%).
- 3) A JJ stent was inserted, followed by a nephrectomy in 8 cases.
- 4) Pyeloplasty in 4 cases.
- 5) A JJ stent was inserted, followed by pyeloplasty in 4 cases.
- 6) Nephrostomy in 2 cases of UPJO.
- 7) A JJ stent was inserted, followed by a nephrostomy in 2 cases.
- 8) One case of nephrostomy followed by contralateral pyeloplasty.

For the 2 patients presenting with lithiasis in front of UPJO, one of whom had benefited from an ascent probe JJ followed by a nephrectomy, and the other from an ascent probe JJ and a contralateral pyeloplasty.

4. Discussion

4.1. Obstructive Uropathy

Obstructive uropathy is caused by an anatomical or functional obstruction to the flow of normal urinary function, sometimes even leading to kidney dysfunction. Its prevalence varied in function of its cause and ranges between 5 on 10,000 and 5 on 1000. Affection has a bimodal distribution: in childhood, it is primarily caused by congenital urinary tract malformations; the incidence rate initially declines after age 60 but subsequently rises again, particularly among men [4] [11].

In our study, we found that out of 88 patients, 57.96% had UPJO and 39.77% of kidney stones. These results are consistent with those of Bettaieb *et al.* [12], which confirm that PUJS is the most frequent congenital obstructive uropathy, and with those of Hubaut Mark Antony [13], for whom UPJO is one of the main causes of urinary tract dilation diagnosed prenatally. In contrast, a study by Kahloul *et al.* [14] found that the majority of malformations were urinary problems, represented by vesicoureteral reflux (VUR), accounting for 45.3% of cases, followed by UPJO

(13.8%) and megaureter (12%). The epidemiology of lithiasis is defined by socio-economic level and the degree of medicalization of populations [15].

4.2. Age

The age of discovery of the uropathies obstructives has seen an evolution in recent years, thanks to progress in prenatal diagnosis and undoubtedly to the generalization of the practice of ultrasound obstetrics.

In our study, the average age at discovery of UPJO was among children of 5 years and 6 months and among adults at 37.5 years. These results are almost superimposable with those of M'hamdi Hasnae Aloui [5], who had regained a peak of frequency which is 7.65 years, with extremes of 3 months and 15 years in the children; Hubault Mark *et al.* [13], where the average age was 58.5 months among the children treated surgically and 51 months in children not operated on.

Our results are different from those of Kahloul *et al.* [14], where the mean age at diagnosis was 29.4 months, with extremes ranging from 1 day to 13 years. Similarly, Seye [16], in the same department, also found a predominance of the 1- to 5-year-old age group among children. This is due to the fact that the majority of the children are diagnosed prenatally.

However, in adults, the age of discovery is not systematic and, most often, clinical or symptomatic signs lead the patient to seek medical advice. We found roughly the same results as Kpatcha *et al.* [17], where age ranged from 18 to 75 years, and Sarf *et al.* [18], with an average age of 33 years and extremes of 22 and 40 years.

However, the study by Ghfir *et al.* [19] found a mean age of 18.92 years, with extremes ranging from 4 to 42 years in the general population.

Similarly, Seye [16] in the service had also found an average age of 14 years in his study on the general population.

4.3. Sex

In our study, a male predominance was found in children, as in adults, at 55.57% and 58.50%, respectively.

In the literature, male predominance has been found in various studies of the UPJO.

Ghfir *et al.* [19] found a sex ratio of 1.83; Kpatcha *et al.* [17] a predominance of males with a sex ratio of 2.57; Sarf *et al.* [18] found 37 boys with a sex ratio of 1.08; Ndong *et al.* [20] found a sex ratio of 1.61; and Samb [21] also found a sex ratio of 1.36 in the department. Alaya *et al.* [22] found 16 boys versus 7 girls among the surgically treated children and 21 boys versus 12 girls among the non-operated children.

4.4. Signs of UPJO Discovery

The clinical signs of postnatal discovery of malformative uropathies are not specific. In our study, the circumstances of discoveries were dominated by clinical signs in 88.24%, with abdominal pain, which occupies first place (46.67%), followed by

signs of urinary tract infection in 28.89% and of a mass abdomen in 13.33%.

However, their discovery of prenatal ultrasound is less space-consuming, at 7.84%.

These results are in line with those in the literature, where urinary tract infection, abdominal pain, and mass abdomen are always in the first plan, as shown in the study by Ndong *et al.* [20].

Our results differ from those of Seye [16], who reported 23% of cases of prenatal diagnosis of UPJO using obstetric ultrasound, but remain almost identical in post-natal diagnosis, with 56% of cases presenting with abdominal pain in Senegal. This, along with the study by Seye [16], demonstrates a clear improvement in prenatal diagnosis thanks to obstetric ultrasound.

4.5. Abdominal Ultrasound

The ASP and ultrasound remain the exams of first intention in the presence of symptomatology of the lumbar region. It helps with the diagnosis by stating the diagnosis and allows evaluation of the cortico-medullary index.

In our study, no ASP was performed, which demonstrates the neglect of this exam by more and more who guard all her interests in abdominal symptomatology.

Ultrasound remains a reliable examination for detecting dilation of the cavities pyelocaliceal.

In our study, ultrasound revealed hydronephrosis in 78.43% of cases, including 65% unilateral (37.5% left and 27.5% right) and 35% bilateral.

These results are almost identical to those from the study by Kpatcha *et al.* [17], which reported a left predominance in the localization of the UPJO in 60% of cases.

However, it remains a very useful complementary examination in the investigation of abdominal symptomatology, as it allows for specifying the diagnosis of hydronephrosis, the unilateral or bilateral character of the attack, the presence or absence of lithiasis, and the assessment of their cortico-medullary differentiation. But this examination is increasingly being used in conjunction with CT scans.

4.6. The Uro-Scanner

The most common abnormality in this region is congenital ureteropelvic junction stenosis, commonly named “syndrome of junction”, which, when it is tight, causes hydronephrosis and stasis conducive to lithogenesis. In our study, uro-scanning allowed us to diagnose the stones. Kidneys in 82.86%, of which 89.66% unilateral (44.83% has right and 44.83% has left) and 10.34% bilateral.

Dilation of the pyelocaliceal cavities was noted in 98.18% of cases.

Hydronephrosis was observed in 35.2% of cases to the right and in 40.6% of cases to the left.

However, the study by Lapray *et al.* [3] refuted these results with an involvement of the left side in 22 cases (62.8%) versus 11 cases (31.4%) on the right side,

and in two cases, it was bilateral.

4.7. The Activity of the Radiotracer Injected at the DRS with ^{99m}Tc -DTPA

In our series, the average dose of radiotracer injected in our patients was 4.73 mci at adults and of 1.41 mci at the house of the children.

Previously, the patient's weight was not recorded in the file. We had thus noted the weight for just 6 children.

The curve of correlation of the activity injected as a function of the weight showed a straight line that did not pass through the maximum points, with a low coefficient of correlation ($R^2 = 0.06$).

Our results differ from those of their correlation curve, calculated starting from the EANM (European Association of Nuclear Medicine) Card dosage, where the coefficient R^2 was 0.8.

The card is recommended for optimal management of injected radiotracer doses. It is beneficial for the department to have a radiopharmacist to optimize injected doses and ensure quality control of radiotracers through systematic patient weight measurement.

4.8. The Results of the DRS at ^{99m}Tc -DTPA

The results of the dynamic renal scintigraphy with ^{99m}Tc had allowed us to classify our patients in function of the two large pathologies studied:

Ureteral junction obstruction (UPJO), which is the most frequent of congenital obstructive uropathies, representing 57.96% of cases in our study. It is defined by a urodynamic disorder of the upper urinary tract upstream of a functional or organic obstacle at the pyeloureteral junction.

The Tmax was extended in 59.80% of the UPJO, with values ranging from 6.20 min to 50 minutes; normal in 40.20%. This is due to the delay in radiotracer uptake. Secondly, most often, hydronephrosis with slowed drainage is reported due to an obstruction.

NORA showed good drainage in 54.90%, partial drainage in 25.49%, and poor drainage in 19.61%. These results allow us to make a good decision about the socket responsible for UPJO.

The FFR of both kidneys was normal in 56.86% and abnormal in 43.14%, varying between 0% and 43%. Of these, 50% are hypofunctional (86.36% greater than 20%), 13.64% inferior, and 20% and 50% are mute. Our results are a little different from those of Archambaud *et al.* [23], where the FRR of the kidneys concerned varied between 6% and 50% in the general population, as reported by Alaoui [5]. In whom the FRR was greater than 10% in 16 cases, *i.e.*, 15.08%, and almost identical to those of Archambaud *et al.* [23], where the FRR varied between 40% and 50% in non-children operated on.

In our study, we found an absence of stasis in 9.80% of patients, organic-like stasis in 49.02%, with a predominance of right stasis (32%) over left (28%) and

bilateral (40%).

A state of stasis is functional in 41.18%, with a predominance of left, or 45.24%, against 35.72% has right, and bilateral in 19.04%.

Our results are consistent with those of Adambounou *et al.* [8], who showed obstructive stasis in 18 cases and partially obstructive stasis in 5. In this case, the condition affected the left side in 13 cases and the right side in 10 cases among children treated surgically.

However, these results differ from those of the study by Ghfir *et al.* [19], which found 41.17% with a functional stasis appearance; 29.41% with an organic case obstruction in appearance; 17.64% with an undetermined answer; and 11.76% with a normal appearance.

Similarly, Gohimont *et al.* [9] found, among pediatric patients undergoing surgery, no stasis in 26 cases, obstructive in 26 cases, and partially obstructive in 7 cases, with involvement that was bilateral in 3 cases, on the left in 17 cases, and on the right in 13 cases.

In our study, we noted an absence of obstruction in 13.51% of the cases; in this case, one stasis in appearance organic in 45.95% with a predominance right in 44.12% against 38.24% on the left and 17.64% bilateral; a stasis is functional in 40.54% with a right-sided predominance in 36.66% against 30% to the left and 33.34% bilateral.

4.9. The Deadline Realization of Their Renal Scintigraphy

The average time between the date of diagnosis of obstructive uropathy and the date of performance of renal scintigraphy was long, from 26 months and 11 days for UPJO.

This is due to a delay in performing renal scintigraphy. In fact, scintigraphy has only been available in Senegal in recent years and intermittently. However, we have noted a marked improvement since 2018, with the establishment of the only functional nuclear medicine service in Senegal.

The average time to perform a renal scintigraphy scan after the diagnosis of the obstructive uropathy was very long, 26 months, 11 days for UPJO. This can be explained by the fact that scintigraphy has only been available in Senegal in recent years, intermittently, with significant improvement since 2018, not forgetting that there is currently only one and unique nuclear medicine service for all of Senegal.

4.10. Follow-Up Renal Scintigraphy

In our series, only 2 patients underwent postoperative isotopic monitoring, despite it being an essential component of postoperative monitoring for obstructive uropathies. This can be explained in part by the high cost of the examination and, on the other hand, by the long waiting period for obtaining the scintigraphic examination due to the very distant appointments linked to problems of order of reagents for foreigners.

Despite these problems raised, we observe that the number of scintigraphic ex-

ams is increasing significantly, which would indicate a considerable contribution of this exam in their therapeutic management.

4.11. Therapeutic Characteristics

The determination of renal functional abnormalities is emerging from the development of resourceful morphological imaging techniques such as ultrasound and uro-CT scans, hence the interest in their scintigraphy dynamic at ^{99m}Tc -DTPA with test hyperdiuresis at furosemide, which acts as a means of physio-functional exploration for pyeloureteral permeability with greater precision while specifying the relative contribution of each kidney to the glomerular filtration function. Such information remains precious for orienting their therapeutic approach towards surgical, endoscopic, or medical treatment, or towards abstention, with monitoring that is narrow and well codified.

In our series, dynamic renal scintigraphy with ^{99m}Tc -DTPA, with furosemide-induced hyperdiuresis, has contributed to the therapeutic indication in all patients and led to surgical treatment (radical and conservative) in 98.86% of obstructive uropathies.

Kpatcha *et al.* [17] confirmed that all his patients have summer been taken in charge by open surgery.

M'hamdi [5] found, with surgical treatment in 34 cases, 19.60% in the study of Ndong *et al.* [20], and Audrey *et al.* [24] among children.

Doizi *et al.* [25] recommended their pyeloplasty as the treatment of reference for UPJO in adults.

The studies by Bettaieb *et al.* [12] at the house of the infants and by Hubaut [13] reported a surgical strategy that was effective.

5. Conclusions

Hyperdiuresis testing allows estimation of each kidney's function and evaluation of urine flow to assess the severity of an obstruction. It can be done at birth, but it is preferable to wait until the first month of life due to the low glomerular filtration rate in newborns during the first weeks of life. Scintigraphy has the dual purpose of defining the impact of the obstruction of the urinary tract on renal function and assessing the extent of the obstruction to the flow of urine. In borderline cases, it must be repeated during the first month of life, sometimes quickly.

Dynamic renal scintigraphy (DRS) with ^{99m}Tc -DTPA and a hyperstimulation test diuresis with furosemide serves as an average exploration physio-non-invasive and low-radiation functional method for exploring pathway permeability of the urinary excretory tract, notably the pyeloureteral tract, all in allowing the evaluation of the relative contribution of each kidney to the filtration function of the glomerulus. Such information is indispensable for orienting their therapeutic conduct towards a radical or conservative surgical procedure, or even towards abstention, with monitoring that is narrow and codified. Renal scintigraphy with ^{99m}Tc -DTPA and furosemide challenge has allowed, through our study, to overcome the

limitations of morphological imaging techniques as to the distinction between organic and functional stasis, thus contributing to better therapeutic management at a favorable dosimetric cost.

Conflicts of Interest

The authors declare no conflicts of interest.

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