

## APPROACH OF RENAL PARENCHYMA INFECTION: RETROSPECTIVE STUDY OF PERIOD 2006-2007.

José Antonio Pérez Arbej and María Isabel Cameo Rico<sup>1</sup>.

Servicio de Urología. Hospital Clínico Universitario. Lozano Blesa.

<sup>1</sup>Servicio de Microbiología. Hospital Universitario. Miguel Servet. Zaragoza. España.

**Summary.- OBJECTIVES:** The renal parenchyma acute infection, known as acute pyelonephritis (APN), is diagnosed and treated in some Hospital Departments of the H.C.U. Lozano Blesa. We want to know if the process was made in a homogeneous way, fixed to the described quality standards and if we could detect improvement areas.

**METHODS:** Retrospective study in admitted patients with the diagnosis of APN over and 2 year period (11-05/10-07), evaluating some variables referred to epidemiological data, diagnosis, treatment and evolution.

**RESULTS:** We studied 118 patients (80.5% women, mean age 34 years), that supposed 0.39% of patients admitted from the Emergency Department (36% in Urology and the rest in Paediatric, Obstetric, Internal Medicine and others).

45% showed risk factors (urinary anomalies, diabetes, pregnancy, immunosuppressant, ...), and it is considered complicated APN (CAPN). In children there was a high rate of urinary tract malformations.

Diagnosis was clinical in 82.2%. The rest required imaging techniques, specially children, using gamma scan. In 82.7 % there was leukocyturia and in 79.9% leukocytosis. A urine culture pre-treatment was made in 76.3%, with a positive rate of 55.5%, detecting negative Gram germs in 94% (E. coli in 82%).

Treatment was empiric in all cases, based on cephalosporin, amoxicillin/clavulanic acid and fluoroquinolones. Evolution was favorable in 93.1% (95.1% of NCAPN and 85.7% of CAPN).

The mean hospital stay was 6.4 days (5.6 in NCAPN and 7.5 in CAPN).

**CONCLUSIONS:** Acute pyelonephritis management in our hospital is highly satisfactory and similar to the revised medical literature.

We could emphasize the low rate of urinary cultures pre-treatment (negative in quite a lot of the cases, due to early beginning of antibiotic treatment) and that mean hospital stay could be reduced in CAPN.

We want to congratulate all involved professionals at the hospital for the good practice demonstrated.

**Keywords:** Acute pyelonephritis. Diagnosis. Microbiological study.



### CORRESPONDENCE

José Antonio Pérez Arbej  
Avda. Alcalde Gómez Laguna, 16, 5º C  
50009 Zaragoza. (Spain)

japereza@salud.aragon.es

Accepted for publication: July, 21<sup>th</sup> 2008.

**Resumen.-** **OBJETIVO:** La infección aguda del parénquima renal, conocida como pielonefritis aguda (PNA), es diagnosticada y tratada en diversos Servicios del H.C.U. Lozano Blesa. Deseábamos averiguar si el proceso se realizaba de forma homogénea, ajustándose a los estándares de calidad descritos y si podíamos detectar áreas de mejora.

**MÉTODOS:** Estudio retrospectivo de pacientes ingresados con el diagnóstico de PNA, durante 2 años (11-05/10-07), valorándose diversas variables, referidas a datos epidemiológicos, diagnóstico, tratamiento y evolución.

**RESULTADOS:** Se analizaron 118 pacientes (80,5% mujeres, edad media 34 años), que suponían el 0,39% de ingresos procedentes del S. Urgencias (el 36% en Urología y el resto en Pediatría, Obstetricia, Medicina Interna y otros Servicios).

El 45% presentaba factores de riesgo (anomalías urinarias, diabetes, embarazo, inmunosupresión, etc.), considerándose como PNA complicadas (PNAC). Entre los niños hubo una elevada tasa de malformaciones del tracto urinario.

El diagnóstico fue clínico en el 82,2%. El resto precisó técnicas de imagen, sobre todo los niños, en los que se utilizó gammagrafía. El 87,2% presentaban leucocituria y el 79,9% leucocitosis. Se realizó urocultivo pre-tratamiento en el 76,3%, con una tasa de positividad del 55,5%, detectándose gérmenes Gram negativos en el 94% (*E. coli* en el 82%).

El tratamiento fue empírico en todos los casos, a base de cefalosporinas, amoxicilina/clavulánico y fluorquinolonas. La evolución fue favorable en el 93,2% de pacientes (95,1% de las PNANC y 85,7% de las PNAC).

La estancia media global fue de 6,4 días (5,6 en PNANC y 7,5 en PNAC).

**CONCLUSIONES:** A la luz de la literatura revisada hemos comprobado que el manejo de esta patología, tal y como se lleva a cabo en el H.C.U. Lozano Blesa es altamente satisfactorio y se aproxima mucho a lo publicado por otros autores.

Cabría destacar que se ha detectado una baja tasa de urocultivos pre-tratamiento, que los resultados de éstos son negativos en demasiados casos (por inicio precoz del tratamiento antibiótico) y que la estancia media, en la no complicada, debería reducirse.

Queremos felicitar a todos los profesionales del Centro, implicados en el proceso analizado, por la "buena praxis" demostrada.

**Palabras clave:** Pielonefritis aguda. Diagnóstico. Estudio microbiológico.

## INTRODUCTION

The acute infection of the renal parenchyma, known as acute pyelonephritis (APN) is defined (6, 9, 16, 19) as an infectious process that affects, mainly, the renal parenchyma. It is shown because of an acute fever feature, lumbar pain, bad general condition, leukocyturia and bacteriuria, normally without micturition symptomatology, and is clearly defined in Internal Medicine (2, 18) or Paediatric (5) treatise and Urology (6, 16) or Obstetric (1) summary. The more frequent denomination implies that the infection affects also to the renal pelvis, but the clinic and the treatment are comparable to the clinical feature of parenchyma exclusive infection, total or focal. To avoid mistakes we use the "classic" terminology (APN).

Two process types clearly different are considerate depending on the presence (or not) of becoming infection factors in the superior urinary tract (9-11, 17, 19). These factors could be urinary tract alterations, diabetes, immunosuppression, liver diseases or pregnancy. It would be the complicated APN (CAPN) and the no complicated APN (NCAPN).

The diagnostic could be because of the characteristic symptomatology, based on the urinary deposit (pyuria or leukocyturia) (1, 3, 6, 9, 13, 15-17, 19). Nowadays is considered as very important the bacteriological study (1, 2, 4-6, 9, 10, 12, 13, 15, 16, 18, 19), above all for indicate a correct antibiotic treatment, directed by the antibiogram, using the more appropriate drug, not only because of its effectiveness but also because of its price or toxicity. However, most of cases have an acute presentation that implies a fast reply. In many patients this reply is traduced in the early and empiric antibiotic therapy beginning, without complementary tests.

It is considered that if there aren't concurrent factors early known, images studios aren't necessary, except when the feature goes down in 48-72 hrs, above all in pregnant women and young children, frequently diagnosed with focal nephritis (2, 4, 6, 8, 9, 11, 14).

The empiric antibiotic treatment with broad-spectrum drugs, as amoxicillin/clavulanic, cephalosporin or fluoroquinilones, gives high cure rates, above all in no-complicated cases, with a low recurrence rate (1, 2, 5-7, 9, 10, 12-16, 18, 19).

## OBJECTIVE

The APN supposes between 3 and 5% (9, 14, 19) of urological emergencies in a hospital, al-

though it's difficult to check because it is a pathology diagnoses by many Hospital Departments (Urology, Paediatrics, Obstetrics, Internal Medicine, and so on). This also happens in a big third-level Hospital, like Clínico Universitario Lozano Blesa Hospital.

Because of that reason it is difficult to find out if this assistance is done in acceptable quality levels. The subjective appreciation of an indeterminate number of patients controlled by different Departments and diagnosed and treated in a non-homogeneous way motivated us to begin this study. Our objective was to know the real updated situation about the management of this pathology in our Hospital. If this was possible we would like detect improvement quality assistance areas.

## MATERIAL AND METHODS

It was impossible to find out the actual incidence of infection or acute renal parenchyma or APN in our environment, since being a clinical diagnosis that can be done by any Primary Care Physicians (Family or Paediatrics Physicians), in the Emergency Department or various Clinical Services at Hospital. There is no diagnostic register for non admitted emergencies and the most reliable data are those obtained after the coding of hospital discharge diagnoses.

We presents a retrospective study conducted at the Universitario Lozano Blesa Hospital on patients admitted under the diagnosis of APN.

Through the Documentation Service of the Hospital we investigated the hospital discharges made and encoded for a period of 24 months, from November 2005 to October 2007, both included, which contained the APN between diagnoses, principal or secondary.

We revised clinical records, rejecting those which by the nature of the clinical pattern or the complementary studies do not correspond to the diagnosis of APN. 118 patients were considered as valid for the study.

We analyzed the data, described in Table I, through percentage study and its correlation ( $\chi^2$ ), as well as analysis of variance.

## RESULTS

During this period there were in the Emergency Department of our hospital 245,644 emergencies, being necessary to the admission of 31,572 patients,

the APN was the 0.39% of such income.

The sex distribution of all 118 patients studied were 95 women (80.5%) and 23 men (19.5%). The mean age was 34 years (0 to 83).

The relationship age / sex in the whole sample, showed an average of 31.5 years for females and 43.8 for men, with statistical significance ( $p < 0.05$ ).

The breakdown by age group (Figure 1) showed that among those under 18 years (childhood), 29 cases (24.5%) were the same gender distribution. But among those older than 65 years, 20 cases (16.9%), women were 60% and 40% men. Between ages 18 to 65 years, 69 cases (58.4%), women were 87% and 13% men. The highest frequency decade was the third (20-30 years), with 33 cases (27.9%), and among them there was only 1 male; 97% was women (coinciding with the reproductive age from the women; in this decade 13 of them were pregnant).

The patients were admitted to various Hospital Departments and only 36% in Urology (Figure 2), with most cases in Paediatrics, Internal Medicine and Obstetrics, but also occurred in Gastroenterology, Neurology, Surgery, and so on.

During the period studied there were 4,982 obstetrics urgent admissions, assuming the APN 0.36%. In 1,326 paediatrics admissions were 1.88% of APN. In Urology were 601 admissions, with a 5.99% of APN.

The average age in Paediatrics was 4 years and 25.5 in Obstetrics. We were surprised that the admissions in Urology, with 39.8 years, were much

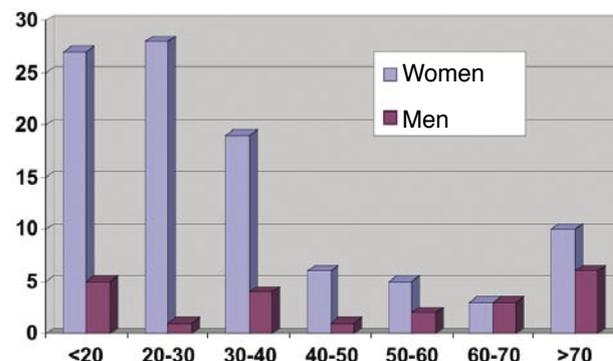


FIGURE 1. Age and sex distribution.

younger than those of Internal Medicine (51.5 years) and Other Departments (66 years).

45% were considered CAPN to present some associated pathology that could have mediated in the genesis of the clinical feature (Table II). 21 (17.7%) of them had urological pathology.

There was no statistically significant association in the fact that 52.1% of men had CAPN compared to 43.1% of women.

It is striking the high rate of children with urological pathology (36%), especially vesicoureteral reflux (28%), which also were diagnosed during their hospitalization for pyelonephritis.

The average age was similar in NCAPN (32.7 years) and CAPN (35.4 years) with no significant difference ( $p > 0.05$ ).

The overall mean stay was 6.4 days (range 1-23), and the analysis of this variable from various points of view provided some interesting data.

The mean stay was 5.6 days in NCAPN, compared to 7.5 days of CAPN, very significant ( $p < 0.01$ ). The mean stay for Departments was also highly variable from the 3.8 days (Obstetrics) to 9.5 days (other Departments), to 7.5 (Urology), 7.3 (Internal Medicine) and 7.8 (Paediatrics).

Surely this variability was influenced by the presence of associated diseases. So if there was no pathology (NCAPN), the mean stay was 5.6 days, reaching 13.4 days in immunosuppressed, 8 days in those with urological pathology, 9 diabetics, 11.6 of the disease varied dropping to 3.8 days in pregnant women. This was due to the need to prolong the treatment (immunosuppressed, diabetics) or conduct more studies, as in children who were diagnosed at the end of vesicoureteral reflux.

Regarding the method for diagnosis (Figure 3) it was clinic in 82.2%. The remainder was based on the findings of imaging techniques (CT, gamma scan or ultrasound) or by a pathological urinary deposit or a positive urinary culture. It is interesting the date that 28% of children were diagnosed using ima-

TABLE I. DATA COLLECTED IN THE CLINICAL FEATURES.

• Sex
• Age at hospital discharge
• Length of hospital stay in days
• Department responsible for the clinical diagnosis
• Existence of associated diseases (and nature)
• Method by which led to the diagnosis
• Whether or not leukocytosis
• Whether or not alterations in urinary deposit
• Existence of urine culture prior to initiation of treatment
• Germ detected in urine culture and antibiogram
• Existence of blood culture
• Germ detected in blood culture and antibiogram
• Antibiotics in the treatment
• Clinical evolution
• Existence of urine culture control after treatment
• Other points of interest (if applicable)

ging tests, especially gamma scan (20%), with the discovery of focal acute nephritis in several cases, or alteration of the urinary deposit (20%). This date is explained by the difficulty to interpret the symptoms of a fever feature in young children. The 100% of pregnant women were diagnosed by the clinic.

Regardless of these methods, the 79.9% was leukocytosis and the 87.2% pathological deposit, data that complemented the suspected diagnosis.

Microbiological studies, before starting antibiotic treatment in hospital, were conducted in 80.5%. Urine culture was made in 76.3% and blood culture in 45%, both carried out in 40.6%.

The positivity rate was only 55.5% in the urine culture and 22.7% in the blood culture. Only 58.9% microbiological studies of the total were positive, probably because many patients when they consulted with the Emergency Department had already begun taking antibiotics, without clinical improvement (home set in Primary Care).

By Departments we found that while Internal Medicine conducted urine culture in almost all patients had a 75% negative result. Paediatric made

urine culture in all children and was positive in 72%. In Obstetrics was conducted in 73% and 75% were positive for urine cultures. But in urology only applied to 50% and the positivity rate was 52%.

Microbiological studies showed the presence of Gram-negative bacteria in 94% of urine cultures, primarily *E. coli* (82%), with a low presence of *P. mirabilis*, *K. pneumoniae* and *K. oxitoca*. Gram-positive germs were uncommon and found *E. faecalis*, *S. mitis* or *Corynebacterium spp.* In blood culture the Gram-negative germs also were in the majority (91.6%), especially *E. coli*.

In our hospital the antibiotics tested to determine the antibiotic sensitivity are reflected in Table III.

The antibiotic sensitivity of Gram-negative germs showed that there was resistance to amoxicillin and ticarcillin in 57.7%, nalidixic acid in 29.2%, cotrimoxazole 17% and 7.3% amoxicillin-clavulanic. The data on the sensitivity of gram-positive germs, by the small number of isolates, were irrelevant.

Antibiotic treatment was set to empirically in 100% of patients, the most used was cephalosporin 44.6% (ceftriaxone 29.6% and ceftotaxime 15%), followed by amoxicillin / clavulanic at 28.9% and 10.1% in ciprofloxacin. Fosfomycin was used in minority (3.3%) and a diverse group of antibiotics in 12.7%. In 22% was used a partnership with aminoglycosides, which was in 17.7% tobramycin.

Revised the treatment by Departments we observed that 88% of paediatric patients were treated

TABLE II. PATHOLOGY FOUND.

18	Pregnancy
4	Decompensate diabetes
5	Immunosuppression (4 HIV)
1	Morbid obesity
1	Alcoholism
1	Multipathology
1	Obstruction by extrinsic compression
1	Septicaemia streptococcal
7	Vesicoureteral reflux
6	Stone
3	Ureteral catheter
2	Way dilatation
2	Neo-bladder
1	Horseshoe kidney

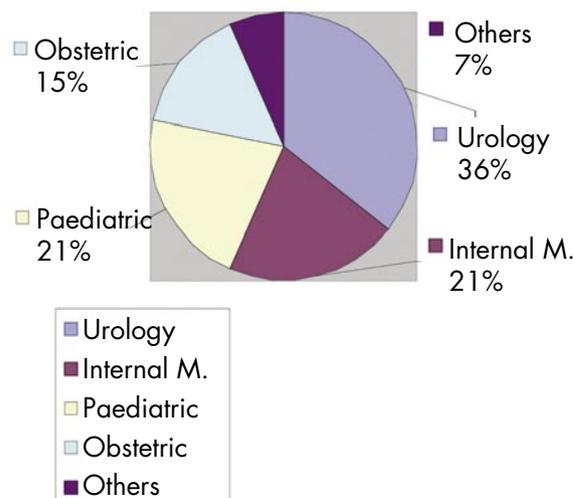


FIGURE 2. Departments Distribution.

with cefotaxime. Pregnant women were treated in 58% with amoxicillin / clavulanic. In Internal Medicine 40% received amoxicillin / clavulanic, cephalosporin 36% and 12% ciprofloxacin. In Urology 57.1% were treated with cephalosporin, in association with 42.8% of aminoglycosides, 23.8% with amoxicillin / clavulanic and 14.2% with ciprofloxacin.

The search made of urine cultures of control after treatment was successful in only 45.9% of patients do not apply to 34.7% and found no data on the rest. In which were located the result were negative in 78.2% and 21.8% positive, detected gram-negative germs in 81.8% (*E. coli* 72.7%).

TABLA III. SENSIBILITY (ANTIBIOGRAM).

Germens gram neg.	Germens gram pos.
Amoxicillin	Penicillin
Ticarcillin	Ampicillin
Amoxi/Clavulanic	Amoxi/Clavulanic
Piper/Tazobactan	Cefuroxim
Cefuroxim	Cefoxitin
Cefoxitin	Ceftriaxon
Cefotaxime	Imipemen
Ceftazidime	Tobramicyn
Cefepim	Erythromycin
Imipemen	Clindamicyn
Meropenem	Tetracycline
Gentamicyn	Chloranfenicol
Tobramicyn	Cotrimoxazol
Amikacyn	Phosphomicyn
Colistina	Ac.Nalidixico
Cotrimoxazol	Ciprofloxacin
Nitrofurantoina	Vancomicina
Fosfomicina	Fusidic acid
Nalidixic acid	Cefalotyn
Ciprofloxacin	

Finally it was considered that the development was good for clinical improvement, do not present new episodes of APN, in 93.2% of the total analyzed (although some cases did TUI). In NCAPN reached 95.1% compared to 85.7% of CAPN, very little significant difference ( $p < 0.05$ ). Regarding the evolution by sex was good in 95.7% of females and 82.6% of men, barely significant, being independent of age, the presence of associated diseases, clinical Departments, the germ isolated or the antibiotic used.

## COMMENTS

The group of patients studied, obtained from the database of coding diagnoses of hospital discharges, as others authors have done (12), shows similar data as published. We had a low rate of hospital admissions for APN (0.39% of total urgent admissions) and we could not find epidemiological data to compare, unless in USA it is estimated that the diagnosis of APN, unspecified hospital, is 11.7 cases/10,000 h / year in women and 2.4 cases/10,000 h / year in men (13).

During the period analyzed the Department of Urology has a 5.99% of admissions by APN, which is higher than the rate quoted as urological emergency (9, 14, 19), given that we only have analyzed the admitted cases.

The frequency was higher in women (80.5%), similar to the literature, between 75.8 and 86.8% of cases (3, 13, 14) and the mean age of presentation was 31.5 in females and 43.8 years for males, similar to what has been published between 30 and 44 years for females (3, 13-15) and about 53 years in males (13). The frequency was the expected by age, both in children, which is more common in girls (5), and older than 65 years, where the proportion of women to men almost equally.

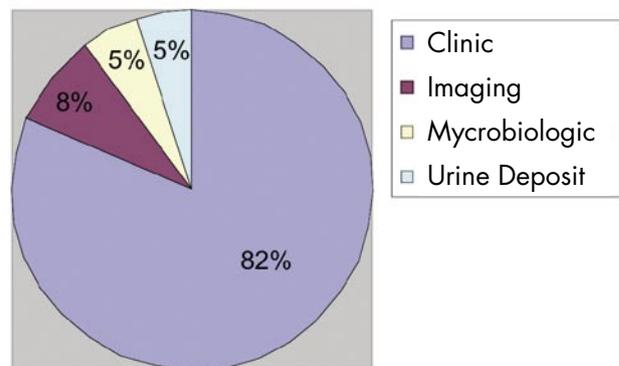


FIGURE 3. Diagnosis method.

The highest rate is in the third decade of life and associated with pregnancy. It is noteworthy that most of the authors estimated a rate in pregnant APN from 2 to 8% (1, 12, 17, 18), because it is estimated that bacteriuria in pregnant women is present in 20-40% (1, 2, 12, 18, 19), while 5% of pregnant women without bacteriuria may also APN (1).

We had a high rate of CAPN (45%), independent of age and sex. The 17.7% of patients had associated urinary pathology similar to that described above, 18% (13).

We encountered an overall mean stay too long (6.4 days), which except for pregnant women was even more striking in CAPN (7.5 days). Most authors believe that APN should improve in about 48-72 hours (7, 9, 13, 16, 18, 19) so the hospital stay should be between 2 and 5 days (14, 19).

All authors agree that the diagnosis of APN is primarily clinical, supported by the finding of leukocytosis and pyuria. Also consider the most essential confirmation infectious feature by urine culture before treatment, which is usually positive in 80% of cases (9, 10, 13, 16). The germ is the most frequently isolated is *E. coli* in the 70-97% (1-7, 12-14, 16-19). But not so clear is the need for blood culture, which is usually positive and much less often, between 10-30% (2, 9, 13, 19), also *E. coli* in the 75-94% (2, 13, 19). In our series was made urine culture in 76.3% and blood culture in 45% of patients, with an overall positivity 58.9%, found *E. coli* in 82%. In children urine culture was made to 100% and the result was positive in 72%.

Regarding the use of imaging tests is quite controversial, is considered unnecessary in NCAPN (2, 4, 6, 8, 9, 11, 14). Some authors believe that ultrasound should be used in almost all cases (12, 14), although there is sufficient evidence to support its little use (4, 8, 11, 13) and that 96% of ultrasound in NCAPN are normal (11) It is agreed that for pregnant women and children, it is essential to use imaging studies and in the young children the differential diagnosis is made with the gamma scan, finding frequently focal nephritis (1, 4 - 6, 9). In cases that do not improve in 48-72 hours or criteria of CAPN (urinary pathological history, diabetes, immunosuppression, liver diseases, alcoholism, and so on) if it is considered necessary to use imaging studies (6, 7, 9, 12, 13, 16, 19).

In our series, the clinical diagnosis was made in 82.2% of cases, especially in paediatric patients often required to perform gamma scan and other complementary studies, which led to several

cases of diagnosed nephritis focal and vesicoureteral reflux.

The treatment requires antibiotics and general measures (hydration, rest, analgesia and antipyretic). It is recommended start parenteral 24-48 hours and continues until oral 2 weeks. There is controversy about the need for hospitalization, it seems clear that in pregnant women and children and if it is suspected CAPN and have published some very interesting experiences in Hospital at Home like as an alternative to hospitalization (13). The antibiotic is empirically chosen in the vast majority of cases, since the onset of the clinic can not wait for the outcome of the antibiogram. It advised the use of amoxicillin-clavulanic, cephalosporin, fluoroquinolones and aminoglycosides, customizing the drug chosen according to age, pregnancy, history of allergies, and so on (1-3, 5-7, 9, 10, 12-16, 18, 19). In our series these treatments are used with certain Departments preferences.

Most of the authors believe that the prognosis for uncomplicated cases is considered good. The trend is towards healing in 100% of cases, with complete recovery of 5-6 days (6). In CAPN the healing is reduced to 80-85% (6), for persistent symptoms or early recurrence of the feature, estimated at a 10-30% of cases (16). In our series was considered to have completed healing in 95.1% of NCAPN because some cases had some later episode of TUI, and 85.7% of CAPN. We also note that recurrences were more numerous among men.

It is considered necessary to perform urine cultures of control after treatment, although in our series was requested by less than half of cases, with positive results in very few cases.

## CONCLUSIONS

The discussed results and the consulted bibliography have given us the great surprised that, in general, the management of the renal parenchyma infection or acute pyelonephritis, in the way that is made in our Hospital is very satisfactory, in spite of being in many different Hospital Departments.

We have noticed that it is less frequent as a cause to admission than we thought, in general, and more frequent than expected in Urology Department (should they be admitted prefer in other Departments, like Internal Medicine or Infectious Diseases?). We have had a high rate of CAPN which maybe shows that most cases of APN don't need hospital admission and should be treated with home care.

It is worth mentioning that the global admission rate was very extend (6.4 days), probably influenced by the high presence of associated pathologies.

The urine culture rates were low (76.3%), inappropriate with the Hospital level, with a low rate of positive results (55.5%). This shows an empiric beginning in the treatment previous to the urine collection. The Paediatric Department was the only one that didn't work in this way.

In conclusion, it is necessary to reduce the hospital stay, avoid treatment beginnings without urine culture and make urine cultures in the most of possible cases.

We also wish that this publication will serve as a tribute and recognition of "good practice" of all of our hospital, encouraging them to continue in this line of good quality care.

## REFERENCES AND RECOMENDED READINGS (\*of special interest, \*\*of outstanding interest)

- \*1. Ación P. Enfermedades coexistentes. Infecciones y enfermedades infecciosas en el embarazo, en Tratado de Obstetricia y Ginecología, 2ª edición, Ediciones Molloy, Alicante (España), 2001; p. 447-476.
2. Caramelo Díaz C, Hernando Avendaño L. Pielonefritis, en Farreras-Rozman, Medicina Interna, 13ª edición, Ediciones Doyma, Barcelona (España), 1996; p. 932-936.
- \*3. Force L, Murgui L, Barrufet P, et al. Pielonefritis aguda: Análisis prospectivo de 91 casos, Rev Clin Esp. 1991; 188: 223.
- \*\*4. García-Ferrer L, Primo J, Juan Escudero, et al. Uso de la ecografía en la pielonefritis aguda del adulto, Arch. Esp. Urol. 2007; 60: 519.
- \*5. García-Fuentes M, González-Lamuño D. Infecciones del tracto urinario", en M. Cruz, Tratado de Pediatría, 9ª edición, Ediciones Ergon, Madrid (España), 2006; p. 1692-1703.
6. Gelabert Mas A, Lorente Garín JA, Placer Santos J. Infecciones urinarias sintomáticas, en J.F. Jiménez Cruz y L.A. Rioja Sanz, Tratado de Urología, 2ª edición, Ediciones Prous Science, Barcelona (España), 2006; p. 1240-1243.
- \*\*7. Gobernado M, Jiménez Cruz F. La infección urinaria", Procedimientos en Microbiología Clínica, S.E.I.M.C., 2002. (Disponible en [www.seimc.org/documentos/protocolos/microbiologia](http://www.seimc.org/documentos/protocolos/microbiologia)).
- \*8. Luján Galán M, Páez Borda A, Fernández González et al. Utilidad de la ecografía en la evaluación de la pielonefritis aguda, Arch. Esp. Urol. 1997; 50: 46.
9. Mensa JM, Pilgrau C, Horcajada JC, et al. Infección urinaria", Protocolos Clínicos de la S.E.I.M.C. 2008. (Disponible en [www.seimc.org/documentos/protocolos/clinicos](http://www.seimc.org/documentos/protocolos/clinicos))
10. Mensa JM. Guía Terapéutica Antimicrobiana, Edit. Masson, 16ª edición, Ediciones Masson, Barcelona (España), 2006; p. 424-427,
11. Ortega Enciso L, Sánchez Martínez F, Escape Díaz-Bonilla I, y colls., "Indicaciones clínicas de la ecográfica en la pielonefritis aguda en mujeres adultas", Rev. Clin. Esp. 1998; 198(10): 647.
- \*12. Pazos Otero N, Fuentes Ricoy L, Fernández Pérez B, et al. Pielonefritis y embarazo. Experiencia durante un año en un hospital general", An. Med. Interna, Vol. 24, nº 12; 585, 2007.
- \*\*13. Regalado J, Mendoza H, Aizpuru F, et al. Pielonefritis aguda atendida en hospitalización a domicilio. Diez años de experiencia", Enferm. Infecc. Microbiol. Clin. 2006; 24(10): 629.
- \*\*14. Roca-Tey R, García-Osuna R, Torguet P, et al. Pielonefritis aguda. Estudio de 153 casos, Nefrología, 2000; 20 (4): 373.
15. Sanford "Guía de Tratamiento Antimicrobiano", 36ª edición, Págs. 26-52-72, Editado por Antimicrobial Therapy, Inc, Estados Unidos, 2006.
16. Schaeffer AJ. Infecciones urinarias, en Campbell, Urología, 8ª edición, Editorial Panamericana, Buenos Aires (Argentina), 2004; p. 599-601.
- \*17. Silmi A, Redondo E, Blázquez J et al. Clínica de las infecciones del tracto urinario superior, Clínicas Urológicas de la Complutense, Servicio de publicaciones de la U.C.M., Madrid, (España), 5, 83, 1998.
18. Stamm WE. Infecciones urinarias y pielonefritis, en Harrison, Principios de Medicina Interna, 16ª edición, págs.1890-1897, Editorial McGraw-Hill Interamericana, Santiago de Chile (Chile), 2006.
19. Yomayusa González N, Altahona Suárez H. Pielonefritis aguda, cap. X, de "Guías para el manejo de urgencias", Ministerio de Protección Social, 2ª edición, Colombia, pag.1112, 2005. (Disponible en <http://www.minproteccionsocial.gov.co>).