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# Study of risk factors for urinary colonization in patients with the double J catheter

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## Abstract

**Background:** The aim of this study is to evaluate the prevalence of urinary colonization in patients with the JJ stent and to define the predictive factors associated with this colonization.

**Methods:** This is a monocentric prospective study (between January 2013 and April 2017), conducted in the department of Urology B of Ibn Sina Hospital in Rabat. One hundred and forty-five double ureteral stents carried by 120 patients, 25 of which had bilateral double ureteral stent, were examined. The bacteriological profile of the urine of our patients was followed by the completion of an initial urine examination and another at the time of the removal of the JJ. The comparison of the means was made by the Student's test and the Mann-Whitney test for continuous variables and by the KHI-2 test and Fisher's test for qualitative variables. The threshold of significance is set at 0.05.

**Results:** The rate of colonization of JJ stent was 35.8% (43 out of 120). The urinary colonization rate was 31.7% (38 out of 120). Average time of indwelling of JJ stent was 90 days.

On double ureteral stent culture, we identified *Escherichia Coli* as the most predominant colonizing pathogen (47.3% of probes) followed by *Enterococcus faecalis* and *Klebsiella pneumoniae* (18.4% and 15.8%, respectively). 11.5% of colonized patients developed infectious complications (5 out of 43) and have been treated successfully except a patient who died from septic shock.

In univariate analysis, diabetes mellitus ( $p=0.007$ , OR=4.1, CI=1.46–11.48), urgent establishment of JJ ( $p=0.03$ , OR=4.61; IC=1.08–19.6) and time of indwelling of the JJ ( $p=0.05$ , OR=1.89, CI=0.95–3.77) were the predictive factors for urinary colonization in patients with JJ. In multivariate analysis, these three factors were statistically associated with this risk: diabetes mellitus ( $p=0.005$ , OR=0.23, CI=0.08–0.64), the urgent establishment of JJ ( $p=0.05$ , OR=0.26, CI=0.06–1.04) and time of indwelling of the JJ more than 30 days ( $p=0.007$ , OR=4.29, CI=1.49–12.37).

**Conclusion:** The prevalence of urinary colonization in patients with the double J stent was 31.7%. Diabetes mellitus, time of indwelling of the JJ more than 30 days and urgent JJ establishment are associated with a higher risk of these urinary colonizations.

Strict monitoring is therefore recommended in patients with these risk factors. These results should be confirmed by multicenter and randomized studies to analyze the development of urinary tract infections in colonized patients.

## 1 Background

The use of double J ureteral catheters has grown considerably in current practice. Ureteral stents are synthetic biomaterials with surfaces suitable for bacterial

colonization and the development of a biofilm of polysaccharides. Under these layers, bacteria increase the number of microcolonies formed [1].

In indwelling ureteral stents, bacterial colonization plays an essential role in the pathogenesis of urinary tract infections [2].

Few studies have addressed the risk factors for bacteriuria and colonization in patients with the double J ureteral catheter [3].

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The purpose of our study is to identify the prevalence of urinary colonization among people with double J stents and the risk factors associated with these colonizations.

## 2 Methods

It is a prospective monocentric study carried out in the department of urology in collaboration with the microbiology laboratory of the same hospital. One hundred and twenty were included in the study between January 2013 and April 2017.

The inclusion criteria were:

- Any patient who has a double J stent whatever the age, sex, co-morbidities and indication
- The patient's informed consent.
- The exclusion criteria were:
- The patient's refusal
- Pregnant women
- The presence of yeasts in the culture

The study protocol consisted in carrying out:

- A CBU examination before the placement of the double J stent.
- A CBU examination when the double J stent was removed (the same day). All bacteriological examinations were carried out in the same microbiology laboratory.

Non-selective media are used for the culture of calculations such as BCP or bromocresol purple lactose broth and CLED medium (cystine–lactose–electrolyte-deficient = medium enriched in cystine and lactose and poor in ions) for an incubation period of 48 h.

All patients received preoperative antibiotic prophylaxis (single dose) in case of negative CBU examination by cefalotin or cover antibiotic therapy (a duration of 5 days including 48 h preoperatively adapted to the antibiogram) in case of positive CBU examination according to the recommendations of SFAR2008, updated in 2010 and the European recommendations of the EAU.

The statistical analysis was carried out using SPSS 10.0 software. The comparison of the means was made by the Student's test and the Mann–Whitney test for the continuous variables and by the KHI-2 test and the Fisher test for the qualitative variables. The significance threshold is set at 0.05.

## 3 Results

Our study involved 120 patients with a sex ratio of 1.26 (F / M). The average age was 44.6 years with extremes ranging from 16 to 80 years.

The double J ureteral stent was performed urgently in 11 patients. In 6 cases, it was acute pyelonephritis, obstructive renal failure (3 cases) and hyperalgesic nephritic colic (2 cases). The double J ureteral catheter was inserted in programming of the department in 109 patients. In 95 patients, the double J ureteral catheter was unilateral (79.2%) and bilateral in 25 patients (20.8%).

The indications for placement of the double J ureteral catheter were varied, 40% of cases (48 cases) by urinary stones in its various forms, in particular before the extracorporeal shockwave therapy (ESWT). Kidney transplantation was in the second position: 28 cases (23.3%).

The time of indwelling of double J ureteral catheters varied between 10 and 540 days, with an average time of 90 days. One hundred and forty-five double J ureteral catheters were analyzed in the microbiology laboratory. The culture was positive on 43 stents, whether colonization rate of the catheters of 35.8%.

In our study, 11 patients benefited the insertion double J ureteral catheters in an emergency context for specific indications. Seven of these 11 stents were found to be colonized on removal with a positivity rate of 63.6%. For the programmed J double-inserted stents, 28.4% of them were colonized, with a statistically significant difference ( $p=0.03$ ). The overall rate of urinary colonization was 31.7%. In univariate analysis, diabetes mellitus ( $p=0.007$ , OR=4.1, CI=1.46–11.48), urgent establishment of JJ ( $p=0.03$ , OR=4.61; IC=1.08–19.6) and time of indwelling of the JJ ( $p=0.05$ , OR=1.89, CI=0.95–3.77) were the predictive factors for urinary colonization in patients with JJ. In multivariate analysis, these three factors were statistically associated with this risk; diabetes mellitus ( $p=0.005$ , OR=0.23, CI=0.08–0.64), the urgent establishment of JJ ( $p=0.05$ , OR=0.26, CI=0, 06–1.04) and time of indwelling of the JJ more than 30 days ( $p=0.007$ , OR=4.29, CI=1.49–12.37) (Tables 1 and 2).

Among the pathological history incriminated in the pathophysiology of urinary tract infections, diabetes and its characteristics were sought and analyzed in these patients.

A subgroup of 23 diabetic patients was identified in our series (19.2%).

Fourteen diabetic patients in this category were colonized (60.9%). This difference in rates between the two groups of diabetic patients who were colonized is not remained statistically significant ( $p=0.005$ ).

We grouped our patients into three groups according to the time of indwelling of the JJ: the first group (less than 30 days), the second group (between 30 and 60 days) and the third group (more than 60 days), in relation to the urinary culture at the time of removal of the JJ and the culture of the double J stent; it was found that the first group exhibit fewer colonizations than the

**Table 1 Comparison of the both groups colonized and not in univariate and multivariate analyses**

Variables	Non-colonized patients	Colonized patients	Univariate analysis		Multivariate analysis	
			OR (95% IC)	p	OR (95% IC)	p
	N=82	N=38				
Sex (%)			0.95(0.36–2.52)	0.92		
Male	38(46.3)	15(39.4)				
Female	44(53.7)	23(60.6)				
Age (years)	44.6 ± 14.1	47.3 ± 13.2	1.01(0.97–1.04)	0.57		
JJ's indications (%)			1.22(0.56–2.64)	0.61		
Renal lithiasis	31(37.8)	17(44.7)				
Kidney transplant	24(29.2)	4(10.6)				
Other diagnosis	27(33)	17(44.7)				
Positioning situation of JJ (%)			4.61(1.08–19.6)	0.03	0.26(0.06–1.04)	0.05
Urgent	4(4.9)	7(18.4)				
Not urgent	78(95.1)	31(81.6)				
Diabetes (%)			4.1(1.46–11.48)	0.007	0.23(0.08–0.64)	0.005
Yes	9(11)	14(36.8)				
No	73(89)	24(63.2)				
Side (%)			0.52(0.16–1.65)	0.26		
Unilatéral	70(85.4)	25(65.8)				
Bilatéral	12(14.6)	13(34.2)				
JJ approach (%)			1.74(0.52–5.80)	0.36		
Open	42(51.2)	12(31.6)				
Endoscopic	40(48.8)	26(68.4)				

**Table 2 Relation between urinary culture at the time of JJ removal and the time of indwelling**

	Urinary culture at the time of DD removal n (%)		Total	p value
	Negative	Positive		
	Duration of implementation of JJ (days)			
< 30	37 (30.8)	6(5)	43(35.8)	0.005
30–59	4(3.3)	3(2.5)	7(5.8)	
Au moins 60	41(34.1)	29(24.3)	70(58.4)	
Total	82(68.2)	38(31.8)	120(100)	

other groups with a statistically significant difference in the two cultures ( $p = 0.005$ ,  $p = 0.002$ ) (Tables 2, 3).

Monitoring the bacteriological profile of urine in non-colonized patients (82 patients) showed the following results:

- 85.3% of patients (70 among 82) had not developed any colonization or symptomatic urinary tract infection,

**Table 3 Relation between the culture of the double J stent and the time of indwelling**

	Culture of the double J n(%)		Total	p value
	Negative	Positive		
Duration of implementation of JJ (days)				0.002
< 30	36(30)	7(5.8)	43(35.8)	
30–59	5(4.2)	2(1.6)	7(5.8)	
Au moins 60	36(30)	34(28.3)	70(58.3)	
Total	77(64.2)	43(35.8)	120(100)	

- 14.7% of patients had urinary colonization (12 out of 82).

Monitoring the bacteriological profile of urine in colonized patients (38 patients) showed the following results:

- 18.4% of patients with colonized double J ureteral catheters (7 out of 38) had negative CBU examination,

- 81.6% of patients (31 out of 38) carrying colonized double J ureteral catheters had one or more colonization (s) during the period of carrying the catheter (s).

Several germs have been isolated from colonized double J ureteral catheters and from the CBU examinations of patients carrying these stents. Among the germs documented during cultures of double J ureteral catheters:

- Escherichia coli was in the first position: 47.3% of the colonized stents (18 probes out of 38), Enterococcus faecalis in the second position in 18.4% (7 probes out of 38) and Klebsiella pneumonia was in third position (6 stents out of 38) or 15.8%. The other germs (15.8%) were represented, respectively, by the enterobacter cloacae carbapenemase and the Staphylococcus aureus (Table 4).

Overall, 31.7% of patients with double J ureteral catheters developed urinary colonization during the drainage period. The occurrence of infectious complications was noted in 11.5% of colonized patients (5 of 43) and was treated successfully except one patient who died from septic shock, and 4% in non-colonized patients (3 of 77) (Table 5).

#### 4 Discussion

The use of double J ureteral stents has become common in urological practice; it is not devoid of certain infectious complications (sepsis, septic shock).

The bacterial colonization of double J ureteral catheters and bacteriuria is described for the first time by RIEDL et al. [4].

**Table 4 The different germs found in urinary culture and the JJ stent**

Microorganisms n(%)	Urinary colonizations N=41	JJ colonizations N=38
Negative Staphylococcus coagulase	3(7.4)	0(0)
E. coli	16(39.1)	18(47.3)
Klebsiella pneumoniae	8(19.5)	6(15.8)
Enterococcus faecalis	7(17.1)	7(18.4)
Staphylococcus hominis	2(4.9)	0(0)
Enterobacter cloacae carbapenemase	1(2.4)	2(5.3)
Serratia marcescens	1(2.4)	0(0)
Staphylococcus epidermidis	1(2.4)	0(0)
Citrobacter freundii	1(2.4)	0(0)
Streptococcus mitis	1(2.4)	0(0)
Staphylococcus aureus	0(0)	5(13.2)

**Table 5 Comparison of various infectious and stent-related complications between colonized and non-colonized patients**

	Colonized patients N=22/43	Non-colonized patients N=7/77
Infectious complications		
Sepsis	2(4.6)	3(4)
Severe pyelonephritis	2(4.6)	0(0)
Septic shock	1(2.3)	0(0)
JJ catheters complications		
Blocking	8(18.6)	1(1.3)
Incrustation	5(11.6)	1(1.3)
Intolerance	4(9.3)	2(2.6)

Table 6 summarizes the main results of various international series studying the bacterial colonizations of the double J stent [2, 4–7, 9, 10].

With regard to the risk factors linked to bacterial colonization, Kehinde et al. mentioned that the risk is increased 2 times for women [8]. Likewise, Atay et al. found a higher rate of colonization in women [11].

Aydin et al. showed that colonization was found in 31.1% of men and 26.8% of women, with a nonsignificant difference [9]. In our series, colonization was objectified in 39.4% of men and 60.6% of women with a nonsignificant difference ( $p=0.92$ ). This is explained by the intimate connection between the female urinary system and the digestive flora.

The time of indwelling of the ureteral stent has been evaluated; Farsi et al. concluded that as the duration increases, the colonization rate increases (58.6% before 1 month, 75.1% after 3 months). [5] Similarly, Kehinde et al. have objectified that the risk of colonization increases with the duration of porting (the 1st month at 4.2% and the 3rd month at 34%) [8].

Özgür et al. grouped the patients according to the length of time the JJ was worn: less than 4 weeks, between 4 to 6 weeks and more than 6 weeks; they found a significant increase in the risk of colonization after 6 weeks [12]. Paick et al. have pointed out that colonization begins after 2 weeks [4].

Aydin et al. divided the patients according to the wearing time of the JJ, i.e., 1–21 days, 22–42 days and more than 43 days. The colonization rate is higher in patients who have kept the double J stent for 43 days or more [9].

Klis et al. [13] objectified a statistically significant correlation between the culture of urine and the time of indwelling of the double J stent ( $p<0.05$ ).

However, chronic kidney disease, diabetes mellitus and pregnancy weaken the immune system; it is possible to mention an increased risk of colonization in

**Table 6 Summary table of the various international series comparing the rate of bacterial colonization with our study**

	Number of cases	Bacterial colonization rate (%)	Duration of JJ	Most present germs (%)
Farsi et al. [5]	237	68	4 months	P. aeruginosa (23) S. epidermidis (19) Streptococcus (16) E. coli (9)
Riedel et al. [4]	71	69	14 days	Enterococcus (51) S. Epidermidis (33) E. Coli (12)
Paick et al. [2]	50	44	14 days	Enterococcus (24) E. coli (20) Gram-positive (12) Neisseria Subflava (8)
Ried et al. [6]	30	90	5–128 days	Cocci gram + (77) Bacillus gram – (15) Candida (8)
Ben-Meir et al. [7]	82	70	6 weeks	Enterococcus (23) Staphylococcus (15) Pseudomonas (7) E. coli (6)
Ayyildiz et al.	39	53.8	75 days	E. coli (28) Enterococcus (28) Candida Staphylococcus
Kehinde et al. [8]	250	Female = 64.3 Male = 34.7	27 days	Staphylococcus species (42) E. faecalis (14) E. coli (14) P. aeruginosa (10)
Our study	120	35.8	10–540 days	E.coli (47.3) Enterococcus faecalis (18.4) Klebsiella pneumoniae (15.7)

these patients [8, 11]. In our study, we found 14 diabetic patients (11.6%) who are colonized with a significant difference ( $p=0.005$ ).

In addition, when colonization is examined according to the indication for insertion of the stent, by comparing the urinary stones with other indications, it has no effect of the reason for insertion on colonization [9].

In our study, 17 colonized patients (14.2%) had kidney stones, 4 colonized patients (3.3%) had kidney transplants and the other diagnoses in 17 patients (14.2%). There is no statistically significant difference ( $p=0.61$ ).

## 5 Conclusion

The prevalence of urinary colonization in patients with the double J stent was 31.7%. Diabetes mellitus, time of indwelling of JJ more than 30 days and urgent implementation of JJ are associated with a higher risk of these urinary colonizations.

A close monitoring is therefore recommended in these patients with these risk factors. These results would be preferable to confirm them by multicentric and randomized studies to better analyze the development of urinary tract infections in colonized patients.

## Abbreviations

CBU: Cytobacteriological urine; ESWT: Extracorporeal shockwave therapy.

## Authors' contributions

AS analyzed and interpreted the patient data regarding the subject. TK, KE, AK and AIAA were a major contributor in writing the manuscript. All authors read and approved the final manuscript.

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## Ethics approval and consent to participate

The ethics committee of the Faculty of Medicine of Rabat has given us its agreement. The reference number is not applicable. Informed consent to participate in the study was provided by all participants.

## Consent for publication

The patient gave his informed and free consent for the publication of this work.

## Competing interests

The authors declare that they have no conflicts of interest in connection with this article.

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## References

1. Yeniyoğlu CO, Tuna A, Yener H, Zeyrek N, Tilki A, Coskuner A (2002) Bacterial colonization of double J stents and bacteriuria frequency. *IntUrolNephrol* 34:199–202
2. Paick SH, Park HK, Oh SJ, Kim HH (2003) Characteristics of bacterial colonization and urinary tract infection after indwelling of double-J stent. *Urology* 62:214–217
3. Al-Ghazo MA, Ghalayini IF, Matani YS, El-Radaideh KM, Haddad HI (2010) The risk of bacteriuria and ureteric stent colonization in immunocompromised patients with double J stent insertion. *IntUrolNephrol* 42:343–347
4. Riedl CR, Plas E, Hubner WA (1999) Bacterial colonization of ureteral stents. *EurUrol* 36:53–59
5. Farsi HM, Mosli HA, Al-Zemaity MF et al (1995) Bacteriuria and colonisation of double-pigtail ureteral stents: long-term experience with 237 patients. *J Endourol* 9:469
6. Reid G, Denstedt JD, Kang YS, Lam D, Nause C (1992) Microbial adhesion and biofilm formation on ureteral stents in vitro and in vivo. *J Urol* 148(5):1592–1594
7. Ben-Meir D, Golan S, Ehrlich Y, Livne PM (2009) Characteristics and clinical significance of bacterial colonization of ureteral double J stents in children. *J PediatrUrol* 5(5):355–358
8. Kehinde EO, Rotimi VO, Al-Awadi KA et al (2002) Factors predisposing to urinary tract infection after J ureteral stent insertion. *J Urol* 167:1334
9. Aydin HR, Irkilata L, Aydin M, Gorgun S, Demirel HC, Adanur S, Keles M, Atilla A, Attilla MK (2015) Incidence of bacterial colonisation after indwelling of double-J ureteral stent. *Archivoltaliano di Urologia e Andrologia* 87:4
10. Ayyıldız A, Yucel M, Nuhoglu B, Çelebi B, Muratoğlu S, Germiyanoğlu C. The evaluation of bacterial colonization on double J ureteral stents
11. Akay AF, Aflay U, Gedik A et al (2007) Risk factors for lower urinary tract infection and bacterial stent colonisation in patients with a double J ureteral stent. *IntUrolNephrol* 39:95
12. Özgür BC, Ekici M, NedimYuceturk C, Bayrak O (2013) Bacterial colonisation of double J stents and bacteriuria frequency. *Kaoh J Med Sci* 29:658
13. Kliš R, Szymkowiak S, Madej A, Blewniewski M, Krześlak A, Forma E, Bryś M, Lipiński M, Różański W (2014) Rate of positive urine culture and double-J catheters colonization on the basis of microorganism DNA analysis. *Cent Eur J Urol* 67:81–85

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