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Differences between the Previous Urine Culture and the Cultivation of the Double J Catheter - Clinical Implications

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Abstract

Complicated urinary infections, among which are those associated with catheters, are a frequent finding in clinical practice. Infectious complications after urological procedures are an important source of morbidity and mortality and consume multiple healthcare resources. Bacterial colonization in the ureteral catheter plays an essential role in the pathogenesis of infection, and the use of antimicrobial prophylaxis in urology is controversial. The objective of our work was to evaluate the usefulness of antibiotic prophylaxis in the extraction of the double j catheter.

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Introduction

Urinary tract infections (ITU) are among the most common bacterial infections acquired in the community and hospitals [1]. Bacteria usually colonize urine from the urethra but are eliminated during urination. Both guest factors and bacterial factors influence that asymptomatic colonization is resolved spontaneously or progresses to symptomatic infection. Guest factors include the presence of anatomical or functional abnormalities, genetic predisposition and hygienic-dietary behaviors that increase exposure to uropathogens or mobilize bacteria toward the bladder, such as sexual relations [2]. Bacterial factors include a variety of virulence characteristics that allow the pathogen to migrate to the bladder, colonize and evade the human immune system [2].

Complicated urinary infections, which are those associated with catheters, are a frequent finding of clinical practice. Infectious complications after urological procedures are an important source of morbidity and mortality and consume multiple health resources. Excessive antibiotic use has contributed significantly to the growth of bacterial resistance, so it is important to balance its use, to avoid iatrogenic microbial resistance. Severe cases have a high mortality rate that ranges between 30% and 40% [3].

A rapid and precise diagnosis is very important to shorten the course of the disease, to prevent progression toward upper urinary infections and renal failure [1]. In turn, nosocomial is an important challenge, both for healthcare and patient safety.

Bacterial colonization in the ureteral catheter plays an essential role in the pathogenesis of infection, but beyond the virulence of microorganisms, one of the most relevant factors for colonization is its duration in the urinary route [5]. In turn, germs can form a biofilm on the surface of the catheter, which protects them from the mechanical drag of urine and antibiotics, thus perpetuating their presence and subsequent translocation of microorganisms to the urine and eventually Blood [6].

The use of antimicrobial prophylaxis in urology is controversial; Its main objective is to reduce the risk of infectious complications such as fever, prostatitis, epididymitis, and urosepsis in patients who undergo diagnostic or treatment surgical procedures. In turn, it prevents the development of non-urological infections such as endocarditis or postoperative pneumonia that can occasionally be a consequence of urological procedures [2].

At present, there is no solid evidence that indicates which is the appropriate antibiotic to use prior to an invasive procedure of urinary route in patients with negative culture, and even those with germs rescue8. In addition, the rescue of catheter colonizing germs in crops is very difficult and on many occasions, the result of the crop obtained by spontaneous urine sample is different from the culture of the stent [5].

The choice of antibiotic used for prophylaxis must consider the individual risk factors of the patient and based on the results obtained in urine crops prior to the procedure.

Our objectives in this work were: to evaluate the coincidence between the cultivation of medium jet urine of patients with double J catheter and the cultivation of the double J catheter J after its extraction; Determine in our group the utility of antibiotic prophylaxis according to the results of both crops and assess the prevalence of complications in our series.

Material and Methods

An observational prospective study was conducted. Patients were included from 06/01/2018 to 06/18/2019 who presented lithian, oncological pathology (with the presence of urinary tract obstruction), or ureteral stenosis and who needed the placement of double catheter J for treatment. Prior to catheter extraction, average jet urine cultivation was performed.

For catheter extraction, a Karl Storz cystoscope of 20 F and a foreign body clamp was used. In all cases, the stents were removed inside the cystoscope shirt avoiding contamination with the genital region and then sent in a sterile bottle for cultivation.

The cultivation of medium jet urine and the cultivation of the catheters were carried out in the same laboratory (central laboratory of the José de San Martín Clinic Hospital).

The crop that developed growth of a single germ, in a recount greater than or equal to 102 was considered positive. The crop that had no proliferation of microorganisms in the growth environment is considered negative.

Patients were divided into 2 groups.

In Group 1, composed of individuals with medium negative jet cultivation, prophylaxis was performed with ciprofloxacin 500 mg 2 hours prior to extraction.

In Group 2, composed of patients with a half jet cultivation prior to the positive procedure, prophylaxis was performed 24 hours prior to the procedure according to the antibiogram of the medium jet urine cultivation.

Inclusion criteria: Patients with oncological pathology with the presence of urinary obstruction, patients with lithian pathology resolved by ureteroscopy, and/or patients with ureteral stenosis who required placement of double J catheter J within their treatment scheme. In all cases with lithian pathology, ureteroscopy was performed with Lithotripsy and full calculation extraction and subsequently, a double J catheter was placed for the drainage of the urinary route.

All patients had a follow-up of at least 60 days after catheter extraction. The complications were evaluated according to the Score of Clavien Dondo.

Exclusion criteria: Patients with non-controlled diabetes mellitus or chronic renal failure, patients with nephrostomy to the presence of double J catheter, those who possessed residual lithiasis after ureteroscopy, and those individuals with bilateral double j catheter.

For the statistical calculation, the SPSS 25 (IBM®) program was used, using Chi-square test for non-parametric variables.

Results

65 individuals were included in the study, of which 7 were discarded for lacking complete data and 2 for presenting simultaneous nephrostomy to the double J catheter. Of the 56 individuals who fulfilled the inclusion criteria, 27 were women, and 29 were men. The average age was 55.66 years (23-81 years). The average permanence time of the catheters was 117 days.

Group 1 (patients with medium pre-surgical jet cultivation), was composed of 46 patients. In these individuals, it was observed that in 44% of the cases (25 individuals) both crops were negative, while in 45.6% (21 individuals) the culture of the catheter was positive.

Group 2 (patients with medium positive pre-surgical jet cultivation) was composed of 11 patients. In this group, coincidence (same germ and antibiogram sensitivity) was found between the mid-jet cultivation and that of the catheter in 18 % of cases (2 individuals) and absence of coincidence (different germ and/or sensitivity between crops) in 81 % of the cases studied (9 individuals).

With respect to prophylaxis and its usefulness in our group. In Group 1, (patients with medium negative jet cultivation who received ciprofloxacin as prophylaxis), 20 of the 45 individuals (44.5%) presented positive culture in the catheter they had inserted; of which in 70% (14 cases) resistance to ciprofloxacin was found. In Group 2 (patients with medium positive jet cultivation who received prophylaxis according to the antibiogram), the coincidence was evidenced in the germ found in both crops in 18% (2 of 11) of the cases; 45.5 % (5 of 11) of the patients had a negative culture in the catheter, while 36.6 % (4 of 11) of the patients presented different germ between both crops.

When observing the antibiograms and prophylaxis carried out according to the previous crop, in 63.6 % (7 individuals), resistance to the applied antibiotic was evidenced.

Of the results, it is evident that in those patients with positive crops prior to surgery antibiotic prophylaxis based on it was not useful compared to the group with negative pre-surgical culture ($p < 0.01$).

Of the 56 patients included in the study, 46.42% (26 individuals) had a rescue of some germ in the cultivation of the STENT. The most frequently isolated germs were: Enterococcus Faecalis in 26% (7 individuals) and Candida spp in 19% (5 individuals).

With respect to asymptomatic bacteriuria prior to stent extraction, 45% of rescues were E. coli (5 individuals) and secondly, and Faecalis in 19% (2 individuals).

The prevalence of complications was 3.5% (2 individuals). Both complications were located within the Clavien II group; Patients who required hospitalization for intravenous antibiotic treatment, and both patients belonging to group 2.

Discussion

A ureteral stent is a fine-caliber catheter that facilitates the drainage of urine from the kidney to the bladder and favors the passive dilation of the ureter and the ureteral meatus. Current urological practice has numerous medical and surgical indications that include urinary obstruction caused by intrinsic or extrinsic factors; intraoperative identification of ureters; and drain for the treatment of a leak or ureteral lesion [9].

The history of the ureteral catheter dates back to the 19th century when Gustav Simon became the first person in ranking the ureter during a cystostomy. In 1885, Joaquín Albarrán developed the first catheter for canulation and ureteral drainage. During the same time, James Brown performed the first cystoscopic catheterization of the ureters in a male patient and showed that ureteral catheters could collect single kidney urine, regardless of contralateral [9].

During the twentieth century, many outstanding urologists of the time, including Foley, Davis, Gibson, Cabot, and Kendall, used soft rubber catheters through the ureter in anterograde form during open operations of reconstruction of the upper urinary tract [10]. Following the industrial revolution, technological advances, and the development of more advanced plastics, catheters were evolving to easier and more effective applications.

In 1978, Finney and Hepperlen presented the double and simple J catheters, and from this moment, they became a routine tool within urology. Over time, there have been many improvements in the design and composition material of the ureteral stents. However, its use is associated with adverse effects that limit their value in long-term urinary drainage, such as urinary infections [9].

One of the problems associated with catheters is their prolonged retention of them, which can cause multiple complications, within which one of the most common is infectious. These can range from asymptomatic bacteriuria to pyelonephritis, and even endanger the patient's life through septicemia. Urinary infections (ITU) associated with catheters represent approximately 70-80% of all urinary infections and more than 30% of nosocomial infections [11-13].

To be perfect, the catheter should have optimal flow characteristics, be well tolerated by the patient, be biocompatible, radiopaco, be visible with ultrasound, and be easy to place and extract, and be resistant to infections, corrosion, and embedding, to achieve its long -term permanence in the ureter.

The standard Gold in the composition material is the polymeric compounds that include silicone and/or polyurethane since they are more inert than metallic or those of other compositions [11]. Improvements in biocompatibility and friction characteristics are directly related to the decrease in urothelial reaction after placement, reducing biofilm formation and, consequently, the increase in long-term stent effectiveness [11].

Heparin-coated polymeric Stents (Endo-Sof Radiance, Urological Cook) have an antiadhesive surface that reduces the bio-filling formation and concomitant inlays of the stent, which would allow for postpone the replacement of endoprosthesis in the short term. In a study where heparin-coated catheters were placed in 2 patients, for 10 and 12 months, it was found that they had no incrustations. However, the demonstration of the capacity of the inhibitor effect on bacterial adhesion was not verified in vitro [9,12].

The ureteral stents covered with active enzymes that degrade biomaterial deposits of the catheter surface are an alternative to the problem of the embedding. In a model of implantation of in vivo rabbit bladder, silicone discs coated with enzyme (oxalyl coenzyme A and coenzyme formil) reduced the number of inlays after 30 days of implantation versus the control discs [11].

Other types of endoprosthesis are diamond-type carbon, a waterproof and inert hydrocarbon material with highly biocompatible properties. A preliminary study of 10 patients who used a STENT with this coating demonstrated a decrease in friction, in the incrustation and formation of biofilms [11].

The hydrogel is a modification made on the surface of the ureteral stents that allows the anchor of water molecules on its surface, achieving adequate biocompatibility of the material, hydrophilization, and lubrication. This allows the combination of the hydrophilic surface with hydrophobic drugs. In an experimental study, they immersed ureteral steps coated with hydrogel in ciprofloxacin, gentamycin and headache solutions, and demonstrated that they had antimicrobial properties.

Recently, vascular endoprosthesis was introduced that allows the creation of steps coated with antibodies. This facilitates the adhesion and proliferation of mature endothelial cells and circulating endothelial progenitor, essential for rapid re-otothelization in situ of cardiovascular stents. Applied to urology, the ureteral steps coated with an antibody could allow the attraction and anchor of specific elements that flow in the urine and that positively interfere with epithelization, the urothelial hyperplastic reaction, the formation of biofilms and the embedding of the stent [11].

One of those responsible for the high prevalence of ITUS associated with catheters is the formation of a "biofilm". Biofilm is a bacterial colony that is generated in the stent, mainly composed of the glycocalyx, which is a compound that, when produced by multiple bacteria simultaneously, generates adhesion with each other. The bacterial biofilm can be divided into 3 layers: the junction membrane, which adheres to the surface of the tissues or biological materials; the basilar membrane, which contains compact bacterial colonies; and a superficial film, located in the outermost layer, from which bacteria to urine can be released [14].

Biofilm can be generated in multiple implants used for medical treatments such as catheters, cardiac pacemakers, articular prostheses, postage dentures, prosthetic heart valves and contact lenses. These foreign bodies provide an ideal surface for the union of bacterial cells. Its formation implies the union of cells to a surface by reversible agglomeration of proteins, polysaccharides and macromolecules [14]. Then these molecules are assembled producing polysaccharides that positively regulate adhesion genes, making adhered bacteria fixed irreversibly and form microcolonies. Finally, the differentiation of the biofilm in a mature structure is due to greater adhesion and multiplication of bacteria within the matrix. After the complete development of the biofilm, its disassembly or dispersion is carried out through both mechanical and active processes [16].

The biofilm allows bacteria to resist hostile environmental conditions such as hunger, desiccation, and temperature and makes them able to cause a wide variety of chronic diseases, which is why it is considered one of the main causes of persistent nosocomial infections [16].

A mature biofilm generates greater adhesion and multiplication of bacteria creating a protective microenvironment for the fight against antibiotics and host immunity. The bacterial biofilm can survive antibiotics at concentrations of 1,000-1,500 times higher than the doses usually used. This is one of the causes by which bacteria can generate continuous infections and antibiotic resistance since antibacterial agents have important difficulties in penetrating the bacterial biofilm [17].

With respect to bacterial colonization, Kehinde EO, et al. (2004) [15], % of the total and Enterococcus Faecalis and E. coli (18% of the total). Compared to our study, patients with positive jet cultivation represented 19% of cases. 45% of the bailouts were E. coli and secondly, and Faecalis 19%.

With respect to catheter crops according to Kehinde EO, et al. (2004) [15], 42% of the total had a positive rescue after extraction. Escherichia Coli was the most frequent body representing 31%, followed by staphylococcus spp. In this study, it was shown that the number of colonized stents increased proportionally to the duration of the stent. In our series, 46.42% of the Stent had bacteriological rescue, and the most frequently isolated germs were: Enterococcus Faecalis in 26% and Candida spp in 19%.

Kehinde EO, et al. (2004) [15], conclude that antibiotic prophylaxis prior to catheter extraction should be recommended only in patients with asymptomatic bacteriuria with risk factors such as diabetes mellitus, diabetic nephropathy, and chronic renal failure since they are pathologies with significantly higher rates of bacteriuria and colonization of stent, and with high predisposition to infections by opportunistic pathogens such as Candida spp [15].

In our reports, the colonization rate of catheters was 46.42%, which can be inferred that medium jet urine cultivation is not an especially sensitive tool to detect the colonization of the stent; therefore, a negative crop would not rule out a colonized stent. Due to this colonization, during its manipulation, urine can be contaminated with colonizing germs, being able to cause bacteriuria with the possible posterior passage of bacteria to the bloodstream.

One aspect to evaluate is the use of antimicrobials such as prophylaxis. Abbott JE, et al. (2020) [1], compared 2 groups of 35 individuals who underwent the extraction of the ureteral stent. All selected individuals had negative uroculture prior to extraction. One group received antibiotic prophylaxis (cases), while the other group did not receive it (controls). The antibiotic used in prophylaxis was ciprofloxacin in 90% of patients. They showed that 2 patients from the group who received prophylaxis developed a urinary infection, while, in the group of controls, there were no registered cases. The isolated germs in the 2 cases of ITU were Staphylococcus epidermidis and Streptococcus viridans. Both patients were treated with oral antibiotics adjusted to the sensitivity of the crop, with a good response. The work concludes that antibiotic prophylaxis at the time of extraction of the cystoscopic stent did not decrease the risk of urinary infection, but that it would be justified in patients with risk factors such as honey diabetes, immunosuppression, or previous background of infections [1].

Conclusions

In our series, there was a lack of coincidence between the previous urine culture and the cultivation of the catheter, so urine cultivation was not the ideal means to detect the colonization of the stent. The use of antibiotic prophylaxis was not useful in those individuals with pre-surgical cultures compared to the group with previous negative cultures.

Declarations

The authors declare not having conflicts of interest of any kind, that the work has been approved by the responsible ethics committee in the workplace, and do not declare means of financing of the work done.

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