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A comparative evaluation between complications of Foley and Nelatone urinary catheters in animal model

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ABSTRACT

Urinary catheter varies in terms of material, shape and size and each type is made for a particular purpose. During some diseases, the urinary catheters should remain in the bladder for a long time and this leads to serious complications such as pathological complications of bladder and urinary tract infections. In this study, pathological complications and lower urinary tract infection following the use of two different types of urinary catheters in male rabbits was evaluated. This study was designed in the form of a randomized clinical trial. 20 five- month-old New Zealand rabbits weighing 2 to 2.5 kilograms were randomly assigned to 2 groups of 10. The first group was under cystostomy with Nelatone catheter, and second group was under cystostomy with Foley catheter for 7 days. After this period, part of the rabbit bladder tissue was isolated and sent to the laboratory for the pathology report. A urine sample was aseptically taken and sent to the laboratory and any number of bacterial growth in urine culture was considered a urinary tract infection. Prevalence of urinary tract infection in the two groups was identified and by Gram staining and specific biochemical tests types of bacteria were determined. Obtained data were entered into SPSS software version 17 and statistical tests such as Chi-square, Fisher's exact test and Mann-Whitney tests were used for data analysis. The highest frequency of grade 3 inflammatory was observed in rabbits with foley catheter, also, rabbits with Nelatone catheter showed the highest frequency in this intensity. There was no significant difference in severity of inflammation. Percent Of inflammatory cells in pathological samples ranged from 5 to 80. In both groups, the most frequency were observed in the samples with five to ten percent polymorphonuclear cell, and no significant difference was observed between the two groups. Difference of frequency of bleeding between the two groups was not significant. No significant difference was found between the two groups in terms of infection. There was no significant difference between the two types of catheters in terms of the severity of inflammation, inflammatory cells, bleeding in the tissues of the bladder and urinary tract infections. This indicates that none of this two types of catheters has particular preference over another.

Keywords: Bladder, Nelatone catheter, Foley catheter, Complications

INTRODUCTION

Urinary catheter varies in terms of material, shape and size and each type is made for a particular purpose. Urinary catheters, are different types as well as of the location and duration of exposure [1]. Due to the fact that some diseases, such as hypospadiasis and damage to the urethra urinary catheters long stay into the bladder, In most cases, the use of latex free Foley catheters are recommended [2], Unfortunately, due to its price and lack of

this type of catheter everywhere, use of this type of catheter is not possible in most cases, so many experts in hypospadiasis restore use the normal Foley catheter [3], there is the risk of changes in bladder tissue, because of latex entity. In some cases, hemorrhagic cystitis has observed [4]. Thus, some surgeons recommend routine use of Nelatone catheters in place of Foley catheters to prevent changes in bladder tissue [5- 7]. But so far, no study has been done to compare these two types of catheters based on the pathology of bladder. In this study, pathological complications and urinary tract infection of two catheter types were evaluated in an animal model.

MATERIALS AND METHODS

This experimental study was performed after the approval of Ethics Committee, and 20 rabbits were randomly divided into 2 groups of 10. One week before the study starts, all the rabbits were fed similarly and kept in similar environmental conditions. After this period, the qutaneous and subqutaneous layer in abdominal zone were opened, and after determining the anatomical position of the bladder, The first group was under cystostomy with Nelatone catheter, and second group was under cystostomy with Foley catheter for 7 days. To avoid confounding effects of ischemia induced by the volume of the Foley catheter balloon and the pressure effects of it, initially through a laparotomy in rabbits by injecting water into the bladder, the bladder volume was estimated, and Foley catheter balloon with a maximum of one-fifth or less the same for all rabbit bladder was full. cystostomy remained in all rabbits for 7 days. after one weeks rabbits were anesthetized by Kethamine (10 mg / kg), and were placed in a Supine posture on the operating table, then midline incision was made on the previous site and a urine sample was aseptically taken by sterile syringe, and sent to the laboratory; any number of bacterial growth in urine culture was considered as a urinary tract infection. Prevalence of urinary tract infection in the two groups was identified and by Gram staining and specific biochemical tests types of bacteria were determined. After that, 3-5 cm of each rabbit's liver was resected, and immediately fixed in formalin, and sent to the laboratory for the pathological report. Based on the defined pathological grading, pathology results were classified into 6 groups: 0. No change, 1. Minor inflammatory infiltration without edema, 2. Mild to moderate inflammatory infiltration with mild edema, 3. Mild to moderate inflammatory infiltration and moderate edema, 4. Moderate inflammation with neutrophils scattered and diffuse edema, 5. Severe inflammation of the tissue and edematous changes, fibrosis and hemorrhage. Bladder bleeding was reported qualitatively: No bleeding, mild: 1 to 2 red blood cells is extravasated from 10 vessels which are visible under the microscope, moderate: 3 to 4 red blood cells is extravasated from 10 vessels which are visible under the microscope, severe: more than 4 red blood cells is extravasated from 10 vessels which are visible under the microscope. Obtained data were entered into SPSS software version 17 and statistical tests such as Chi-square, Fisher's exact test and Mann-Whitney tests were used for data analysis.

RESULTS

In this study effect of two cystostomy methods with Foley catheter and Nelatone catheter on pathology, inflammation of the bladder cells and bleeding were evaluated in 20 rabbits, and in none of the variables including the severity of inflammation, inflammatory cells, bleeding and urinary tract infections, there are significant differences between the two types of catheters. The highest frequency of grade 3 inflammatory was observed in rabbits with Foley catheter, also, rabbits with Nelatone catheter showed the highest frequency in this intensity; According to Fisher's exact test indicated that the frequency of severe inflammation in the two groups are roughly equal; However, in this case due to the severity of inflammation is variable rate, compared to which group had more inflammation, non-parametric Mann-Whitney test was performed. According to the findings of these tests, however, group with Nelatone catheter had a brief more inflammation than Foley catheter, but this difference was not significant (P value = 0.875) (Table 1). Percent Of inflammatory cells in pathological samples ranged from 0 to 100; in both groups, the highest frequency were observed in the samples with five to ten percent polymorphonuclear cell, and no significant difference was observed between the two groups (P value = 0.077) (Table 2). According to the findings of Mann-Whitney test, however, the average number of inflammatory cells in group with Foley catheter is less than Nelatone catheter, but this difference was not significant (P value = 0.756).

Table 1 - Compare the severity of inflammation in two groups

Severity of inflammation	Nelatone catheter		Foley catheter		**Sum**		***PV**
	N	**%**	**N**	**%**	**N**	**%**	
1	2	20	0	0	2	10	0.385
2	1	10	3	30	4	20	
3	3	30	5	50	8	40	
4	2	20	0	0	2	10	
5	2	20	2	20	4	20	
Sum	10	100	10	100	20	100	

**Fisher exact test*

Table 2 - Compare the percentage of PMN cells in two groups.

Bleeding	Group						*PV
	Nelatone catheter		Foley catheter		Sum		
	N	%	N	%	N	%	
No	2	20	3	30	5	25	**0.7**
Mild	3	30	1	10	4	20	
Moderate	5	50	5	50	10	50	
Sever	0	0	1	10	1	5	
Sum	10	100	10	100	20	100	

**Fisher exact test*

Comparison of bleeding in the bladder tissue in two groups based on Fisher's exact test showed no significant difference between the two groups in the severity of bleeding (P value = 0.756) (Table 3). To check the total amount of bleeding in the two groups, Mann-Whitney test was performed. Accordingly, the Foley catheter group had a higher ranking in bleeding, but this difference was not significant (P value = 0.743).

Table 3 - Compare the amount of bleeding in the bladder tissue in two groups

PMN (%)	**Group**						***PV**
	Nelatone catheter		Foley catheter		Sum		
	N	**%**	**N**	**%**	**N**	**%**	
0-10	**5**	**50**	**5**	**50**	**10**	**50**	**0.077**
10-25	2	20	4	40	6	30	
>25	3	30	1	10	4	20	
Sum	10	100	10	100	20	100	

**Fisher exact test*

Foley catheter group compared to the Nelatone catheter has the lower chance of infection, although the difference observed in the two groups was not significant based on the chi-square test (P value = 0.37) (Table 4).

Table 4 - Compare the frequency of urinary tract infection in two groups

Urinary tract infection	Group						***PV**
	Nelatone catheter		Foley catheter		Sum		
	N	%	N	%	N	%	
No	4	40	7	70	11	55	0.37
Yes	6	60	3	30	9	45	
Sum	10	100	10	100	20	100	

**Chi-square test*

Enterococcal infection in the Foley catheter group was lower than the Nelatone catheter, but chi-square test showed that this difference is not statistically significant (P value = 0.37). In the Nelatone catheter group, there was a case of urinary tract infection with Staphylococcus aureus; but in the Foley catheter group, there was no case of urinary tract infection with Staphylococcus aureus, and Fisher's exact showed no significant difference (P value = 1) (Table 5).

Table 5 - Compare the prevalence of Staphylococcus and Enterococcus in the urine samples of two groups

Urinary tract infection		Nelatone catheter		Foley catheter		**PV**
		N	%	N	%	
Enterococcus	Neg	5	50	7	70	**0.65***
	Pos	5	50	3	30	
	Sum	10	100	10	100	
Staphylococcus	Neg	9	90	10	100	**1****
	Pos	1	10	0	0	
	Sum	10	100	10	100	

**Chi-square test*
***Fisher exact test*

DISCUSSION

In none of the variables including the severity of inflammation, inflammatory cells, bleeding and urinary tract infections, there are significant differences between the two types of catheters. This indicates that none of these two types of catheters has particular preference. Despite extensive searching, a similar study didn't found, and this topic shows the uniqueness of the findings of this study. On the other hand, compared with the findings of other studies (which actually don't exist) would be extremely difficult.

Ekelund and his colleagues proposed that 41 of 51 patients undergoing long-term catheterization, had bladder inflammation as polypoid cystitis; the authors reported that the extent and severity of inflammation was associated with duration of catheterization, and peak inflammation has been occurred three months after catheterization [8]. The results of this study were consistent with the findings of the present study and Indicating high levels of inflammation in people who are undergoing catheterization. Norlen and his colleagues suggested that catheters are responsible for polypoid cystitis. These researchers also found that all patients with urinary catheters have urethral mucosal lesions. Severity of the inflammation in lesions has been variable [9]. The results of this study also indicate inflammation as a result of the use of a urinary catheter. However, no comparison has been made between the two types of catheter.

In the study of Delnay and colleagues is seen that the degree of inflammation and duration of catheter placement has a direct relationship, but no relationship with the type of catheter used for patient and degree of inflammation was detected [10]. Vaidyanathan and his colleagues showed that if permanent catheters such as Foley used less, and temporary catheters such as Nelatone used more, histologic and inflammatory changes in the tissue will be less [11]. In the study of Peychl and colleagues, bladder inflammation was evaluated in patients with Foley catheterization, this study also proved the inflammation due to the use of urinary catheters; The results of this study were consistent with the results of present study [12].Vaidyanathan and his colleagues have reported that urinary catheterization can be viewed as a definite risk factor for the occurrence of symptomatic urinary tract infections [13].Seiler and colleagues who have studied the relationship of urinary tract infections and long-term catheterisation in older people, Have mentioned that the catheterization, especially in the long term, damage the lining of the bladder and also act as a foreign body and carries the bacteria into the body, and can increase the risk of urinary tract infections in patients [14-17].

CONCLUSION

This study indicates that none of these two types of catheters has particular preference.In repeated use of this two types of catheter, there won't be superiority about the inflammation, bleeding of the bladder and cause infection between Foley and Nelatone catheter, and this two types of catheters can replace each other in all cases, while we do not have significant increases in inflammation, bleeding and infection risk.

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Conflict of Interest
The authors have no conflict of interest to disclose.

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