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Effects of modified double balloon catheterization for prostatic fluid collection in dogs

Ki-dong Eom, Jung-hee Yoon*

Yong-Ma Veterinary Clinics
*Department of Veterinary Radiology, College of Veterinary Medicine, Seoul National University**
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개에서 전립선액의 채취를 위한 이중발룬 카테터의 효과

엄 기 동 · 윤 정 희*

용마동물병원
서울대학교 수의과대학*
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초 록 : 개에서 전립선액의 채취를 위한 이중발룬카테터의 효과를 알아보고자 새로이 고안한 이중발룬카테터를 이용하여 추출한 전립선액의 오염여부를 검증하였다. 총21두의 개를 이용하여 전립선액 오염여부에 대한 검증으로서 전립선액, 생검조직 및 요도 관류액 중의 요크레아틴 농도측정과 배양검사를 실시하였다.

요크레아틴 농도를 측정한 결과 전립선액(0.028mg/dl)과 조직내(0.66mg/dl)에서 세척관류액(18.71mg/dl) 보다 유의성 있게($p < 0.001$) 낮은 농도를 보여 뇨성분의 혼입을 최소화 할 수 있는 것으로 평가되었다.

요도부 시료의 배양검사에서 양성결과를 나타낸 12마리중, 이중발룬카테터를 이용하여 전립선액을 채취한 결과 방광으로부터의 오염을 보인 1마리를 제외하고 독립적인 배양결과를 얻을 수 있었으며, 방광 및 요도로부터의 오염방지 효과는 92%를 나타냈다.

이중발룬카테터는 전립선 요도부의 카테터 장착의 용이성 및 요도로부터 오염방지 효과를 갖고 있어 손쉽게 전립선액을 추출할 수 있는 유용한 방법이라고 사료된다.

Key words : double-balloon catheter, urine creatinine, prostatic fluid collection, transrectal ultrasonography, prostatic biopsy.

Address reprint requests to Dr. Ki-dong Eom, Department of Veterinary Radiology, College of Veterinary Medicine, San 56-1, Shilim-dong, Kwanak-ku, 151-742, Seoul, Republic of Korea.

Introduction

Prostatic diseases commonly occur in middle-aged and older dog[1~3]. Various techniques for diagnosis of these diseases have been described in veterinary and human medicine[4~7]. To make or confirm a diagnosis, prostatic fluid culture and cytological examination, radiography, ultrasonography (USG) and prostatic biopsy or aspiration techniques were used in previous studies[4~21]. Prostatic fluid examination is much easier and safer than biopsy for cytological examination[1~9].

Several investigators have been reported different prostatic fluid collecting methods. Prostatic urethral washing which is most well known is routinely used. But this method is complex and yields inaccurate results due to urine and urethral contaminations; furthermore, microbiological results are sometimes refutable because of concurrent bacterial cystitis or normal flora[1~4].

The ejaculation technique is not specific enough to determine primary lesions of the prostate because of a high possibility of being mixed with residual materials from the testes, ejaculation route and urethra, and there is a low success rate in obtaining the ejaculate itself because of problems such as sexuality, discomforts, environment and age[1~4].

The urethral brush technique can be localized to the prostate gland[4,5]. Though the specimen is useful for cytological and microbiological examination, catheters are expensive and cannot be reused[3].

We performed an experimental trial to assess the feasibility of collecting uncontaminated prostatic fluid by localizing the prostate gland through blind catheterization ; ie, without prior USG, fluoroscopy or palpation and to evaluate of the degree of contamination with culture findings and level of urine creatinine concentrations obtained from urethral swab, urethral washing fluid, prostatic fluid, and biopsied tissue.

Materials and Methods

Experimental animals : total 21 dogs(average 6 years old) were selected on the basis of lack of urinary problems as determined by rectal palpation of the prostate and physical examination. This investigation was performed using 10 mongrels, and 7 retriever, and 4 beagle dogs, weighing a mean average of 14.35kg (8.7 to 24.5 kg).

Double balloon catheter and thechnique[22] : Modified double balloon cathetr was used for the prostatic fluid collection. The collecting procedure including specimen handling of prostatic fluid and tissue was followed the previouse study.

Laboratory examination : Each urethral flushing fluid, prostatic fluid and tissue sample were cultured following as previous reports[1~9]. Cultured bacteria were sent for identification to microbiologic examination center (BML Ltd. Co., Sapporo, Japan). Prostatic tissue samples were homogenized with 0.3ml saline solution for 1 minute and centrifuged. The first flushing fluid, collected prostatic fluid and supernatant of homogenized prostatic tissue were tested for urine creatinine concentration using a biochemical analyser(COBAS-MIRAS, Roche Ltd., Switzerland).

Results

All dogs well tolerated the catheterizing procedures and did not show any problems. But mild bleeding was presented when the biopsy needle was inserted and extracted from perianal skin and at the prostatic parenchymal area also after the biopsy procedure by TRUS findings. However, urinary and clinical complications were not recognized.

Urine creatinine level and collected prostatic fluid volume (Table 1) : The prostatic fluid was obtained as 394.3$\pm$117.9μl. The color of collected prostate fluid was clear and was separated into two portions after centrifugation ; a precipitated creamy-colored material and a clearer fluid. Precipitated materials were found to be a small amount of sperm and prostatic epithelial cells by microscopic examination. Urine creatinine concentration of collected specimens was examined to determine whether prostate fluid contained urine components. The urine creatinine concentrations of the flushing fluid, the prostatic fluid and the prostatic tissue were 18.71$\pm$11.54mg/dl, 0.028$\pm$0.026mg/dl and 0.66$\pm$

Table 1. Urine creatinine concentration levels and prostatic fluid volumes

No.	Prostatic fluid volumn(μl)	Urine creatinine cocentration(mg/dl)		
		prostatic fluid	prostatic tissue	1st flushing fluid
1	250	0.030	1.34	8.8
2	310	0.050	0.32	19.6
3	530	0.000	0.63	26.8
4	410	0.060	0.12	13.6
5	540	0.010	0.88	6.9
6	430	0.020	0.61	19.7
7	440	0.050	0.57	8.4
8	530	0.080	0.53	21.2
9	350	0.013	0.95	〉58
10	150	0.010	0.61	6.4
11	470	0.010	0.23	2.9
12	340	0.020	0.78	42.3
13	220	0.050	0.46	15.4
14	550	0.001	0.06	22.4
15	520	0.001	0.69	12.1
16	490	0.045	0.58	22.5
17	280	0.020	1.21	14.8
18	270	0.003	0.18	46.6
19	430	0.000	1.64	18.2
20	320	0.020	0.36	12.3
21	450	0.085	1.08	33.3
mean	394.3	0.028*	0.66	18.71
SD	117.9	0.026	0.41	1154

1st flushing fluid : Collected from urethral flushing procedure with saline from opening of penis to prostatic urethra.
* $p < 0.01$.

0.4mg/dl, respectively. The prostatic fluid level was significantly low compared with the flushing fluid and the prostatic tissue($p < 0.01$).

Core biopsy and ultrasonographic findings : Normal prostatic echogenicity was seen in 14% (4/21) of the dog. Hetero-hypoechogenic signs in the TRUS were present in 52. 4% (11/21) of the animals. The number of intraprostatic cysts ranged from 2 to 7mm with diameter ranging from 2 to 13mm as determined by real time calculation were presented in 13 dogs. If cysts were small, they were differentiated from a blood vessel by the ultrasonographic scan (Table 2 and Fig 1). Biopsied tissue was weighed 0.08~0.01mg.

Culture findings : Of the 21 dogs, culture growth occurred in 10 cases from prostatic fluid, 6 cases from prostate tissue, 12 cases from urethral swabs and 3 cases from the

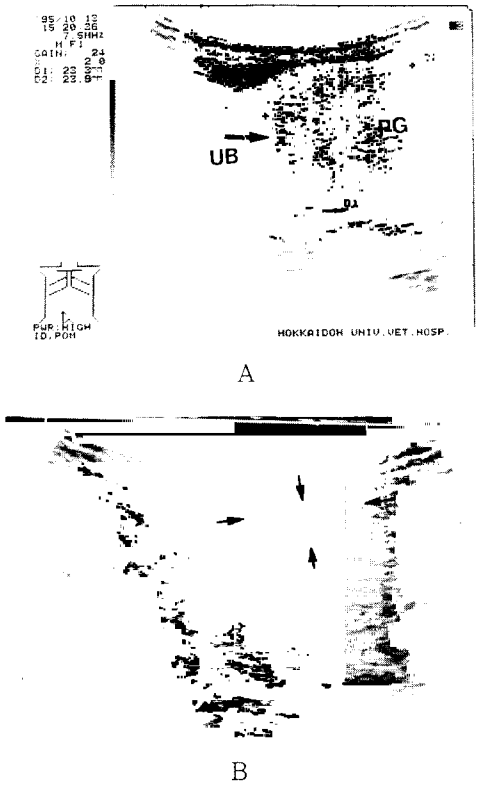

Fig 1. A longitudinal sonogram, obtained following a transrectal scan in normal prostate of a dog before the catheterization. The parenchymal pattern is homoechogenic and cyst is not seen Urinary bladder(UB), Prostate gland(PG) and opening of urethra(arrow) can be identified. B. Hypoechoic focal lesions (white arrows) compared with homoechogenic patterns of other parenchymal areas. Normal prostatic lobule(black arrows) were seen as more hypoechoic than other lesions in a mongrel dog.

second flushing fluid (Table 2). *Escherichia coli* was predominantly isolated. The 6 cultured cases of prostatic tissue showed the same results as prostatic fluid specimens.

Cytological findings(Table 2) : A smear for cytological evaluation of prostatic fluid and an impression smear made from the core biopsy specimens obtained with the Tru-cut biopsy instrument were examined microscopically. Chronic prostatitis and benign prostatic hyperplasia were represented in cytological findings from prostatic fluid specimens. One dog(dog No. 4) had prostatitis and hyperplasia. Chronic

Table 2. Results of culture and cytoligical findings

No.	Culture findings(No. of bacteria/ml)				Cytological findings	
	prostatic fluid	prostatic tissue	urethral swab	2nd flushing fluid	prostatic fluid	prostatic tissue
1	*E coli* ($>10^7$)	*E coli* (4.8×10^5	*E coli* ($>10^7$)	Nf	Bp	Bp
2	*E coli* (2×10^5)	*E coli* ($>10^7$)	*E coli* ($>10^7$)	Nf	Bp	Bp
3	*E coli* (3.3×10^4)	*E coli* (10^2)	Nf	Nf	Bp	Bp/Ph
4	*E coli* (6×10^5)	*E coli* (3×10^4)	Nf	Nf	Bp/Ph	Ns
5	*P areu* (8×10^3)	*P areu* (2×10^5)	*E coli* (5×10^3)	*E coli* (2.6×10^3)	Ph	Ns
6	*A cal* (10^5) *E coli* (3×10^2)	*A cal* (3.7×10^4)	Nf	Nf	Ph	Ns
7	*K spp* (3×10^2)	Nf	*S spp* (9.4×10^5)	Nf	Ph	Ph
8	*E coli* (5.3×10^2)	Nf	*E coli* (3×10^4)	*E coli* (5.8×10^2)	Ns	Ns
9	*E coli* (1.6×10^3	Nf	Nf	Nf	Ph	Ns
10	Nf	Nf	Nf	Nf	Ph	Ns
11	Nf	Nf	*S spp* (4×10^4)	Nf	Ns	Ns
12	Nf	Nf	*E coli* (9×10^3)	Nf	Ns	Ns
13	*E coli* (9×10^2)	Nf	*E coli* (8.5×10^2)	Nf	Ns	Ns
14	Nf	Nf	Nf	Nf	Ns	Ns
15	Nf	Nf	*E coli* (5×10^5)	Nf	Ns	Ns
16	Nf	Nf	Nf	Nf	Ns	Ns
17	Nf	Nf	*E coli* (7×10^3)	Nf	Ns	Ns
18	Nf	Nf	Nf	Nf	Ns	Ns
20	Nf	Nf	*E coli* (4.6×10^3)	Nf	Ns	Ns
21	Nf	Nf	Nf	Nf	Ns	Ns

2nd flushing fluid; collected from the last urethral flushing procedure with saline from the opening of the penis to the prostatic urethra.
S spp : *Staphylococus aureus*, Bp : Bacterial prostatis, Nf : not found
P areu : *Pseudomonas aeruginosa*, Ph : Prostatic hyperplasia, Ns : non-specific
A cal : *Acinetobacter calcoaceticus*
K spp : *Klebsiella spp*

prostatitis(dog Nos. 1 and 2) and benign prostatic hyperplasia (dog Nos. 3, 4, 5, 6, 7, 9 and 10) were represented in cytological findings from prostatic fluid specimens. One dog (dog No. 3) had prostatitis and hyperplasia. Chronic prostatitis(dog Nos. 1, 2 and 3) and prostatic hyperplasia (dog Nos. 3 and 7) were resulted in the prostatic tissue specimens.

Discussion

Of the main diagnostic tests in prostatic diseases, prostatic fluid examination is considered the most useful. By cytological and microbiological examinations of prostatic fluid various types of prostatic disease can be differentiated[1~3]. The most important condition of prostatic fluid as a specimen is that it should not be contaminated with residual materials from the urethra or bladder. The urethral brush method for prostatic fluid collection was the first reported technique which could be localized to the prostate[4,5]. Clinical use of this technique has been limited to cytological and microbiological tests and it has not been used widely in recent reports on prostatic fluid collection. It is, however, recognized to be useful and valuable compared with ejaculation and prostatic washing techniques[1~3]. This study was undertaken with the hope that the modified double balloon catheter would be effective for collection of uncontaminated prostatic fluid.

In normal dogs, using an ordinary urethral catheter, we found that it was hard to obtain as much as 1 ml even after surgical exposure and localization of the prostate by ligation at the bladder and urethra. The volume collected in this study was sufficient to carry out various tests include biochemical, culture, smear for microscopic examination.

The creatinine concentration test for the degree of urinary contamination in collected specimens is appropriate because creatinine is abundant in urine (100~300mg/dl) compared with serum (0.6~1.2mg/dl) in normal dogs[23]. This was significantly low 0.028mg/dl ($p < 0.001$) in the prostatic fluid compared with the flushing fluid (18.71mg/dl) and the tissue (0.66mg/dl). The concentration could easily be checked and the sensitivity evaluated in homogenized tissue and prostatic fluid in this study. The creatinine concentration test alone could not confirm that prostate fluid specimens collected using the modified double balloon catheter did not contain any residual urethral materials. However, supporting results were obtained in the culture tests of specimens of prostatic fluid and tissue which were independently cultured and then compared with urethral swabs and flushing fluid, except for one dog(dog No. 8). Ultrasonographic examination of this case revealed abnormal parenchymal patterns like the heterogenic and cystic prostate, but microbiological findings were detected as a normal. This anomaly was recognized as cytological misinterpretation of results due to an insufficient smear profile or urethral contamination.

Specimens could be collected and independently cultured. When the culture results from urethral swabs compared with those of flushing fluid, it could recognized that urethral flushing with saline had a cleansing effect on the urethra and contributed to minimizing of contamination in 83% of the cases (10/12). The possibility of contamination in the prostatic fluid from urethra is 2 cases(dog Nos. 5 and 8) after flushing procedure. However, dog No. 5 has a different organism in between fluid and flushing specimens. Dog Nos. 1 and 2 has a positive culture result in the fluid, tissue and urethral swab specimens, but not found in the second flushing fluid. Therefore, it was considered that these 2 cases were independently cultured each specimens and prostatic fluid has been collected with an uncontaminate from prostatic urethra. Double balloon method was useful to protect a prostatic fluid contamination from prostatic urethra in 92% of the cases (11/12).

Biopsied tissue culture results were different from results of prostatic fluid culture. This could have resulted from insufficient biopsy when the cystic lesions were too small (dog Nos. 7, 8, and 10). The automated biopsy gun was very convenient to obtain tissue specimens under guidance by a transrectal ultrasonographic examination[19~21].

In cytological examination, moderate prostatic infection was recognized in 3 dogs. Results in two dogs (dog Nos. 1 and 2) which were also demonstrated in prostate fluid were interpreted as prostatitis.

There are several advantages of this technique over the previous collecting methods used, including the facts that : 1) adequate prostate fluid can be collected and might be useful for some other tests which are needed a volume such as prostatic biochemical procedures ; 2) this technique is very easy to carried out and the catheter is reusable, moreover it does not require any special equipment and palpation for catheter tip alignment to the prostate localization ; and 3) it has a very low rate of contamination from residual urethral and bladder materials.

Conclusion

1. The levels of creatinine concentration of the prostatic fluid and homogenized tissue were significantly low, whereas flushing fluid from the urethral tract contained a high level of creatinine concentration.

2. Prostatic fluid was independently cultured and the contamination rate was low.

3. The modified double balloon catheter was technique to minimize prostatic fluid contamination from the urinary tract and could easily localized to prostatic urethra.

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