



Some Serum Biochemical Alterations after Urinary Diversion with Colonic Segment in Dog

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Abstract

Objective- To evaluate the some serum biochemical alterations after urinary diversion with colonic segment.

Design- Experimental in vivo study.

Animals- five adult healthy mixed breed dogs of both sexes weighing between 25-40 kg.

Procedures- In this approach, fifteen centimeters of the descending colon with preservation of its mesenteric vessels was resected and this segment longitudinally was opened and flushed with copious amount diluted Povidin Iodine 0.1% and the remaining colon re-anastomosed with seromuscular sutures. Then two ends of transected ureters were drawn into the resected colon by mosquito hemostatic forceps and simple interrupted sutures were placed between the ureters and the colonic mucosa for uretero-colonic anastomosis. The uretero - colonic part in a cap form transplanted to partially cystectomized bladder with one layer of cushing pattern suture. In this study, blood urea nitrogen (BUN), serum creatinine, Ca, P, Na, K, Cl ions, pH, and bicarbonate levels were measured before surgery and at the 1, 2, 3, 4, 5, 6, 7, 10, 15, 20, 25, 35 and 45 postoperative days.

Results- BUN and serum creatinine concentrations were increased significantly at first three postoperative days but regressed to the normal levels gradually. After operation, hyperchloremic metabolic acidosis with low sodium and potassium levels was diagnosed in 5 dogs. In all animals, hypocalcemia and hyperphosphatemia were significant. All of the biochemical parameters except calcium, phosphor, and sodium regressed to the normal levels within the study.

Conclusions and Clinical Relevance- In conclusion, the salt-loss syndrome and metabolic acidosis are the most complications after urinary diversion with colonic segment in dog.

Key Words- Urinary Diversion, Ureter, Colon, Serum Biochemical Alteration, Dog.

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Introduction

Permanent urinary diversion may be indicated in small animals especially dogs when neoplasia involves the bladder trigone¹, or when the bladder can no longer safely function as a reservoir for urine storage.² Urinary diversion includes performing partial or total cystectomy with surrounding tissues and re-routing of urinary stream by re-anastomosing the ureters to an isolated bowel conduit or reservoir or into the intact colon, jejunum or ileum.^{1,3,4,5} For more than a century the gastrointestinal tract has been employed in numerous creative and sophisticated procedures to correct abnormalities of the genitourinary tract.⁶ Intestinal segment are frequently used in the reconstruction of the urinary tract in human undergoing radical cystectomy for invasive bladder cancer.⁷ A myriad of procedures incorporating stomach, jejunum, ileum, different parts of the colon and a combination of the above bowel segment have been used in diverting, reconstructing and remodeling different portions of the unitary tract.⁶ Ureterocolonic anastomosis and trigonal-colonic anastomosis have been the most commonly performed techniques for permanent urinary diversion in dogs.^{1,8} The indications for urinary diversion include bladder cancer, cystic agenesis, complete aplasia of the bladder, hostile neurogenic bladder, intractable incontinence, refractory interstitial or radiation cystitis, extropy or tuberculosis of the bladder and congenital anomalies of the lower urinary tract.^{2,9,10,11} In animals because the literature documents too few cases, no specific discussion concerning effectiveness, complications or postoperative management is presented^{11,12}, therefore the primary aim of this study is to introduce a continent, simple and effective technique in urinary diversion surgery with colonic segment in dog and evaluate the outcome of this operation based on serum biochemical alterations.

Materials and Methods

In this study five adult healthy mixed breed dogs, 3 males and 2 females, weighing between 25-40 kg and average age of 1.5 years underwent continent urinary diversion with colonic segment in Shahid Chamran University of Ahvaz in Iran. Anesthesia was induced with thiopental sodium (10 mg/kg, IV) and maintained by halothane in oxygen (1-1.5%) delivered in a closed circuit anesthetic system. The abdomen was opened by a midline incision. In this approach fifteen centimeters of the descending colon with preservation of its mesenteric vessels was isolated and the continuity of the intestinal tract was re-established by a one layer seromuscular end- to- end anastomosis with polyglycolat coated 2/0 suture. The isolated colonic segment was opened longitudinally along its antimesentric border to form an intestinal plate. The mucosa of this intestinal plate was thoroughly cleaned with an aqueous solution of povidin iodine 0.1% and normal saline. Then the ureters were severed at ureterovesical junction. A mosquito homeostatic forceps was passed from inside to outside of the isolated colonic wall at a slightly oblique angle to create a short submucosal tunnel and the ureters were drawn into the colon via the tunnels. Simple interrupted sutures were used for uretero-colonic anastomosis and this segment transplanted to the partially cystectomized bladder in a cap form with one layer of Cushing pattern suture. Tramadole (4 mg/kg, bid) was used for pain management in dogs. All ordinary clinical signs like pulse, respiratory rate, body temperature, appetite, and animal behavior were examined and inspected daily. Some serum biochemical parameters such as BUN (Diacetyl mono-oxim method), serum creatinine (method of Jaffe), Ca (Ortho cresolphthalein method), P

(Molybdate reduction method), Na, K (Flame photometry method), Cl (Thiocyanate method), pH, and bicarbonate levels were measured before surgery and at the 1, 2, 3, 4, 5, 6, 7, 10, 15, 20, 25, 35 and 45 postoperative days. pH and bicarbonate were measured by blood gas analyzer ABL 500. Data were analyzed by repeated measure ANOVA with pairwise comparisons (SPSS version 16) to determine significant differences. Probabilities of $P < 0.05$ were considered to be statistically significant.

Results

All five dogs survived after surgery. There were no urinary leaks or extravasations of urine into the abdominal cavity based on clinical examination and radiography. Mean values (\pm SE) for *measured parameters in serum in the 5 dogs are shown in table 1.

Table 1. Measurements of BUN, Cr, pH, bicarbonate, and Ca, P, Na, K, Cl ions before and after experimental urinary diversion surgery in 5 dogs (Mean \pm SE)

	BUN	Cr	pH	Bicarbonate	Na	K	Cl	Ca	P
Before Surgery	26.2 \pm 7	1.4 \pm .03	7.35 \pm .058	23.08 \pm .03	147.4 \pm 1.7	4.08 \pm .18	108.8 \pm .4	8.80 \pm .37	4.24 \pm .06*
1	51.4 \pm 8.7*	2.7 \pm .49*	7.32 \pm .08	21.86 \pm .25	145.6 \pm 2.0*	3.90 \pm .20*	116.8 \pm .4*	8.60 \pm .24	4.76 \pm .11
2	61.2 \pm 11.0*	3.3 \pm .58*	7.28 \pm .01*	21.34 \pm .11*	140.2 \pm 1.8*	3.60 \pm .16*	118.4 \pm .4*	7.90 \pm .17*	8.14 \pm .35*
3	49 \pm 8.6*	2.6 \pm .43*	7.23 \pm .02*	19.32 \pm .83*	135.2 \pm 1.2*	3.22 \pm .08*	119.6 \pm .7*	7.56 \pm .23*	8.64 \pm .40*
4	43 \pm 7.3	2.2 \pm .33	7.20 \pm .02*	19.18 \pm .82*	133.8 \pm .4*	3.04 \pm .09*	121.6 \pm .6*	7.16 \pm .07*	9.32 \pm .08*
5	32.4 \pm 3.0	1.7 \pm .15	7.19 \pm .02*	19.12 \pm .78*	132.8 \pm .8*	2.82 \pm .11*	120.6 \pm .7*	7.08 \pm .10*	9.36 \pm .09*
6	27 \pm .8	1.4 \pm .05	7.20 \pm .01*	19.62 \pm .70*	132.0 \pm .6*	2.82 \pm .09*	119.6 \pm .7*	6.88 \pm .17*	9.64 \pm .21*
7	25.2 \pm .7	1.3 \pm .02	7.21 \pm .01*	20.24 \pm .59*	132.4 \pm .4*	3.00 \pm .08*	118.0 \pm .6*	6.74 \pm .15*	9.88 \pm .16*
10	26.5 \pm .7	1.4 \pm .02	7.24 \pm .01	21.00 \pm .12*	133.2 \pm .4*	3.10 \pm .04*	118.0 \pm .6*	6.52 \pm .16*	10.26 \pm .27*
15	25.5 \pm .7	1.3 \pm .02	7.26 \pm .01	21.22 \pm .13*	133.6 \pm .4*	3.18 \pm .06*	116.6 \pm .6*	6.42 \pm .16*	10.32 \pm .25*
20	26.3 \pm .7	1.2 \pm .02	7.30 \pm .08	21.56 \pm .13*	138.2 \pm 1.5*	3.54 \pm .06*	116.0 \pm .5*	6.60 \pm .08*	9.92 \pm .13*
25	25.7 \pm .7	1.4 \pm .03	7.33 \pm .06	22.18 \pm .25	141.6 \pm 1.1*	4.16 \pm .04	112.2 \pm 1.8*	7.04 \pm .09*	9.44 \pm .13*
35	26 \pm .8	1.5 \pm .02	7.35 \pm .04	23.00 \pm .05	143.4 \pm .8*	4.16 \pm .07	110.0 \pm 1.5	7.40 \pm .10*	8.76 \pm .19*
45	25.5 \pm .7	1.2 \pm .02	7.36 \pm .05	23.10 \pm .08	143.8 \pm 1.0*	4.20 \pm .08	108.8 \pm 1.0	7.70 \pm .10*	7.44 \pm .62*

*The changes in compare with baseline (before surgery) are statistically significant ($p < 0.05$).

BUN and serum creatinine concentrations were increased significantly at first, second and third postoperative days but regressed to the baseline levels gradually. pH and bicarbonate decreased significantly at days 2, 3, 4, 5, 6, 7 after surgery and began to increase at days 10, 15, 20, 25, 35 and 45 after surgery. Decreasing of calcium and increasing of phosphor were seen at day 2 and continued to the end of study.

Potassium and sodium decreased significantly at days 1, 2, 3, 4, 5, 6, 7, 10, 15, and 20 but the decline of sodium continued at day 45. Chloride increased at days 1, 2, 3, 4, 5, 6, 7, 10, 15, 20, and 25.

Discussion

Hyperchloremic metabolic acidosis was diagnosed in 5 dogs. Also hypokalemia and hyponatremia (The salt-loss syndrome) was detected in all animals which had to be continuously treated by potassium/sodium citrate and rehydration with NaCl 0.9%. The salt-loss syndrome and metabolic acidosis are the most frequent undiagnosed complication after an intestinal bladder substitution.¹³ Metabolic disturbances may result from the interaction of urine with the absorptive surface of the bowel used for the procedure that has been mentioned previously.² Hyperchloremic metabolic acidosis develops as a result of sodium secretion (in exchange for hydrogen) and bicarbonate (in exchange of chloride), as well as reabsorption of ammonia, ammonium, hydrogen ions and chloride when these segments are exposed to urine. The mechanism that appears to be most responsible for hyperchloremic metabolic acidosis is excess absorption of chloride and ammonia, which maintains a chronic endogenous acid load.¹⁴ A metabolic acidosis can also occur independent of a salt-losing state because of the reabsorption of ionized ammonium and chloride from the stored urine in intestinal pouch. Ammonium will substitute for sodium in the sodium-hydrogen antiport in the reservoir wall, with the ammonium acting as a competitive inhibitor of sodium. This absorption can be limited by increasing the sodium concentration in the urine with a high dietary salt intake.^{13,15}

Hypokalemia is probably the result of renal potassium wasting as a consequence of renal damage, osmotic diuresis and gut loss through intestinal secretion that has been previously reported.¹⁴ Values for serum inorganic phosphorous was probably elevated due to intestinal recycling of phosphate.¹⁶ In studies using isolated intestinal loops, it was found that chloride, urea and phosphate are absorbed more readily than sodium or potassium. Bicarbonate is readily lost in an intestinal loop. Serum inorganic phosphorus is the most frequently elevated constituent in the plasma as a result of absorption from the colon.¹¹ Chronic metabolic acidosis may result in bone demineralization. This is thought to result from the release of carbonate into the blood from bone in order to counter the acidosis. This is accompanied by an efflux dissolution.¹⁷ Chronic metabolic acidosis poses particularly problematic responses in children, leading to vitamin D resistance, Hypokalemia, hypercalciuria and bone demineralization.^{18,19} Bone demineralization has been documented in patients with ureterosigmoidostomies, long-term urinary conduits and bladder augmentations. However, these changes have not been reported in patients with bladder substitutes.¹³ Hypocalcemia is a consequence of depleted body calcium stores and excessive renal wasting.¹⁴ The chronic acidosis is buffered by carbonate from the bone with subsequent release of calcium into the circulation, which is then cleared by the kidney and results in a gradual decrease in body calcium stores.²⁰ An impairment of renal tubule calcium reabsorption also occurs. Normal bone mineral metabolism requires the interaction of calcium, magnesium and phosphate, which are influenced by parathormone, calcitonin and vitamin D.²⁰ While the metabolic acidosis induces buffering of the skeletal system, impairment of vitamin D synthesis and osteoclast activation in the bone.¹³

In this experimental study, marked increases in BUN and serum creatinine at the first three postoperative days may be attributed to intestinal recycling of nitrogenous products. Similar

observation had been reported in dog¹⁶ and goat.²¹ As has been previously reported^{22,23}, BUN and serum creatinine concentrations were increased following ureterocolonic anastomosis because of colonic absorption of urea. Blood urea nitrogen is the most frequently elevated constituent in the plasma as a result of absorption from the colon. The increases in concentration may be minor, and values may remain in high-normal range. It should be understood these changes may have no relation to renal function in this situation.¹¹ Additionally, creatinine is not a good measure of the glomerular filtration rate (GFR) in a patient who received a continent diversion. Varying amounts of urinary creatinine are reabsorbed by the bowel segment used to store urine; therefore, elevated serum levels of creatinine may not accurately predict the GFR.²

In conclusion, the salt-loss syndrome and hyperchloremic metabolic acidosis are the most complications after urinary diversion with colonic segment in dog. In addition, BUN and serum inorganic phosphorus are the most frequently elevated constituents in the plasma as a result of absorption from the colon.

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تغییرات برخی از فاکتورهای بیوشیمیایی سرم متعاقب انحراف ادراری با قسمتی از قولون در سگ

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هدف ارزیابی برخی تغییرات بیوشیمیایی سرم متعاقب عمل جراحی انحراف ادراری با قسمتی از قولون. طرح مطالعه- مطالعه تجربی در شرایط زنده.

حیوانات- پنج قلابه سگ بالغ، سالم با نژاد مخلوط از هر دو جنس با وزنی بین ۴۰-۲۵ کیلوگرم روش کار- در این رهیافت پانزده سانتیمتر از قولون نرولی با حضور عروق مزانتریک آن جدا شد و این قطعه از امتداد طولی باز شد و با مقادیر فراوان مخلوط ۰/۱ درصد بتادین شسته شد و قولون باقیمانده به روش بخیه سرورزی- ماهیچه‌ای آناستوموز مجدد گردید. سپس دو انتهای حالب‌های جدا شده توسط پنس خون بند موسکیتو به داخل قطعه قولونی جدا شده، کشیده شدند و بخیه‌های ساده تکی بین حالب و مخاط قولون به منظور آناستوموز آنها به یکدیگر نصب گردیدند. این قطعه حالب - فولوبی به شکل کلاهک به مثانه ای که قسمتی از آن برداشت شده بوده در یک لایه بخیه کوشینگ متصل گردید. در این مطالعه ازت اوره خون (BUN)، کراتینین سرم، یون‌های کلسیم، فسفر، سدیم، پتاسیم و کلر اسیدیتنه و بی‌کربنات قبل از جراحی و در زمان‌های ۱، ۲، ۳، ۴، ۵، ۶، ۷، ۱۰، ۱۵، ۲۰، ۲۵، ۳۵ و ۴۵ روز پس از جراحی اندازه‌گیری شدند.

نتایج- ازت اوره خون و کراتینین در سه روز اول پس از جراحی بطور معنی‌داری افزایش یافت اما به تدریج کاهش و به میزان طبیعی رسید. پس از جراحی اسیدوز هیپرکلرمیک به همراه مقادیر یائین سدیم و پتاسیم در پنج قلابه سگ تشخیص داده شد. در تمامی حیوانات کاهش کلسیم و افزایش فسفر خون معنی‌دار بودند. تمامی پارامترهای بیوشیمیایی به جز کلسیم، فسفر و سدیم در طول مدت مطالعه به مقادیر طبیعی خود بازگشتند.

نتیجه‌گیری و کاربرد بالینی- می‌توان نتیجه گرفت که سندروم از دست دادن نمک (کاهش سدیم و پتاسیم خون) و اسیدوز متابولیک از مهمترین مشکلات پس از عمل متعاقب جراحی انحراف ادراری با قطعه قولونی در سگ می‌باشد. کلید واژگان- انحراف ادراری، حالب، قولون، تغییرات بیوشیمیایی سرم، سگ.