Influence of dosage and chemical restraints on feline excretory urography

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ABSTRACT

Three series of trials involving 10 domestic short-haired cats were carried out to determine the influence of dosage of contrast media or type of chemical restraint on feline excretory urography. The 1st series (group A) involved 5 cats sedated with 2.0 mg/kg intramuscular (i.m) injection of 2 % xylazine and receiving 800 mg/kg of 76 % meglumine diatrizoate (urografin). The 2nd series (group B) involved another 5 cats sedated with 2.0 mg/kg (i.m) injection of 2 % xylazine and receiving 1200 mg/kg of 76 % urografin. The 3rd series (group C) involved the repeat urography of the group B cats but sedated with 15 mg/kg (i.m) injection of 5 % ketamine hydrochloride. Ventrodorsal radiographs were obtained immediately, 5, 15 and 40 minutes after the injection of 76 % urografin. Scores were assigned to nephrographic opacification as described in the literature. The heart rates, respiratory rates and rectal temperatures of the cats were also determined before sedation, after sedation, immediately after the injection of 76 % urografin and at 15-minute intervals over a period of 60 minutes. In this study, there were significant differences ($P < 0.05$) in the nephrographic opacification scores between the group A and group B cats at times 0 and 40 minutes post-administration of urografin. Group A cats had good initial nephrographic opacification which faded later while the nephrographic opacification of group B cats progressively increased. Similarly, nephrographic opacification was significantly ($P < 0.05$) higher in the xylazine-sedated cats (groups A and B) than the ketamine-sedated cats (group C). However, there were no significant differences ($P > 0.05$) in heart rates, respiratory rates and rectal temperatures between the 3 groups of cats. It was therefore concluded that increasing the dosage of urografin above 800 mg/kg in cats does not provide additional beneficial effects on the nephrograms produced. Xylazine sedation was observed to produce better nephrographic opacification, however, with delayed nephrographic fading compared to ketamine sedation.

Key words: cat, chemical restraint, dosage, excretory urography, ketamine, urografin, xylazine.

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INTRODUCTION

Excretory urography is defined as sequential radiographic imaging that includes the opacification of the kidneys, renal pelves and ureters following the administration of iodinated contrast medium[7,12]. This technique has been used in small animal clinical practice as a satisfactory anatomical tool and for making a crude qualitative evaluation of renal function in both azotemic and non-azotemic patients[5].

The relative rate of nephrographic opacification and fading provides subjective insight into renal blood flow, glomerular filtration and status of renal outflow tract[3,16]. These rates have been shown to depend on factors altering the amount of contrast agent in the glomerular filtrate and those modifying its concentration as it passes through the renal tubule[1,14]. Although there are circumstances in which the use of central nervous system depressant drugs is contraindicated, most radiological examinations in cats are best performed under some form of chemical restraint, in order to make the uncooperative cat calm, as well as to reduce the risk of personnel irradiation[13]. The ideal agent should produce a dose-dependent central nervous depression without adversely affecting the patient or the result of the radiographic examination[2,4].

Xylazine, an α_2-adrenergic agonist and ketamine are commonly used chemical restraints for radiographic purposes in cats[19]. Xylazine has been reported to delay nephrographic fading in dogs[1]. However, the effect of xylazine on the relative rates of nephrographic opacification and fading is not well known in cats.

In our previous study of the excretory urography of xylazine-sedated dogs[1], we suggested that increasing the dosage of contrast agent administered might improve the nephrogram of animals with prior sedation. The aim of this study therefore was to determine the influence of dosage of contrast media and type of chemical restraint on the rates of nephrographic opacification and fading in cats.

MATERIALS AND METHODS

All procedures were approved by the Animal Care Committees of the Faculty of Veterinary Medicine, University of Ibadan.

Ten adult domestic short-haired cats comprising 8 non-lactating, non-pregnant queens and 2 intact tomcats with a mean body weight of 2.2 ± 0.35 kg were used. They were sourced from a local market and housed inside battery cages for the duration of the experiment. Prior to the study, all the cats were considered to be in good general health and with no renal abnormality based on the findings by complete physical examination, urinalysis and serum creatinine analysis.

Three series of trials were carried out. The 1st series (group A) involved the excretory urography of 5 cats sedated with 2 % xylazine (Chanazine®, Chanelle, Liverpool, UK) at 2 mg/kg and receiving 800 mg/kg of 76 % urografin. The 2nd series (group B) involved the excretory urography of another 5 cats sedated with 2 % xylazine at 2 mg/kg and receiving 1200 mg/kg urografin. The 3rd series (group C) involved the repeat excretory urography of group B cats but sedated with 5 % ketamine hydrochloride (Ketalem®, Hanslemlocke, Hamburg, Germany) at 15 mg/kg. An interval of 1 week was allowed between each series and cats were assigned randomly to groups A and B. Cats were starved overnight but had free access to water until the commencement of the experiment. Effective sedation was taken as the cat's assumption of lateral recumbency.

Following lateral recumbency, 76 % urografin (Schering Pharmaceuticals, Berlin, Germany) was rapidly administered through the cephalic vein using a 23-gauge needle connected to a 5 mℓ

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syringe. Urograffin was then administered at the dose rate of 800 mg/kg (group A) or 1200 mg/kg (groups B and C). With the cat quickly havinf been positioned in dorsal recumbency, ventrodorsal radiographs were obtained at 5–15 seconds (*i.e.* immediately), and 5, 15 and 40 minutes post-injection of the contrast agent using a Phillip Practex 20 mA portable unit.

The cats' heart rates (HR), respiratory rates (RR) and rectal temperatures (RT) were determined before sedation, after sedation, immediately after contrast medium injection and thereafter at 15-minute intervals over a period of 60 minutes. Heart rates were counted in beats/min with the aid of a pre-cordial stethoscope. Respiratory rates were counted in breaths/min by visual observation of chest excursion, while the rectal temperature was measured in centigrade using a clinical thermometer.

Nephrographic opacity was evaluated by assigning scores ranging from 4 (excellent opacification) to 0 (poor opacification) (Table 1). Scoring of nephrographic density was done by a veterinary surgeon that had no previous knowledge of the sedation or contrast given.

Data are presented as mean ± SEM. Nephrographic opacity scores were compared using Student's paired *t*-tests. Physiological variables were compared using analysis of variance (ANOVA) for repeated measures. A P value <0.05 was accepted as significant in all cases.

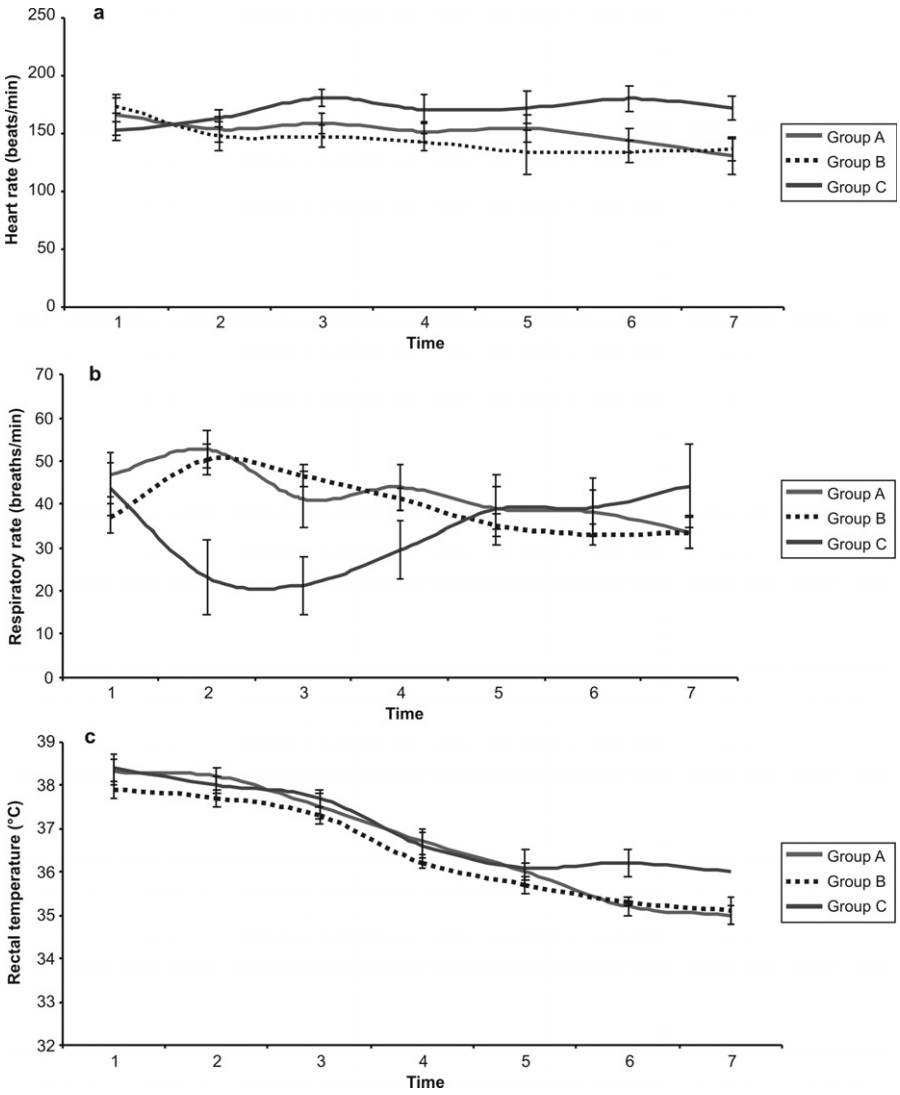

Fig. 1: **Mean heart rate** (a)**, respiratory rate** (b)**, and rectal temperatures** (c) **of cats sedated with either 2 % xylazine and receiving 800 mg/kg urografin** (group A)**, 2 % xylazine and receiving 1200 mg/kg urografin** (group B) **or 5 % ketamine and receiving 1200 mg/kg urografin** (group C)**. Values were obtained before sedation** (1)**, after sedation** (2) **and at times 0** (3)**, 15** (4)**, 30** (5), **45** (6) **and 60** (7) **minutes after the injection of urografin.**

RESULTS

The HR, RR and RT of the 3 groups of cats are shown in Fig. 1. Although, there was no significant difference ($P > 0.05$) in the HR, the ketamine-sedated cats (group C) tended to have a higher HR than the xylazine-sedated cats (groups A and B) following the administration of 76 % urografin. Similarly, the ketamine-sedated cats showed an increasing RR (Fig. 1) following the administration of 76 % urografin, while the xylazine-sedated cats showed a decreasing RR. The dosage of urografin administered did not affect the HR and RR of the cats (group A versus group B). In all 3 groups of cats, the temperature decreased progressively following the administration of urografin (Fig. 1).

There was a significant difference ($P < 0.05$) in the nephrographic opacification score between the group A and group B cats at times 0 and 40 minutes post-contrast medium injection (Table 2). Group B cats tended to produce an initial faint nephrogram which improved later. Group A cats initially produced a good nephrogram which persisted longer. Nephrographic opacification was also significantly higher ($P < 0.05$) in the xylazine-sedated cats (group B) than ketamine-sedated cats (group C) (Table 3). Opacification tended to persist longer in the xylazine-sedated cats compared to ketamine-sedated cats.

DISCUSSION AND CONCLUSION

Both chemical restraints and urographic contrast agents have been reported to affect the heart rate (HR) and respiratory rate (RR) of cats[8,9]. In this study, administration of 76 % urografin did not alter the HR and RR significantly in the xylazine-sedated cats compared to the ketamine-sedated cats. It may be that there is an antagonistic effect between xylazine and the contrast agent. Xylazine causes cardiovascular depression resulting in bradycardia[17], while organic contrast mediums produces a compensatory increase in heart rates due to decreased systemic blood pressure[6].

It is of interest to note that the adminis-

Table 1: **Scoring of nephrographic opacification.**

Score	Remark	Signs
4	Excellent	Renal pelves and calyces distinctly visible
3	Very good	Renal pelves and calyces faintly visible
2	Good	Renal pelves and calyces not visible but kidney outline distinctly visible.
1	Fair	Kidney outline not distinctly visible.
0	Poor	Kidney outline not visible.

Table 2: **Comparison of the influence of dosage of urografin on the nephrographic opacification of cats.**

	Nephrographic scores	
Time (min)	Group A[a]	Group B[b]
0	2.2 ± 0.3*	1.5 ± 0.1*
5	2.4 ± 0.2	2.2 ± 0.2
15	2.4 ± 0.3	2.2 ± 0.2
40	1.4 ± 0.0*	2.6 ± 0.3*

[a]Sedated with 2 % xylazine and receiving 800 mg/kg urografin.
[b]Sedated with 2 % xylazine and receiving 1200 mg/kg urografin.
*$P < 0.05$.

Table 3: **Comparison of the influence of xylazine or ketamine on the nephrographic opacification of the cats.**

	Nephrographic scores	
Time (min)	Group B[a]	Group C[b]
0	1.5 ± 0.1	2.0 ± 0.2
5	2.2 ± 0.2*	1.6 ± 0.1*
15	2.2 ± 0.2*	1.2 ± 0.0*
40	2.6 ± 0.3*	0.6 ± 0.0*

[a]Sedated with 2 % xylazine and receiving 1200 mg/kg urografin.
[b]Sedated with 5 % ketamine and receiving 1200 mg/kg urografin.
*$P < 0.05$.

tration of 76 % urografin resulted in a progressive decrease in rectal temperature in all groups of cats. This drop in temperature may also contribute to the hypotensive action of the contrast medium[15]. It has been reported that organic contrast mediums stimulate the hypothalamus, causing cardiovascular and respiratory collapse[9].

Prior treatment of cats with either xylazine or ketamine significantly affected the rate of nephrographic opacification and fading following administration of 76 % urografin. The optimal dosage is 800 mg/kg as a higher dosage does not produce any additional beneficial effect on the quality of the nephrogram in premedicated cats. This is in contrast to what has been reported in dogs[5].

Nephrographic opacification was significantly higher in the xylazine-sedated cats than in the ketamine-sedated cats. Also, opacification tended to persist longer in the xylazine-sedated cats. Xylazine has been shown to cause initial hypertension followed by persistent hypotension[8,10]. This effect might have resulted in a severe reduction in glomerular filtration rate and stasis within the tubule with consequent avid reabsorption of salt[12,14]. This might have brought more contrast into the tubule thus accounting for the persistent nephrogram[11]. Ketamine, on the other hand, produces a slight increase in arterial pressure while blood flow to the kidney is not altered[17,18]. This might have impaired the reabsorption of solvent in the proximal tubule, thereby decreasing nephrographic opacification.

In conclusion, prior administration of chemical restraints in cats affected the quality of the nephrogram produced during excretory urography. This effect depended on the type of chemical restraints used. The optimal dosage of urograffin in cats is 800 mg/kg.

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