

Review Article

## Anaesthesia Management Strategies for Cystotomy in Dogs

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**Abstract:** Geriatric and Portosystemic shunts could increase the risk of anaesthetic drug toxicity during cystotomy in dogs experiencing urolithiasis. The study reviewed the use of anaesthesia in cystotomy in dogs, from case reports published during the period between 2012-2022, retrieved using the Google Scholar search engine. Inclusion criteria for the review involved a detailed description of the examinations and treatments. Ten articles were reviewed and showed that the most frequently used premedication, - induction anaesthesia, and maintenance anaesthetic agents were Xylazine, Ketamine, and Isoflurane, consecutively. In geriatric cases, Atropine Sulphate, Diazepam and Xylazine were used as premedication, while Ketamine and Propofol were used as induction anaesthesia. In large breeds, Xylazine, Meloxicam, Atropine Sulphate, Diazepam, and Buprenorphine were used as premedication, while Ketamine, Diazepam, and Propofol were used as – induction anaesthesia, and Isoflurane was used as maintenance anaesthesia. Considerations in using anaesthesia in different medical conditions are discussed.

**Keywords:** anesthesia, breeds, cystotomy, dog, geriatric

## INTRODUCTION

Urolithiasis is the formation of calculi in the urinary system as a result of an excessive concentration of minerals, such as calcium, oxalate, and phosphate, in the urine, these calculi could travel through the ureters, urinary bladder, and urethra (Men & Arjentina, 2018). The diagnosis of urolithiasis in dogs relies on the medical history, physical examination, and further laboratory diagnostic tests such as radiography (Pluta, 2011).

Cystotomy is performed when the size of the calculi is too big or the non-invasive urohydropropulsion method was not to be implemented (Fossum, 2018). Anaesthesia is a necessary step prior to the cystostomy, and general anaesthesia is a commonly employed method of anaesthesia in dogs during cystotomy. While the objective of anaesthesia is to reduce pain and induce muscular relaxation, the choice of an anaesthetic agent should include consideration of avoiding harm to body functions in patients with specific medical conditions, such as geriatric, large breed and internal organ disorders (Sardjana & Kusumawati, 2011).

The aim of the review was to describe the gallery of anaesthetic agents used in cystotomy in dogs and discussing considerations in choosing an anaesthetic agent in different medical conditions in dogs during cystotomy.

## METHOD

The articles used in this study were open access papers published between 2012 and 2022, retrieved from Google Scholar database. The keywords "cystotomy in dogs" were used during an internet search. A total of 13 individual case reports were included, of which, 10 articles were selected for this study, based on the criteria of the presence of the description of anamnesis, clinical signs,

laboratory diagnostic tests, and the procedure of administration of anaesthetic agents and its follow-up until the patient recovered consciousness (**Table 1**).

## RESULT AND DISCUSSION

**Table 1.** Signalement, anamneses, clinical signs and examinations of cases of – urinary problem in dogs published during 2012–2022

	Patient	Anamneses	Clinical signs	Diagnostic Examination	Reference
1.	Local dog 7 yo; 10.5 kg; Female	Dogs were fed commercial dry food for three years, had irregular vaccinations, and had a deworming history.	History of urinary incontinence since the previous three months, dysuria, hematuria, urine dripping at the end of urination. Slight dehydration, abdominal discomfort	Hematology (lymphocytosis), Urine strip (glucose, leukocytes, erythrocytes, trace protein), Ultrasound (cystitis with cystolith), Lateral radiograph was found four big cystolith) urine microscopy (leukocytes and transitional epithelial cells), the culture urine presence of <i>Staphylococcus spp.</i>	Devi et al., 2020
2.	Labrador Retriever 3.5 yo; 37 kg; Male	Anorexia, vomiting, and adipsia for the last three days	Hematuria, anuria.	Abdominal radiography (urolith mass), Abdominal ultrasound (urinary bladder distention), blood biochemistry (azotemia)	Salve et al., 2021
3.	Labrador Retriever 8 yo; 15 kg; Female	Animals are active and alert and have no appetite since the previous five days.	Hematuria, dysuria	Hematology (normal range), biochemistry (hypercalcemia), radiography (small round, mineral opacity formation), ultrasound (hyperechoic bladder with presented small cystoliths).	Sharma et al., 2020
4.	Labrador Retriever 10 yo; 31 kg. male	There were drops of urine mixed with blood, and then it stopped. Diuretics were given but failed.	Vomiting, hematuria, stranguria, animal stress, and slight dehydration.	Radiography (several uroliths like a bunch of grapes in the bladder), urinalysis (epithelial cells present).	Ghosh et al., 2020
5.	Labrador Retriever 2 yo; 12 kg; male	Pain in the penile area, urine mixed with blood, and stranguria.	Urination incontinence, abdominal distention, hematuria and stranguria.	Radiographs (various sizes of stones are seen in the bladder and urethra behind the penile bone-hematology (normal range).	Begum et al., 2019
6.	Labrador Retriever 7 yo; 35.9 kg; male	Vomite, inability to urinate, urinary incontinence, anorexia, and anorexia for one week. The owner also complained of foul-smelling urine.	Abdominal and rectal palpation revealed a hard cylindrical mass in the bladder; urinary catheterization was attempted but was unsuccessful. The dog was oliguric and stranguria	Urinalysis (isosteric urine), Abdominal radiography (presence of several stones trapping in the mass)	Mishra et al., 2020
7.	Beagle 5 yo; 8.8 kg;	The animal indicates an aversion to eating, presence of blood in	Anorexia, hematuria, stranguria, polakuria	Radiography revealed the existence of visible calculi in the urinary bladder.	Mahesh & Nagaraja, 2020

	Patient	Anamnesis	Clinical signs	Diagnostic Examination	Reference
	female	urine, urinary difficulties, and many attempts to urinate without successful voiding.		Ultrasound examination showed the presence of many hyperechoic structures in the urinary bladder, with an acoustic shadow indicating the presence of multiple tiny cystoliths and echogenic masses in the bladder walls.	
8.	Lhasa Apso 2 yo; 7.45 kg; female	The history were complete vaccination	Hematuria; stranguria	Ultrasound revealed hyperechoic in the bladder (area hyperechoic indicated the presence of <i>cyst calculi</i> )	Njoku et al., 2021
9.	Spitz 10 yo; 10 kg Male	Animals show signs of lethargy and depression. The individual has experienced abdominal swelling for a duration of 4 days, and testicular enlargement has been observed for the past month. presence of multiple tiny cystoliths and echogenic masses in the walls of the VU.	The individual is experiencing dysuria, hematuria from the prepuce, loss of appetite, and abdominal distension persisting for a duration of 4 days. An examination of the body found testicles that were not symmetrical and an abdomen that was tight.	A lateral radiograph reveals an enlargement of the bladder with calculi, while an ultrasound shows the presence of stones that appear as shadows floating	Rafeel et al., 2014
10.	Cocker Spaniel 1.9 yo; 13.2 kg; Male	Dogs with previous portosystemic shunt (PSS) conditions were then given a lactose diet and given ampicillin. Since then, his condition has improved, although the owner reported the dog became polyphagic. Owners prefer non-surgical treatment of PSS.	One month earlier, the dog had been examined due to complaints of lethargy, poor appetite and weight loss.	Hematology (thrombocytopenia, biochemistry (low urea, high ALP and ALP), urine dipstick (hematuria), ultrasound (the bladder swelling, amorphous and pedicular formation in the lumen, several calculi visible).	Schauvliegh e et al., 2010

The 10 case studies reported clinical signs of haematuria, dysuria, anuria, stranguria, and urinary incontinence. The examinations conducted include radiography, ultrasound, urinalysis, haematology, and blood biochemistry. Most cases were diagnosed based on the identification of a mass with mineral opacity on urinary tract radiography and the presence of a hyperechoic mass on urinary bladder ultrasonography. **Table 2** presents the premedication, -induction and maintenance anaesthetic - for each dog in articles included in this review.

In large breed dogs, premedication used were Meloxicam (0.3 – 0.4 mg/kg bw), Atropine Sulphate (0.02 – 0.04 mg/kg bw), Xylazine (1.0 – 1.5 mg/kg bw), Diazepam (0.25 – 1.00 mg/kg bw) and Buprenorphine (0.02 mg/kg bw). All drugs were given intramuscularly or intravenously except the large dose of Atropine sulphate (0.04 mg/kg bw), which was given subcutaneously in a geriatric case. Large breeds often respond severely to normal therapeutic doses of premedication such as Acepromazine (Kreins, 2012), thus, lowering doses of premedication might be needed. Alternatively, the subcutaneous route may help to release the drugs into the bloodstream slower. Medium dog breeds

usually do not have an issue with normal dosing of premedication, but the small toy breeds have a larger ratio of body surface area to body mass and a higher metabolic rate, and a normal dose of premedication might lower body temperature and lead to hypoglycemia. In such cases, a warming pad may be needed during surgery (Kreins, 2012).

**Table 2.** Anesthetic agents used in cystotomy in dogs

	<b>Breed</b>	<b>Age Group</b>	<b>Breed</b>	<b>Drug</b>	<b>Dosage</b>	<b>Route</b>	<b>Indication</b>
1.	Local dog	Adult	Large Breed	Meloxicam	0.3 mg/kg bw	IM	Premedication
				Diazepam	1.0 mg/kg bw	IV	Induction
				Ketamin	10 mg/kg bw	IV	Induction
2.	Labrador Retriever	Adult	Large Breed	Xylazine	1.0 mg/kg bw	IM	Premedication
				Diazepam	0.25 mg/kg bw	IV	Induction
				Ketamin	3 mg/kg bw	IV	Induction
				Isoflurane	1 - 2 %	Inhalation	<i>Maintenance</i>
3.	Labrador Retriever	Adult	Large Breed	Atropine Sulphate	0.02 mg/kg bw	IM	Premedication
				Xylazine	1.5 mg/kg bw	IM	Premedication
				Ketamin	5 mg/kg bw	IM	Induction
				Isoflurane	1 - 2 %	Inhalation	<i>Maintenance</i>
4.	Labrador Retriever	Geriatric	Large Breed	Atropine Sulphate	0.04 mg/kg bw	SC	Premedication
				Xylazine	1.0 mg/kg bw	IM	Premedication
				Diazepam	0.5 mg/kg bw	IV	Premedication
				Propofol	6.0 mg/kg bw	IV	Induction
5.	Labrador Retriever	Adult	Large Breed	Diazepam	0.25 mg/kg bw	IV	Premedication
				Buprenorphine	0.02 mg/kg bw	IV	Premedication
				Propofol	4.0 mg/kg bw	IV	Induction
				Isoflurane	2 - 3 %	Inhalation	<i>Maintenance</i>
6.	Labrador Retriever	Adult	Large Breed	Meloxicam	0.4 mg/kg bw	IM	Premedication
				Atropine Sulphate	0.02 mg/kg bw	IM	Premedication
				Xylazine	1.0 mg/kg bw	IM	Premedication
				Ketamine	5.0 mg/kg bw	IM	Induction
				Isoflurane	1 - 2 %	Inhalation	<i>Maintenance</i>
7.	Beagle	Adult	Medium Breed	Atropine Sulphate	0.02 mg/kg bw	IM	Premedication
				Xylazine	1.0 mg/kg bw	IM	Premedication
				Ketamine	5.0 mg/kg bw	IM	Induction
				Isoflurane	1 - 2 %	Inhalation	<i>Maintenance</i>
8.	Lhasa Apso	Adult	Medium Breed	Atropine Sulphate	0.03 mg/kg bw	IV	Premedication
				Xylazine	2.0 mg/kg bw	IV	Premedication
				Ketamin	10.0 mg/kg bw	IM	Induction
9.	Spitz	Geriatric	Toy Breed	Atropine Sulphate	0.04 mg/kg bw	IM	Premedication
				Xylazine	1.0 mg/kg bw	IM	Premedication
				Ketamin	5.0 mg/kg bw	IV	Induction
10.	Cocker Spaniel	Adult	Medium Breed	Methadone	0.2 mg/kg bw	IM	Premedication
				Propofol	4.0 mg/kg bw	IV	Induction
				Isoflurane	2 - 3%	Inhalation	<i>Maintenance</i>
				Meloxicam	0.1 mg/kg bw	IV	Premedication
				Lidocaine	2.0 ml, 2%	Epidural	Induction
				Morphine	0.1 mg/kg bw	Epidural	Induction

The age of dogs patients also needs to be considered to choose anesthesia. Urolithiasis more commonly occurs in old dogs, yet geriatric patients are at higher risk of contracting the adverse effects of anaesthesia on the functions of the cardiovascular, respiratory, kidney, liver, and neurological systems (Ramsey, 2017). Two case studies included in this review involved two geriatric dogs of ten years old. In these dogs, Atropine Sulphate, Xylazine, and Diazepam were used as premedication, while Ketamine and Propofol were used as anaesthesia. In geriatric ages, Atropine Sulphate needs to be used with caution because its anticholinergic properties could increase tachycardia (Plumb & Pharm, 2011). In normal situations, the use of Xylazine as a muscle relaxant is recommended for cystotomy to maintain bladder relaxation, but Ramsey (2017) did not recommend the drug for geriatrics as it has a tendency to cause respiratory depression in geriatrics. An alternative to Xylazine as a muscle relaxant in geriatric patients is Diazepam (Plumb & Pharm, 2011). The adverse effects of Propofol and Ketamine in the geriatric ages have not been apparent (Plumb & Pharm, 2011).

In the geriatric cases of this review in which Atropine Sulphate was given, the subcutaneous and intramuscular routes of administration were used. In subcutaneous administration, the drug is injected into the fatty layer of subcutaneous tissue, which has fewer blood vessels than other organs. The drug would be absorbed slowly and gradually, thus entering circulation in continuous, but low doses. This route may be preferred for geriatric patients, whose body metabolism is slower compared to younger animals (Fossum, 2018).

One case report included in the review involved a dog with a portosystemic shunt (PSS). The PSS usually follows portal hypertension or liver trauma, including iatrogenic injury. Normally, the blood flows from the intestines to the portal vein of the liver where it is filtered, and flows back to the heart via the caudal vena cava. A portosystemic shunt (PSS) is an abnormal vein that connects the blood supply from the intestines to the caudal vena cava and bypasses the liver portal vein. Portosystemic shunts may affect anaesthetic management due to reduced hepatic metabolism of the drug. Most dogs with congenital PSS have smaller livers due to deficient hepatportal circulation. Decreased hepatic drug clearance manifests as poor tolerance to anaesthetic or sedative drugs in some affected patients (Schauvlieghe et al., 2010).

Xylazine, an Alpha-2 agonist, was not used in the case report of PSS included in this review. One consideration can be to avoid its adverse cardiovascular effects. Ketamine was also absent in the list of anaesthesia administered to the case. Ketamin can cause seizures and should be avoided in cases with hepatic encephalopathy and PSS. In this case, Propofol is the anaesthesia of choice as it undergoes rapid and extensive hepatic metabolism (Schauvlieghe et al., 2010).

The epidural anaesthesia was also used in the case of PSS included in this review, along with induction of general anaesthesia. The aim was to improve the analgesic effect in the caudal of the first lumbar region. In this report, the epidural anaesthesia induction was performed using a combination of lidocaine and morphine and was reported to produce synergistic effects (Schauvlieghe et al., 2010).

Some of the anaesthesia protocols did not include specific maintenance anaesthesia. In cases where maintenance protocol was used, Isoflurane has been the drug of choice, given 1 – 3% concentration as an inhalant.

## CONCLUSION

Dogs could experience urolithiasis as young as 1.9 yo, but half of the reviewed cases occurred in dogs more than seven years old. The most frequently chosen anaesthesia protocol is Xylazine at 1 – 2 mg/kg bw as premedication, Ketamine as induction anaesthesia at 3 – 10 mg/kg bw, and Isoflurane at 1 – 3% as a maintenance anaesthetic agent. However, there are still pros and cons to using Xylazine in geriatrics, so other alternatives such as diazepam can be used. For patients with hepatic or vascular issues like PSS, it is advisable to choose for a rapidly metabolized anesthetic, like the propofol.

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