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INSTITUTO DE CIÊNCIAS BIOMÉDICAS ABEL SALAZAR
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Relatório Final de Estágio

Mestrado Integrado em Medicina Veterinária (MIMV)

ULTRASOUND PRESENTATION OF DEFERENT DUCTS IN DOGS

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Orientadora:
Prof. Dra. Claudia Sofia Narciso Fernandes Baptista (ICBAS)

Co-Orientadora:
Prof. Dra. Rosa Novellas Torroja (UAB)

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Abstract

The deferent duct (*ductus deferens*) is the connection between the tail of the epididymis and the pelvic urethra. It can be divided into a scrotal segment – running along the testis and continuing dorsally in the spermatic cord until the inguinal canal – and an abdominal segment – crossing ventral to the ureter, at the lateral ligament of the bladder, until it penetrates the prostate to enter the pelvic urethra.

In veterinary medicine, the visualization of this structure is uncommon, due to its difficult location. However, the ducts can exhibit different pathological presentations such as obstruction, agenesis and neoplasia.

To evaluate the feasibility of visualization of the deferent duct in a standard ultrasound exam, the ducts of 28 dogs without suspicion of deferent duct pathology were evaluated. Between February and November of 2020, they were assessed by 5 operators in the Veterinary Hospital of the Autonomous University of Barcelona. We were interested in evaluating if characteristics such as breed, weight, age, neutering status and prostate size influenced the likelihood of duct visualization. In the dogs where the ducts were found, its measurements were taken.

This study showed that the abdominal segment of the deferent duct in dogs can often be seen in a standard ultrasound exam. The duct can be identified as an anechoic tubular structure with a muscular wall, and be distinguished from adjacent arteries using colour Doppler.

There are several factors that can have an impact in the likelihood of the visualization of this structure. The experience of the operator can be a determining factor, not only the general experience in performing ultrasound evaluations, but also the specific experience of finding the deferent duct. A positive correlation was found between the size of the prostate and the probability of finding the duct. The age and weight of the animal was not found to be associated with its visualization.

In conclusion, the deferent duct can be found by ultrasound imaging in a large percentage of dogs, and so should be evaluated routinely in abdominal ultrasounds, especially if reproductive or urinary problems are present.

Acknowledgements

During my academic journey, culminating in the writing of this thesis, I have been supported and encouraged by many amazing people who I would like to now thank:

My family, for the love and support through my entire journey. A particular thank you to my mom an sister-in-law, for their guidance and wisdom during the writing of this work.

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My friends, for always making me laugh away my anxiety, and not being afraid to be honest. To Rafaela and João, a special thanks for always being there for me.

My thesis coordinator, Prof. Cláudia Baptista and my co-coordinator Prof. Rosa Novellas, for guiding me in this project.

The teams of the Imaging Department of the Autonomous University of Barcelona, +Ani+ Veterinary Hospital, and Dr. Telmo Fernandes for teaching me so much, and helping me become a veterinarian.

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1 Preamble

My curricular externship started at the UAB Veterinary Hospital, in Barcelona, in the Imaging Department. During this time, a work on the ultrasound presentation of the deferent ducts was suggested, and I collaborated in the data collection.

On account of the COVID-19 pandemic, I had to stop this part of my externship, and therefore prepared a contingency plan to finish the remainder of my time in +Ani+ Veterinary Hospital in Portugal[1]. During this time, data was still collected in Barcelona to allow the study to continue.

1.1 Externship

During my time in Barcelona, from February 3rd to March 11th, I participated in the daily work of the Imaging Department at the UAB Veterinary Hospital. I was able to follow the five veterinarians – one DipECVDI, one radiology professor and three residents – working there in ultrasound, radiology, computed tomography (CT) and magnetic resonance imaging (MRI). Given the work volume and my personal preference for ultrasound, I spent most of my time in this imaging modality. In this area, I observed 141 abdominal ultrasounds, 18 cardiac ultrasounds and 10 ophthalmic ultrasounds. I also saw and participated in 42 radiographic examinations, as well as 10 MRI and 9 CT studies.

After the lockdown period, I managed to complete my internship at +Ani+ Veterinary Hospital, in Maia, from August 3rd to October 16th. I believe this part of the internship allowed me to get a well rounded experience, giving me practice in Internal Medicine as well as contact with clients. During this time, I accompanied several veterinarians in both the treatment of hospitalized animals – where I was able to follow their clinical progress – as well as in clinical consultations – where I had the opportunity to observe a wide range of routine to critical conditions. In addition to this, I also observed and participated in other areas of veterinary practice, such as surgery, ultrasound and radiology. All of this provided me with with a general view of hospital work, as I rotated between work shifts similarly to the hospital veterinarians.

1.2 Deferent Duct Study

While in Barcelona, Dr. Rosa Novellas suggested the execution of a study on the viability of evaluating the deferent duct in dogs by ultrasound. According to veterinary literature this procedure is not performed routinely due to the difficulty in finding the duct using ultrasound imaging techniques. On the other hand, this procedure is commonly reported in human medicine as a convenient way to evaluate the duct. As such, it seemed relevant to know whether the ultrasound

[1] https://www.maisanimais.pt/

observation of the duct in dogs is possible. We also wanted to evaluate if the ability to visualize the duct was related to other factors, namely age, weight, breed and neutering status, or to measurable aspects in the ultrasound examination, such as prostate size.

For the purpose of this deferent duct study, we started to collect data on February 14th on dogs coming to the department for abdominal ultrasound. I participated in the collection of data until March 9th, after which time I was forced to leave the hospital. While on the second portion of my internship, the imaging team in Barcelona was able to collect more data, which allowed me to continue to analyse it and complete the project.

2 State of the Art

The deferent duct (*ductus deferens*) is a tubular structure present in male mammals. Its function is to carry sperm from the epididymis – after leaving the testicles – to the urethra at the level of the prostate – which will carry it to the exterior.

The deferent duct is embryologically derived from the mesonephric duct, which also forms the ureters and renal pelvis (McGeady et al., 2017). It consists of three layers: the *tunica adventitia*, the *tunica muscularis* and the *tunica mucosa*. Of these three layers, the muscular wall is the widest – being composed of two longitudinal layers, enclosing a circular layer – making this duct a peculiar tubular structure thanks to its small lumen compared to the thickness of the wall (Evans and de Lahunta, 2012; Chan and Schlegel, 2002).

Anatomically, the deferent duct starts at the tail of the epididymis – starting as a tortuous structure before straightening out –, and runs along the dorsomedial border of the testis, previous to integrating the spermatic cord. In the spermatic cord, alongside its vessels and nerves, as well as the testicular vessels and nerves, it runs until the vaginal ring, where it enters the abdomen through the inguinal canal. Supported by the *mesoductus deferens* – which runs from the testis to the dorsal surface of the bladder –, the deferent duct passes ventral to the ureter, before continuing caudally and penetrating the prostate to open into the pelvic urethra (Evans and de Lahunta, 2012).

As seen in Table 1, the reviewed literature on this topic consists of both human and veterinary medicine, namely canine, with one study including both areas, since it refers to a comparison between the two. This comparison between the deferent ducts of men and dogs shows they are similar both in histological characteristics and size (Leocadio et al., 2011), making the anatomical and ultrasound data collected on men applicable to dogs. Since the deferent duct in general, and the the ultrasound imaging of this structure in particular, are not well researched in veterinary medicine, approximately two thirds of the studies found were concerning human medicine. It is also worth noting that, from the studies with a sample size, the sample size in human studies are significantly larger than in animal studies (average of 105 vs 7).

Although infrequent, the deferent duct can be subject to different pathological presentations. In dogs with azoospermia, obstruction of the deferent duct is a possible diagnosis (Olson, 1991). This obstruction can be caused by inflammation, cystic dilation, calculi, fibrosis, neoplasia or agenesis, and can result in deferent duct dilation proximal to the obstruction (Kim et al., 2009). Inflammatory conditions of the deferent duct have been described in men, namely vasitis nodosa – caused by damage to the duct resulting in spermatozoa leakage –, and infectious vasitis – usually secondary to prostatitis or orchitis (Chan and Schlegel, 2002). While primary neoplasia of the deferent duct has not been reported in veterinary medicine, there is a report of a transitional cell carcinoma

Table 1: Analysis of the Available Literature.

Reference	Studies	Books and reviews	Pathologic Presentation	Normal Presentation	Ultrasound	Duct Anatomy	Duct Measurements	Scrotal Presentation	Abdominal Presentation	Sample Size
Human Medicine										
(Donohue and Fauver, 1989)	X		X			X		X	X	26
(Jarow, 1993)	X		X		X		X		X	180
(Velasquez et al., 1995)		X	X		X			X	X	-
(Oyen, 2001)		X	X	X	X	X	X	X		-
(Chan and Schlegel, 2002)		X	X					X	X	-
(Xue et al., 2003)	X		X		X			X		123
(Puttemans et al., 2006)	X		X	X	X	X	X	X		112
(Middleton et al., 2009)	X			X	X	X	X	X		25
(Kim et al., 2009)		X	X	X	X	X	X		X	-
(Du et al., 2010)	X		X		X		X	X	X	100
(Singh et al., 2012)		X	X			X		X	X	-
(Ammar et al., 2012)		X	X	X	X			X	X	-
(Abdulwahed et al., 2013)	X		X		X			X	X	268
(Lotti and Maggi, 2015)		X	X	X	X			X	X	-
(Tyloch and Wieczorek, 2016)		X	X	X	X			X		-
(Li and Liang, 2016)	X		X	X	X	X	X	X	X	96
(Kühn et al., 2016)		X	X	X	X	X		X		-
Veterinary Medicine										
(Olson, 1991)		X	X					X	X	-
(Nyland and Matoon, 2002)		X	X	X	X	X			X	-
(Davidson and Baker, 2009)		X	X	X	X	X		X	X	-
(He et al., 2011)	X			X	X			X		6
(Cilip et al., 2011)	X			X	X			X		9
(Cilip et al., 2012)	X			X	X		X	X		6
(Guerin et al., 2012)	X		X		X				X	1
(Evans and de Lahunta, 2012)		X		X		X	X	X	X	-
(Schnobrich et al., 2016)	X			X	X				X	11
(McGeady et al., 2017)		X		X		X		X	X	-
Human & Veterinary Medicine										
(Leocadio et al., 2011)	X			X			X	X	X	17
Total	14	11	20	18	21	12	10	23	19	

This table presents an overview of the available literature on deferent duct ultrasound. Publications are first divided according to whether they include human or veterinary medicine. Subsequently we show, using green, whether they are categorized as studies or reviews and books; whether they reference normal or pathological presentation of the ducts; whether ultrasound, deferent duct anatomy or duct measurements are covered in the work; whether they reference the duct in its scrotal or abdominal segments; and what the sample size is for the studies.

involving the duct (Guerin et al., 2012), suggesting that tumoral invasion from the prostate or bladder is plausible (Kim et al., 2009). Deferent duct agenesis is a rare finding in veterinary medicine, even though it might not be that uncommon a pathology. Owing to their common origins, there seems to be an association between renal and deferent duct agenesis, which makes identification of both structures important (Donohue and Fauver, 1989). Lastly, other pathological presentations have been described in men, such as variant positions of the deferent duct in infertile patients (Puttemans et al., 2006), or calcification of the duct in diabetic patients (Velasquez et al., 1995).

In the veterinary literature, the ultrasound image of the deferent duct is not frequently discussed. The publications that do reference it, describe it as difficult to visualize unless altered by anomalies such as cystic dilations (Davidson and Baker, 2009). The deferent duct is therefore mostly described as a structure not commonly found when examining the caudal abdominal area via ultrasound. Whenever it is referenced, it is only described as hypoechoic linear echoes, passing through the dorsal portion of the prostate gland (Nyland and Matoon, 2002). On the other hand, this structure is reliably found in men using ultrasound examinations, both in abdominal (Ammar et al., 2012) and extrapelvic segments (Middleton et al., 2009).

In men, the echographic appearance of the deferent duct is described as a tubular structure with a thick muscular wall and a small lumen (Oyen, 2001). It is seen as hypo- to anechoic with two parallel hyperechoic lines representing the internal lumen walls, which, together with the muscular wall, give it a target-like appearance in a transverse view. The duct is distinguishable from adjacent structures by not being compressed by the probe when pressure is applied – which happens with adjacent veins – and not showing a flow on colour Doppler – separating it from adjacent arteries (Puttemans et al., 2006; Middleton et al., 2009; Li and Liang, 2016).

There are few mentions of the dimensions of the deferent duct in dogs, placing it between 1.6 and 3 mm in diameter (Evans and de Lahunta, 2012) with 0.27 ± 0.07 mm lumen diameter and 1.09 ± 0.06 mm wall thickness (Cilip et al., 2012). This is congruent with the measurements seen in the extrapelvic duct in men, where the diameter ranges from 1.5 to 2.7 mm and the lumen from 0.2 to 0.7 mm in healthy adults (Puttemans et al., 2006; Middleton et al., 2009; Li and Liang, 2016). Abdominal measurements of the duct by transrectal ultrasound range from 2.6 to 5.4 mm (Jarow, 1993).

3 Materials and Methods

In the periods between February 14th and March 9th, 2020 as well as between August 2nd and September 15th, 2020, data was collected in the Imaging Department of the Veterinary Hospital of the Autonomous University of Barcelona.

Abdominal ultrasound was performed by five veterinarians: two senior radiologists and three residents. To perform the exams, an Esaote, MyLab8 XP ultrasound machine, combined with a 3-10 MHz microconvex probe and a 4-15 MHz linear probe were used. The cases included in this study are from a convenience sample of 28 male dogs referred for abdominal ultrasound for any medical indication.

The visualization of the ducts was attempted in their entrance to the prostate and dorsal to the bladder. When a tubular structure consistent with the duct was seen, confirmation of the correct structure was obtained by following its course, as well as using colour Doppler to exclude an artery.

Observational data was collected on all dogs undergoing this procedure, namely weight, age, indication for exam and neutering status. During the ultrasound, data was collected on prostate length, width and height in addition to deferent duct size, visualization area and probe used to view it, whenever it was found.

Table 2 shows that the breed distribution is consistent with the distribution of common breeds in the area, with mixed breed dogs being most frequent, followed by French Bulldogs and Labrador Retrievers.

Table 2: Distribution of Breeds in Sample.

Breed	
Mixed	7
French Bulldog	3
Labrador Retriever	3
Beagle	2
Maltese	2
Yorkshire Terrier	2
Irish Setter	1
St. Bernard	1
Akita Inu	1
Shih Tzu	1
American Staffordshire Terrier	1
Greyhound	1
Golden Retriever	1
Pinscher	1
Podengo	1

The distribution of the medical reasons for ultrasound examination, represented in Table 3 shows neurological and gastrointestinal complaints as the most common, followed by the other systems.

Table 3: Distribution of Abdominal Ultrasound Indication in Sample.

Indication for Exam	
Neurological	8
Gastrointestinal	7
Urinary	4
Reproductive	3
Ophthalmic	3
Trauma	2
Other	2

The weight and age distribution of this sample were as follows: a weight distribution with a median weight of 20.4 kg, and 25th and 75th percentiles of 9.5 kg and 31.2 kg respectively; and an age distribution with a median age of 8 years, and 25th and 75th percentiles of 3.25 years and 11 years respectively. Of the 28 dogs examined, 11 had been neutered (39%), while 17 remained intact.

Since the assumptions needed to run a linear regression could not be met, a non parametric Spearman's rank correlation coefficient test was run to study the association between mean duct size and prostate length and height, as well as weight and age. Analysis of this data was done using IBM SPSS Statistics, version 27.

4 Results

The visualization of the ducts was executed using a 3-10 MHz microconvex probe, with the exception of three ducts where a 4-15 MHz linear probe was used. Five veterinarians performed the studies: three residents obtained images in 12 animals and two senior radiologists in 16. The ducts were visualized in their path between the dorsal surface of the bladder and its entrance to the prostate. However, in one case we were able to follow this structure as far as its caudal curvature. The right deferent duct was searched for in 26 animals and found in 19, while the left duct was searched for in all 28 animals and found in 19. Overall, at least one of the ducts was found in 24 dogs – 86%. A mean duct size distribution can be seen in Figure 1.

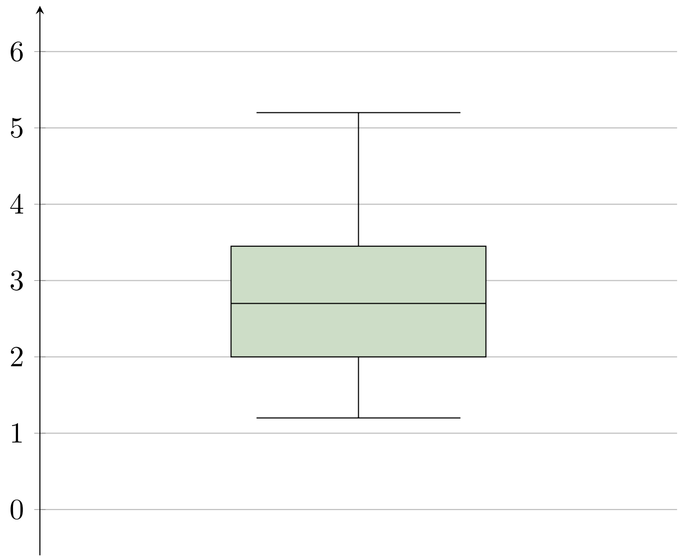

Figure 1: Mean Duct Size (mm)– For this boxplot, an average of the two ducts was used, when both values were present, otherwise the value of the single duct registered was used.

In the following images, we will evidence structures pertinent to this study that were found in six of the examined animals – such as the prostate and deferent ducts – using both a microconvex and a linear probe. We will refer to the animals as animal 1–6 in order to protect identifying data.

To begin an examination intended to find the deferent ducts, the first structure we need to locate is the bladder. Figure 2 shows an example of the bladder of animal 1, found before searching for the ducts.

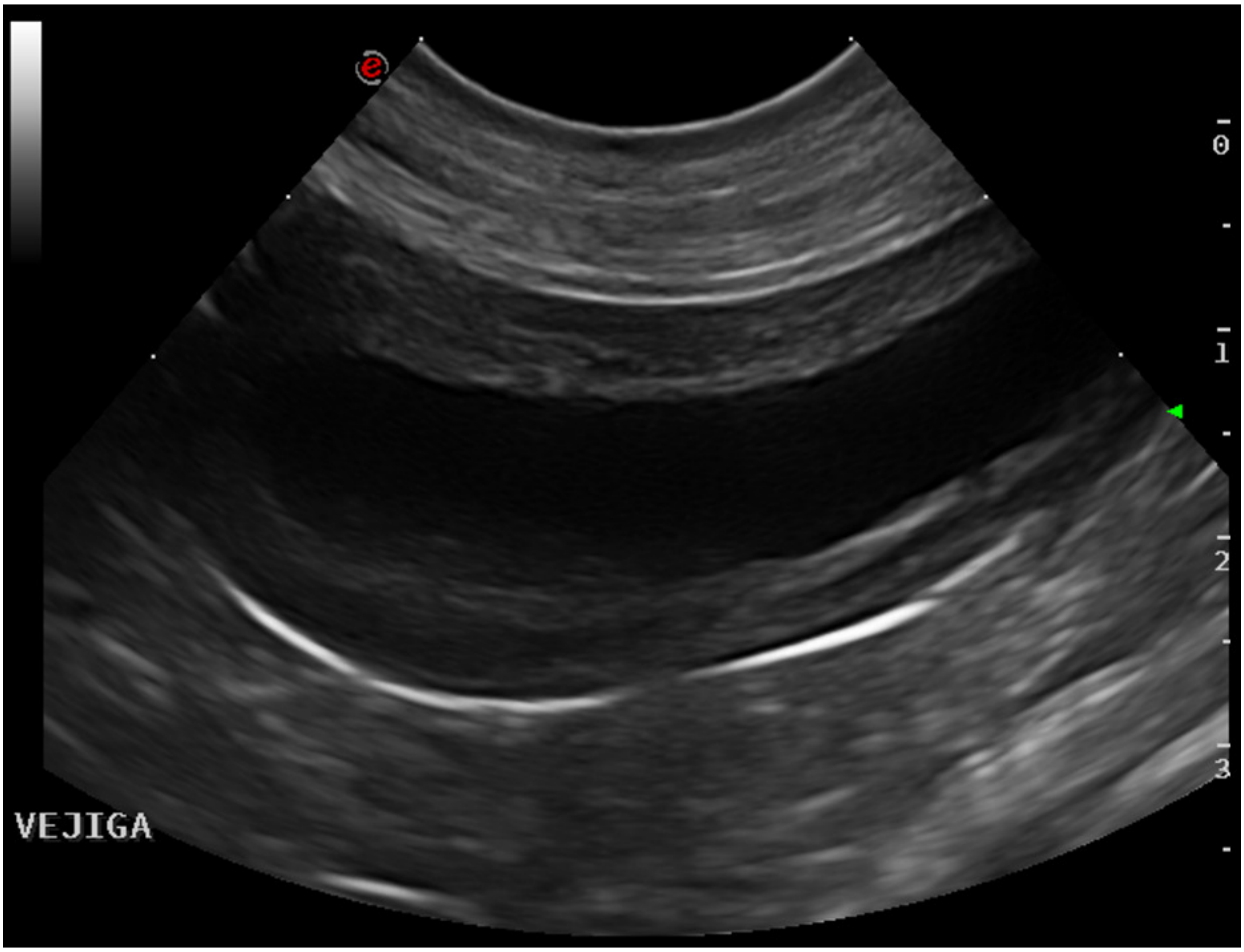

Figure 2: Longitudinal section of the bladder of animal 1, visualized using a 3-10 MHz microconvex probe.

After the bladder, we must visualize the prostate. For this work, length, width and height measurements of this structure were collected after locating it. Figures 3 to 11 show the prostates of animals 1–6 and were obtained after observation of the bladder. In these images, measurements and appearance of the prostate can be evaluated.

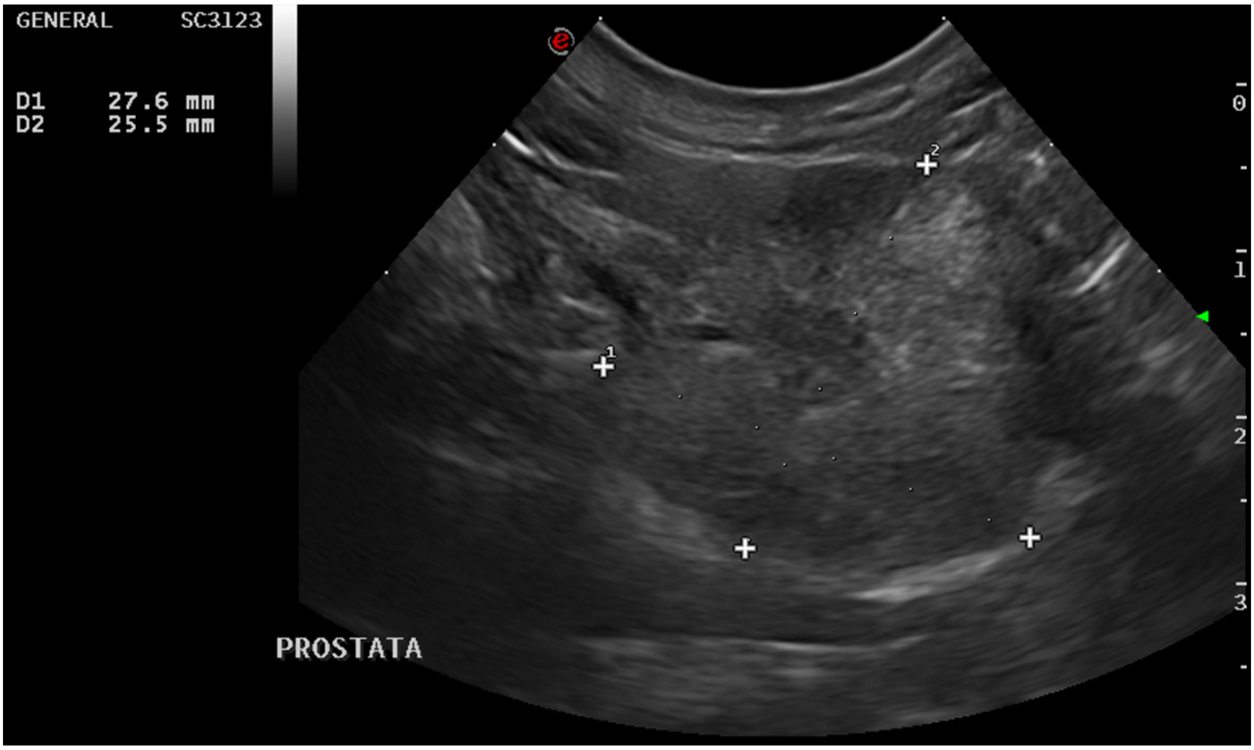

Figure 3: Longitudinal section of the prostate of animal 1, visualized using a 3-10 MHz microconvex probe – measurements indicate a prostate length of 27.6 mm and height of 25.5 mm.

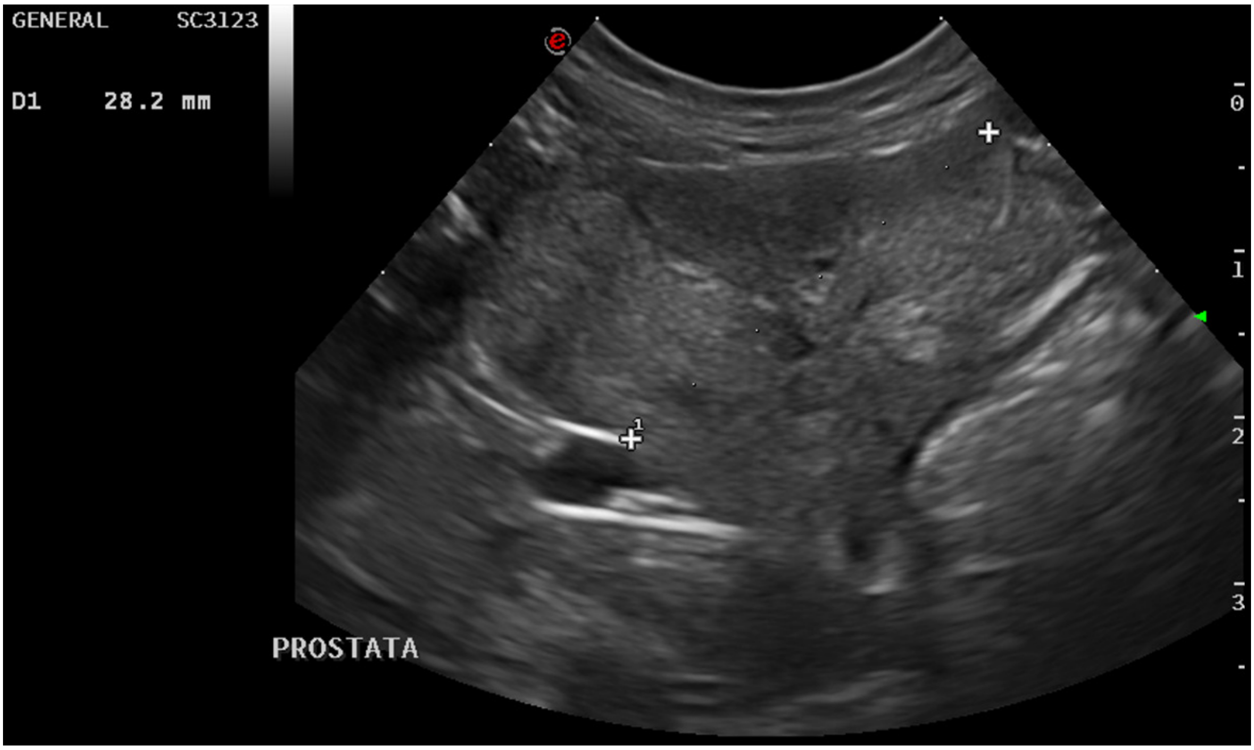

Figure 4: Transverse section of the prostate of animal 1, visualized using a 3-10 MHz microconvex probe – measurement indicates a prostate width of 28.2 mm.

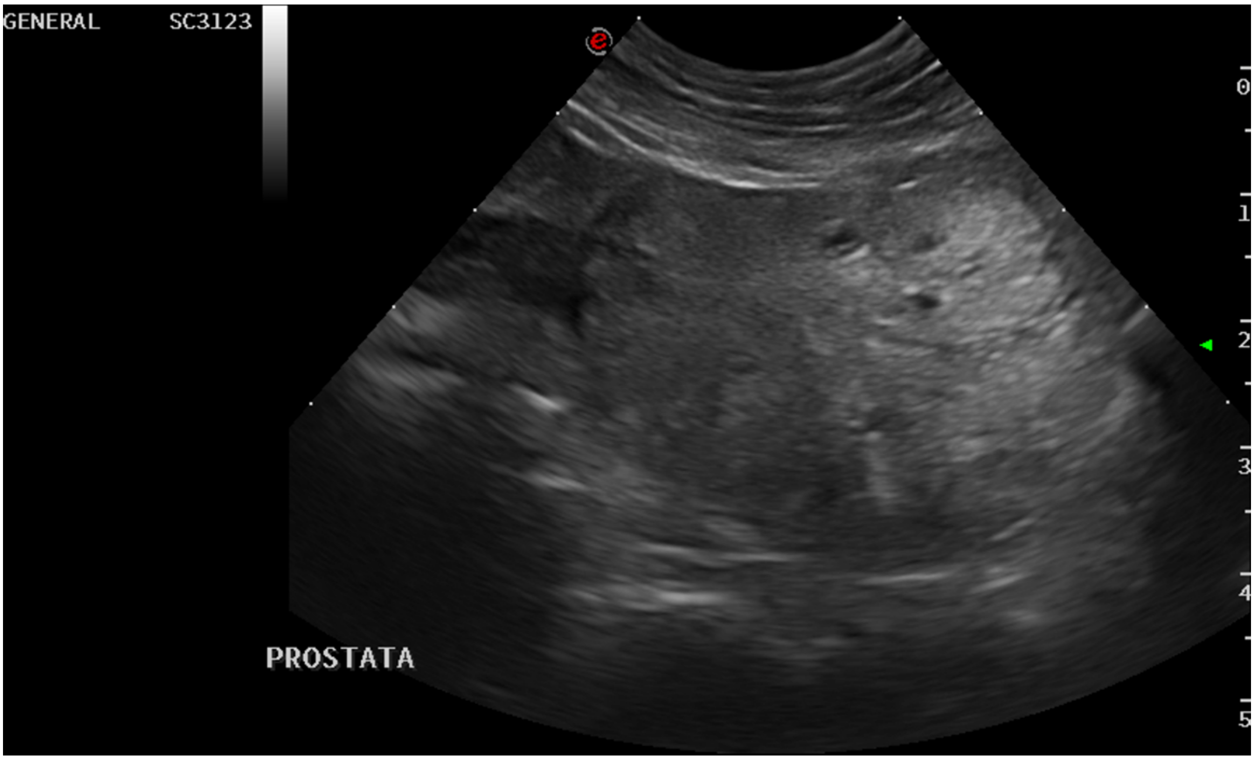

Figure 5: Longitudinal section of the Prostate of animal 2, visualized using a 3-10 MHz microconvex probe.

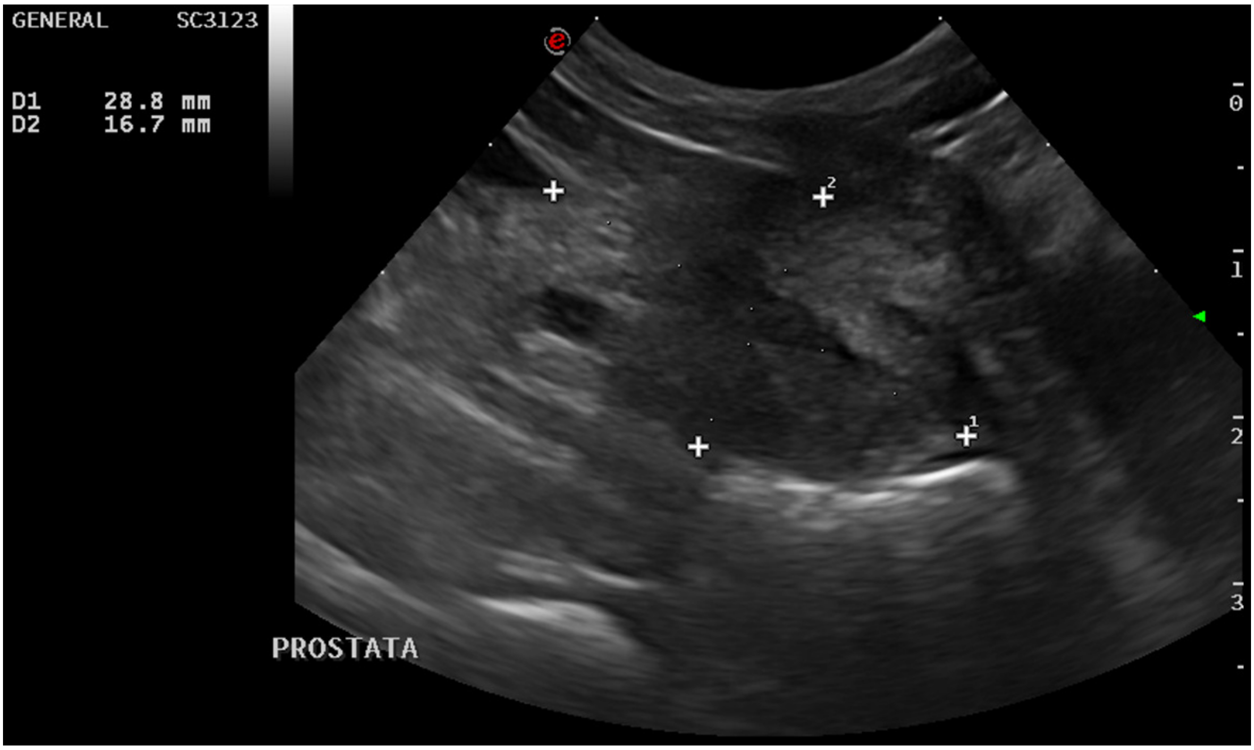

Figure 6: Longitudinal section of the prostate of animal 3, visualized using a 3-10 MHz microconvex probe – measurements indicate a prostate length of 28.8 mm and height of 16.7 mm.

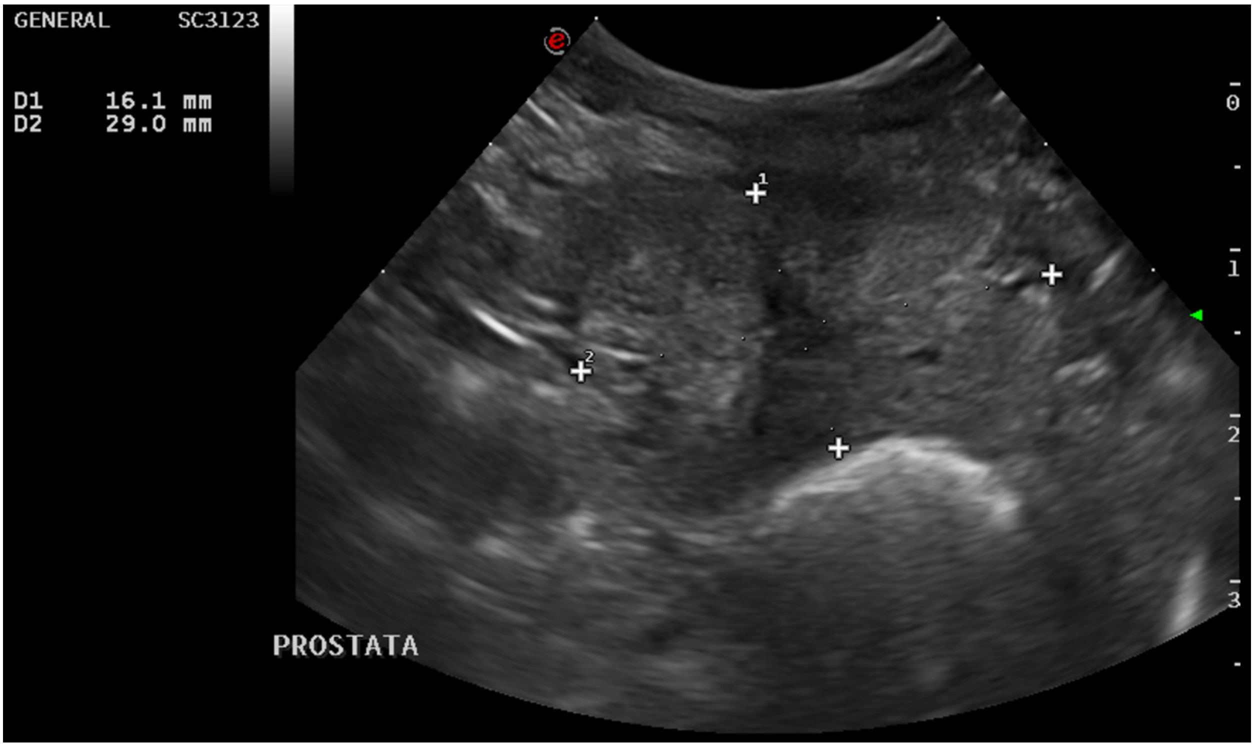

Figure 7: Longitudinal section of the prostate of animal 3, visualized using a 3-10 MHz microconvex probe – measurements indicate a prostate length of 29.0 mm and width of 16.1 mm.

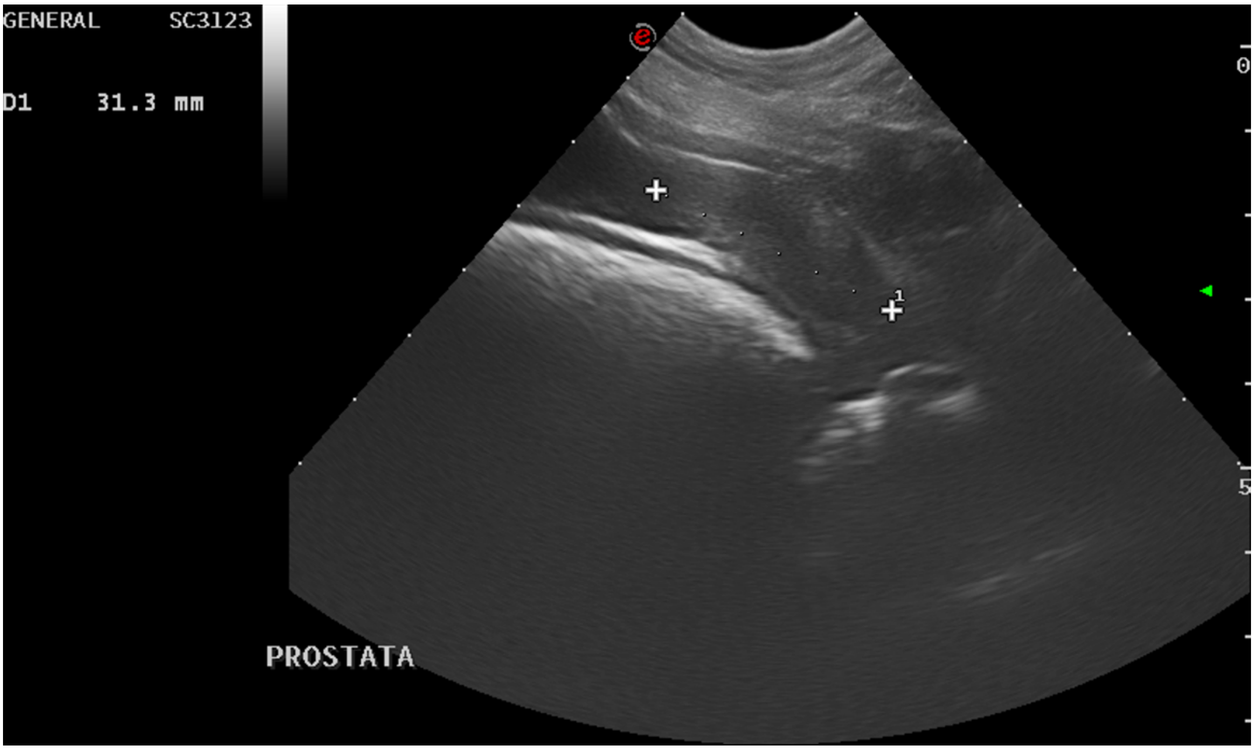

Figure 8: Longitudinal section of the prostate of animal 4, visualized using a 3-10 MHz microconvex probe – measurement indicates a prostate length of 31.3 mm.

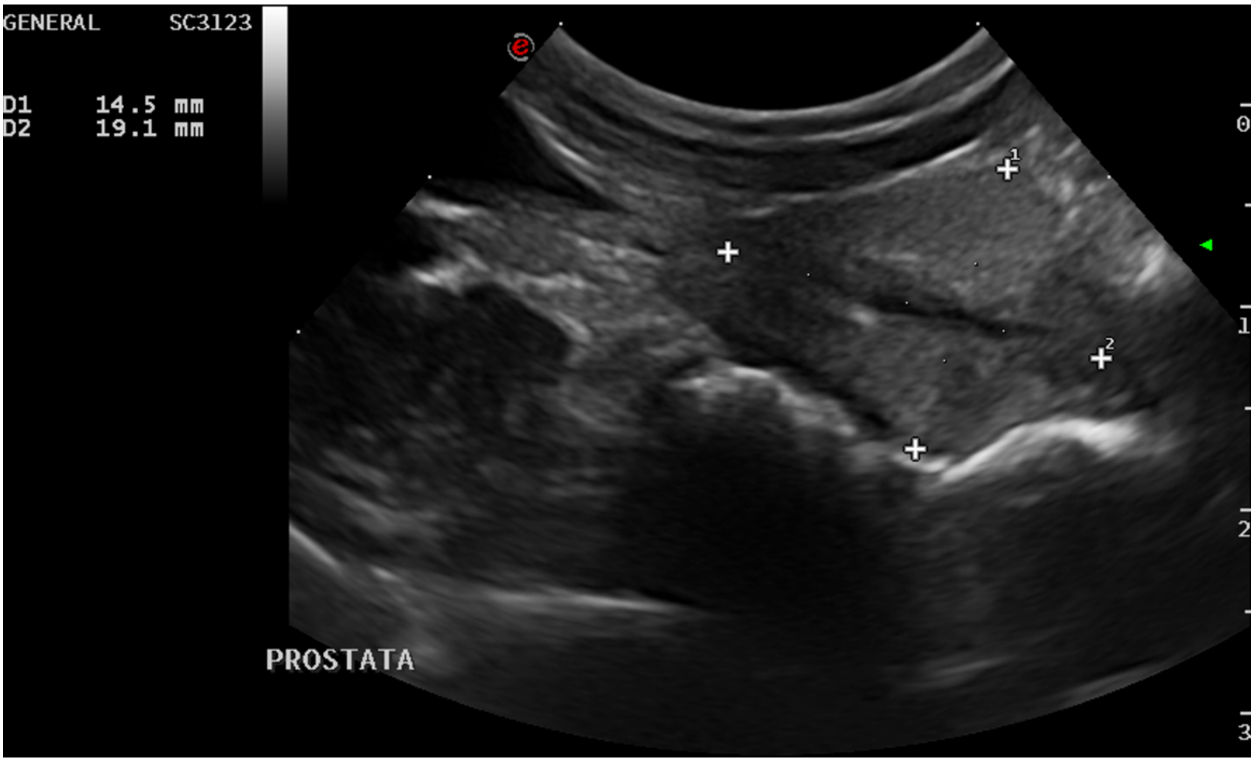

Figure 9: Longitudinal section of the prostate of animal 5, visualized using a 3-10 MHz microconvex probe – measurements indicate a prostate length of 19.1 mm and height of 14.5 mm.

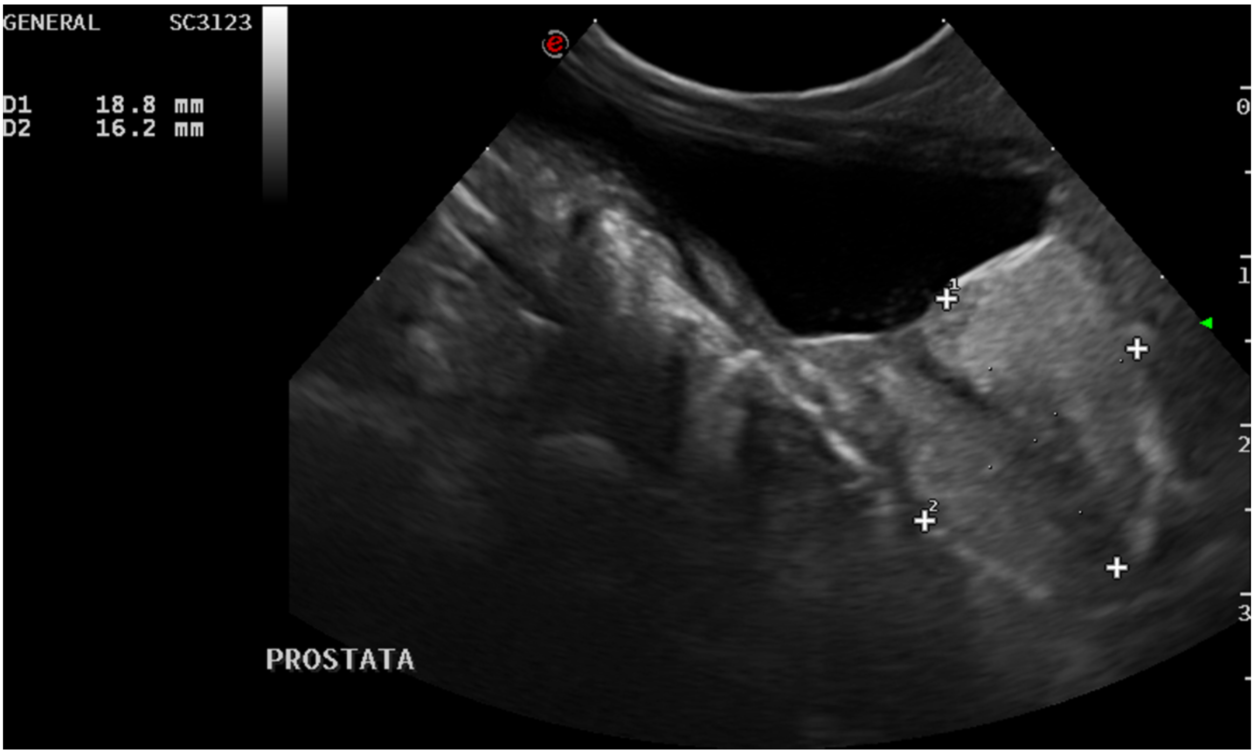

Figure 10: Longitudinal section of the prostate of animal 6, visualized using a 3-10 MHz microconvex probe – measurements indicate a prostate length of 18.8 mm and height of 16.2 mm.

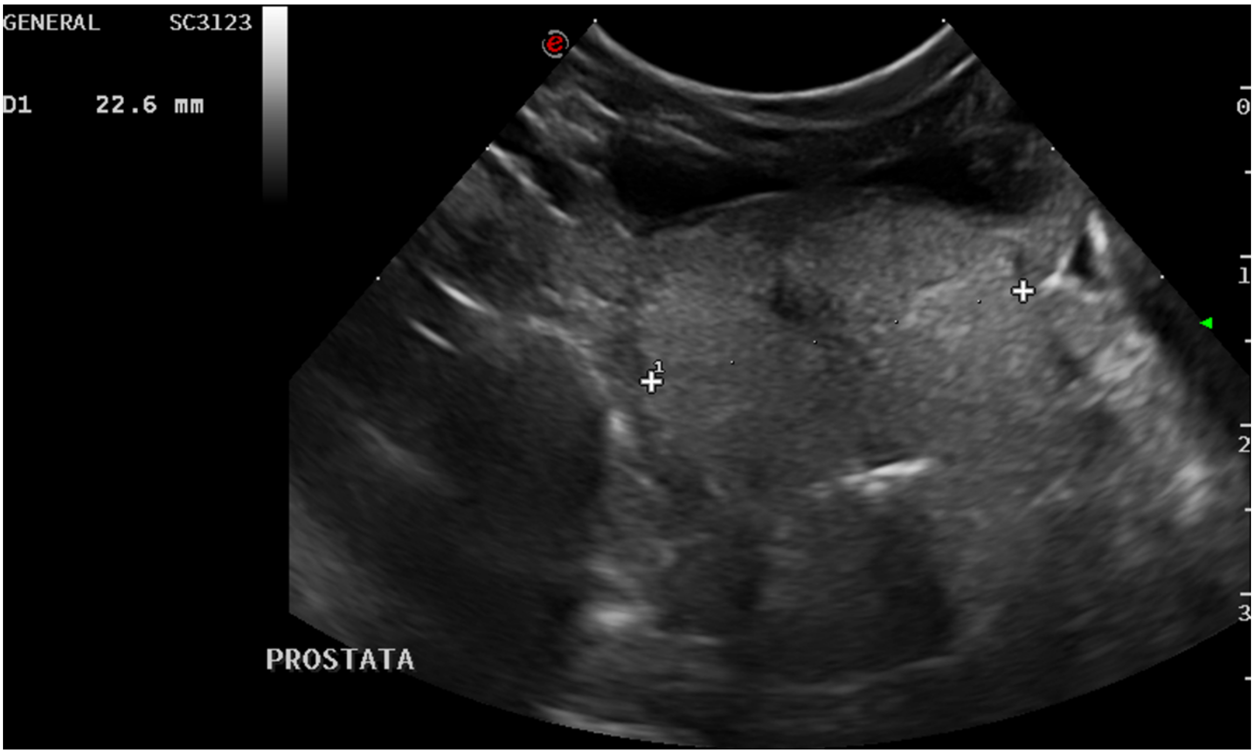

Figure 11: Transverse section of the prostate of animal 6, visualized using a 3-10 MHz microconvex probe – measurement indicates a prostate width of 22.6 mm.

Figure 12 shows the distribution of prostate measurements – namely length and height –, found in the sample. Measurements of a third prostate dimension, width, were also collected in some but not all of the animals. In this sample, we have an median prostate length of 27.5 mm, height of 21.1 mm and width of 25.4 mm.

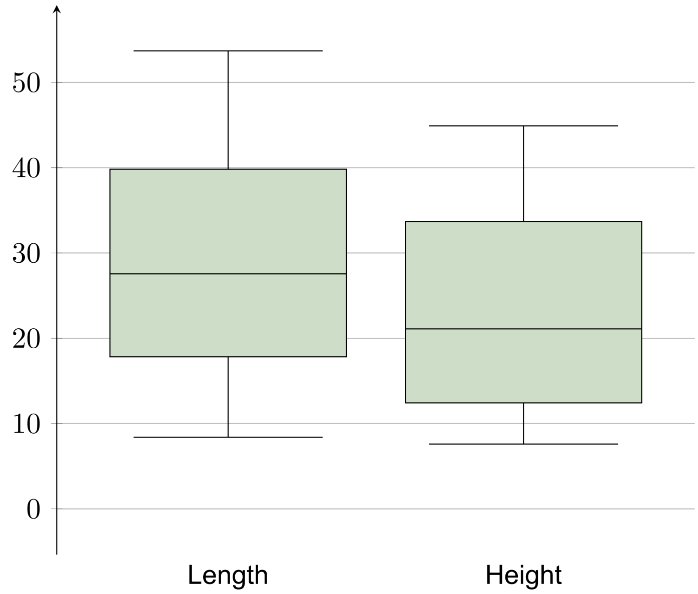

Figure 12: Distribution of Prostate Dimensions in Sample (mm).

Running dorsal to the bladder and toward the prostate, a small tubular structure must then be searched for, confirming that it merges with the prostate at the end of its path. This structure, as illustrated in Figure 13, will appear as a tube-like structure with a muscular wall and a small lumen. To distinguish it from adjacent arteries and confirm the visualization of the correct structure, colour Doppler imaging should be used, which should demonstrate the lack of flow.

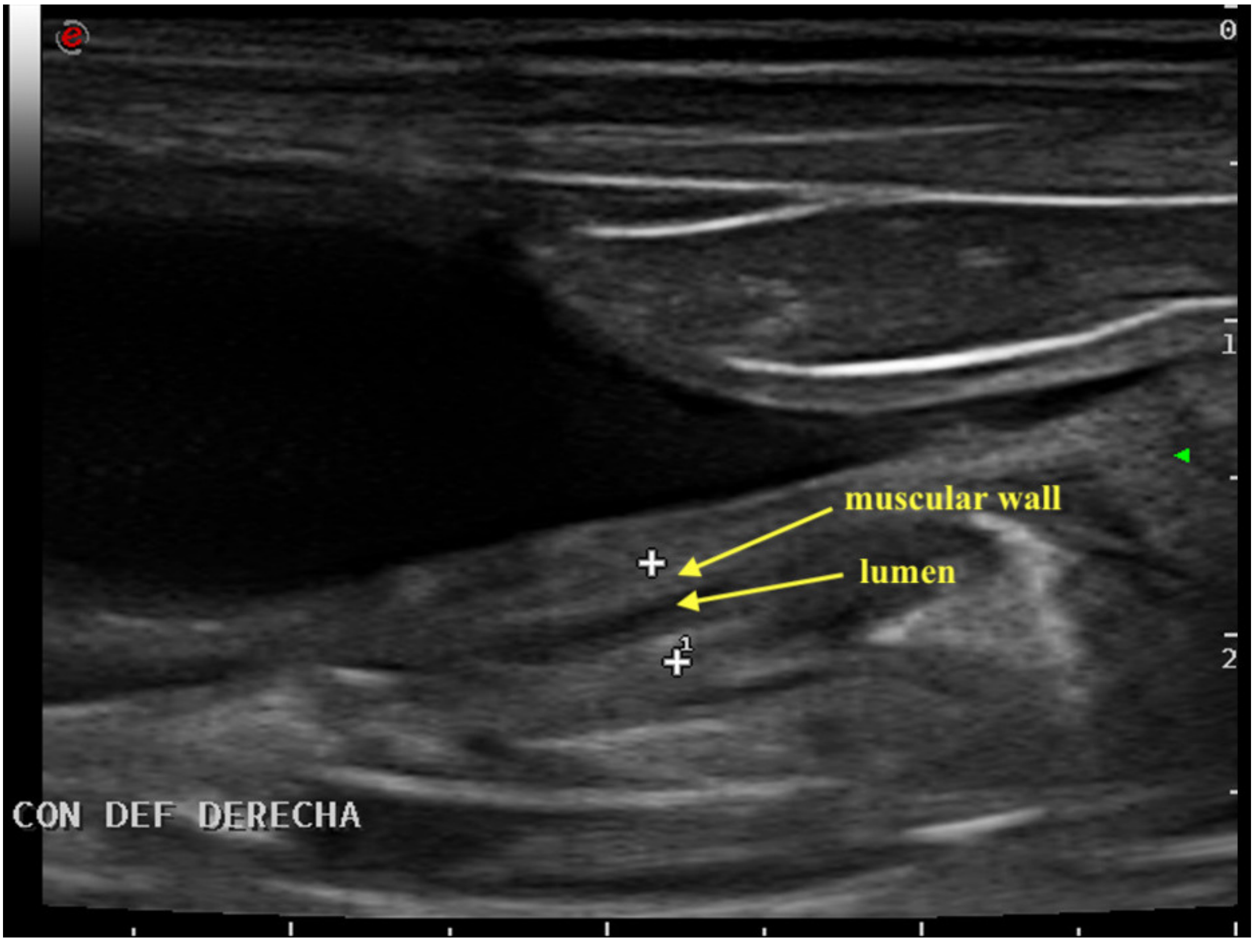

Figure 13: Deferent Duct of Animal 3, visualized using a 4-15 MHz linear probe – arrows identify the lumen and muscular wall of the duct.

We were able to observe the duct running along the dorsal surface of the bladder as shown in Figures 14 to 16).

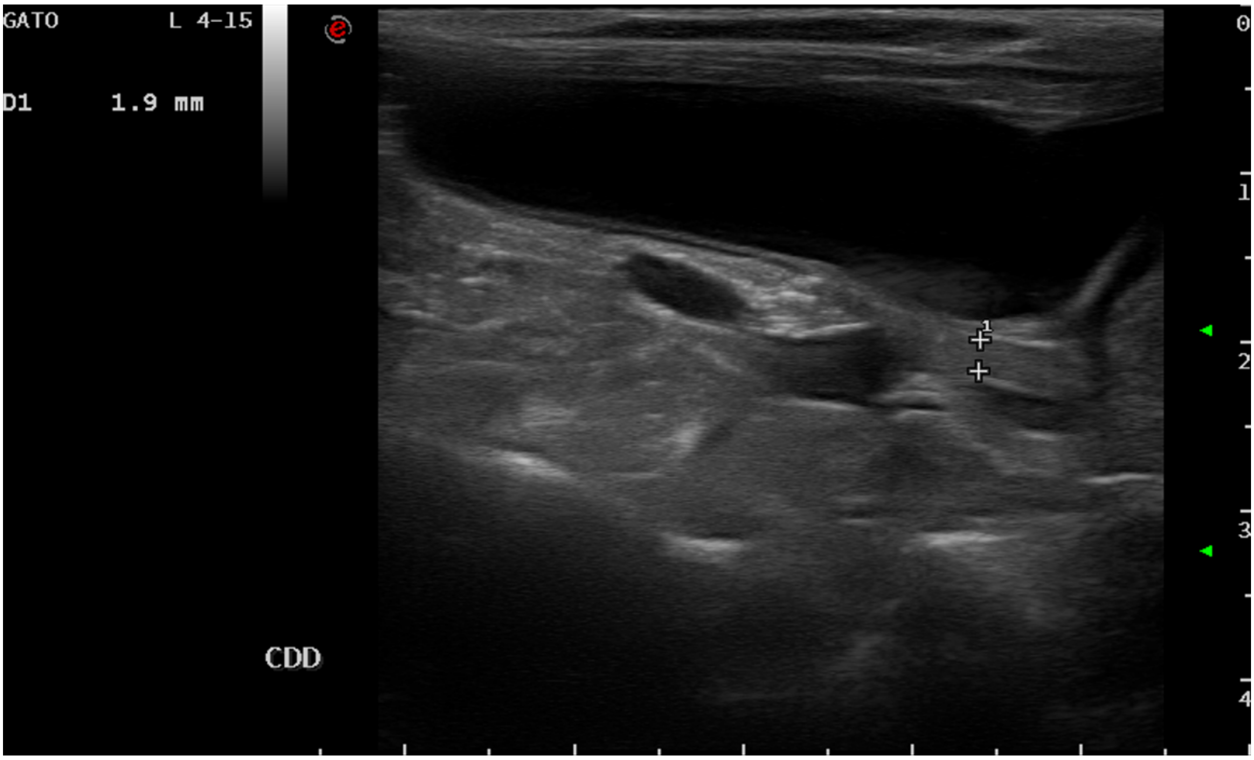

Figure 14: Right deferent duct of animal 6, visualized using a 4-15 MHz linear probe.

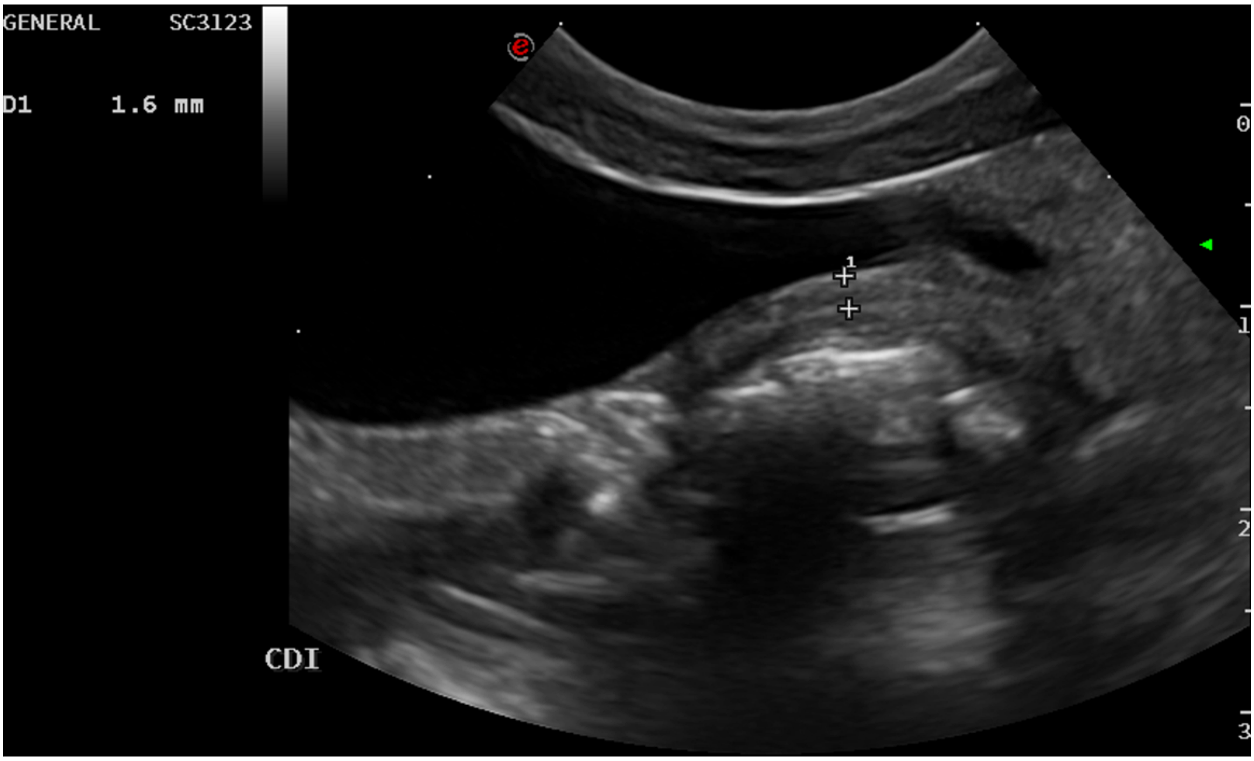

Figure 15: Left deferent duct of animal 5, visualized using a 3-10 MHz microconvex probe.

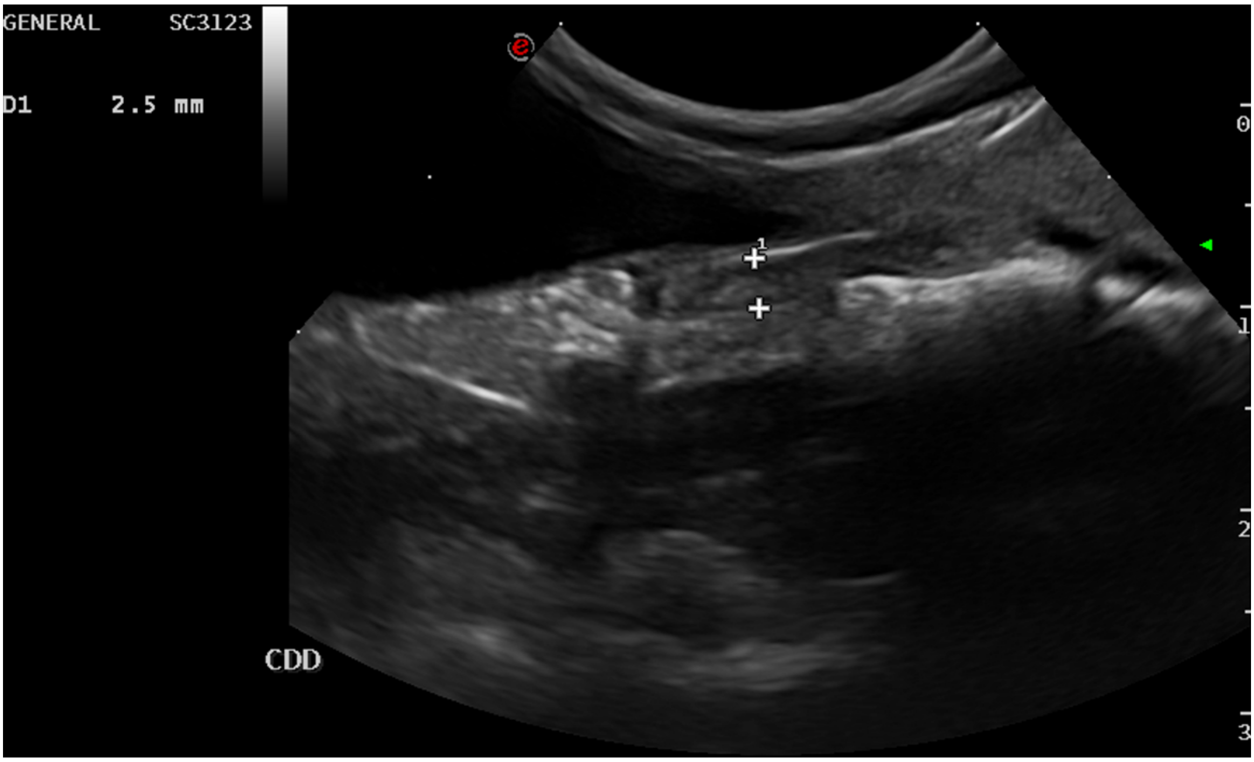

Figure 16: Deferent duct of animal 5, visualized using a 3-10 MHz microconvex probe.

The duct was seen following the bladder until it got close to the prostate (Figures 17 to 18).

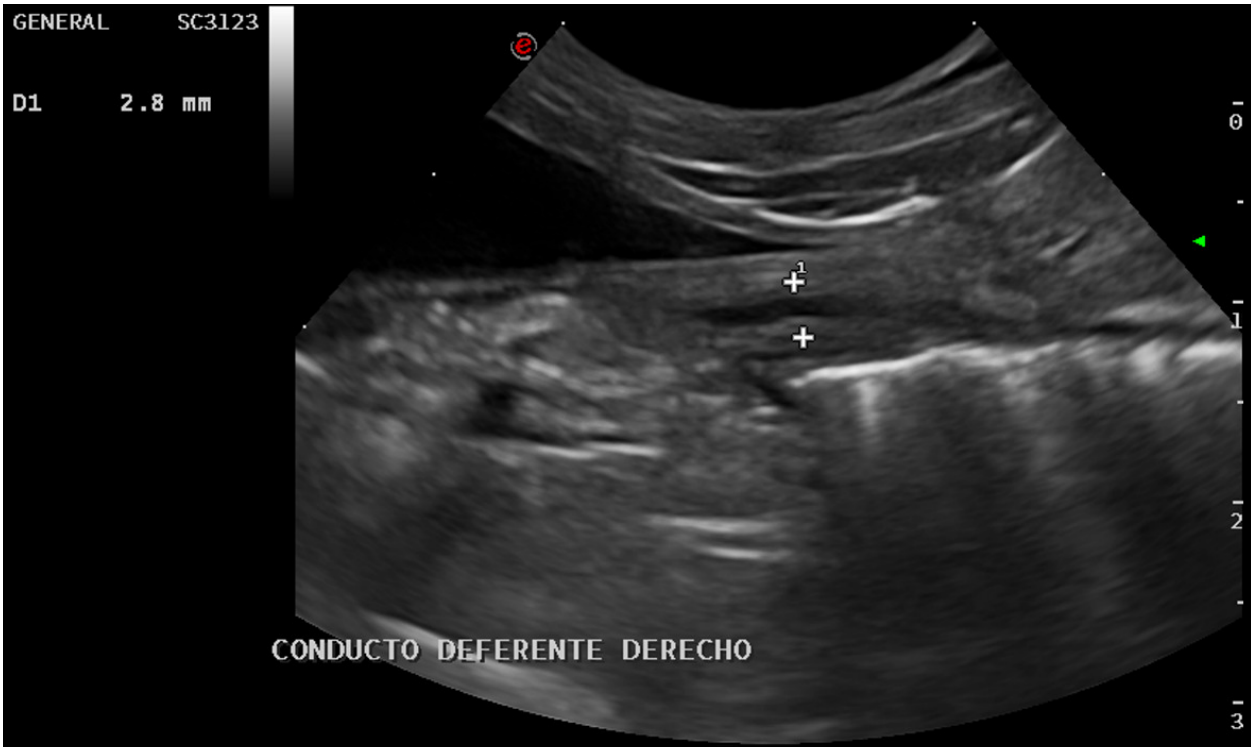

Figure 17: Right deferent duct of animal 3, visualized using a 3-10 MHz microconvex probe.

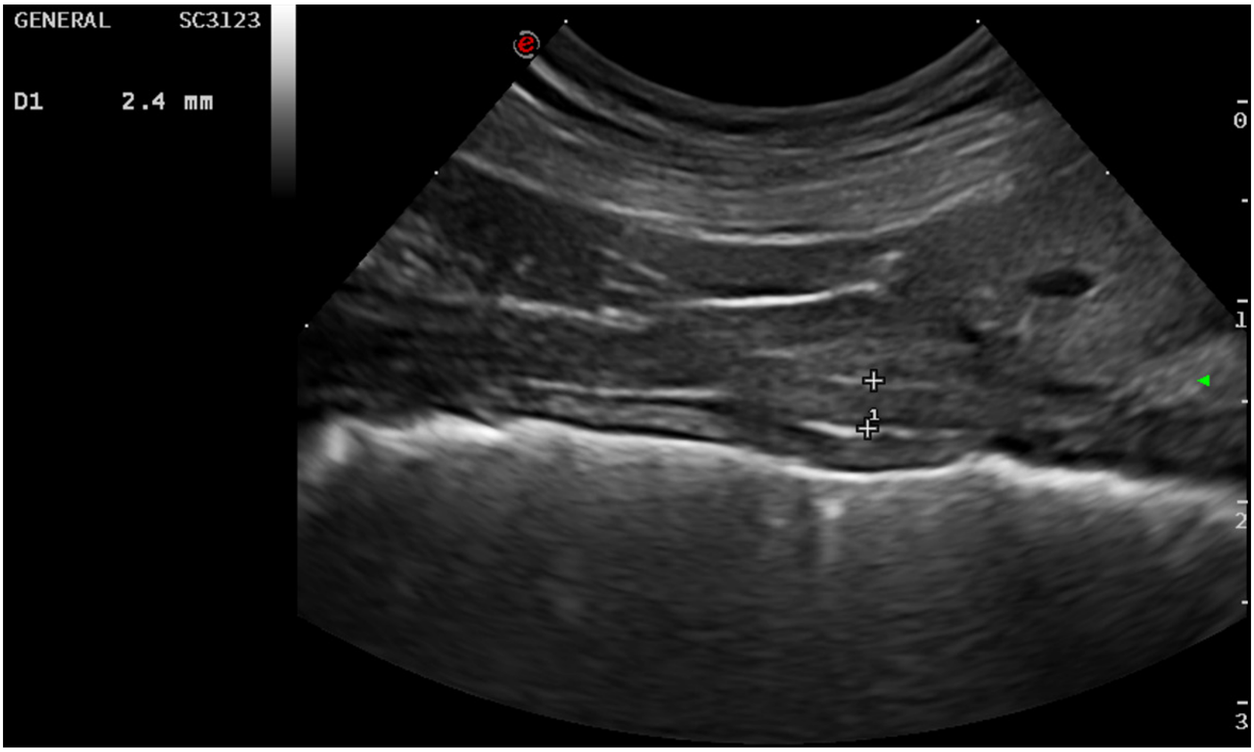

Figure 18: Deferent duct of animal 2, visualized using a 3-10 MHz microconvex probe.

We were also able to see it as it entered the prostate, such as in Figure 19.

Figure 19: Prostate and deferent duct of animal 3, visualized using a 4-15 MHz linear probe.

In some cases, the duct appeared to be distended, such as illustrated in Figure 20.

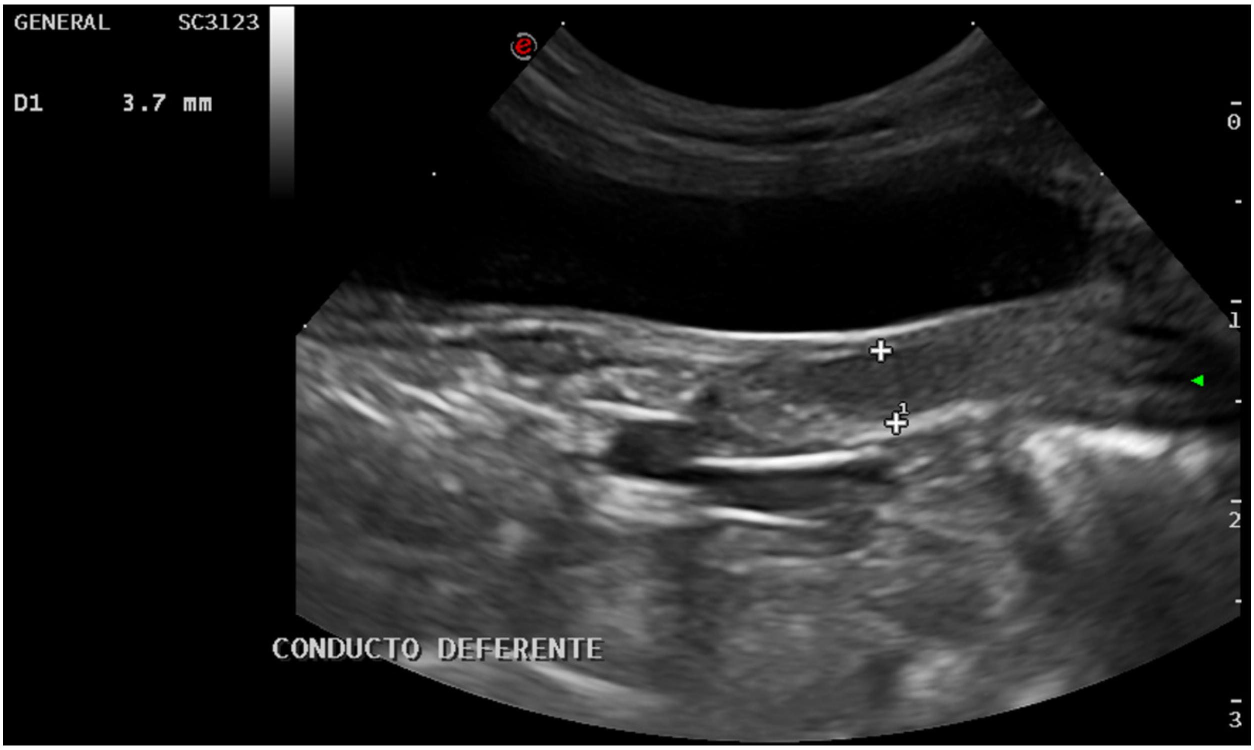

Figure 20: Deferent duct of animal 3, visualized using a 3-10 MHz microconvex probe.

In several animals, we were also able to see both the ducts on the same image – when a transverse section was possible –, as illustrated in Figures 21 to 23.

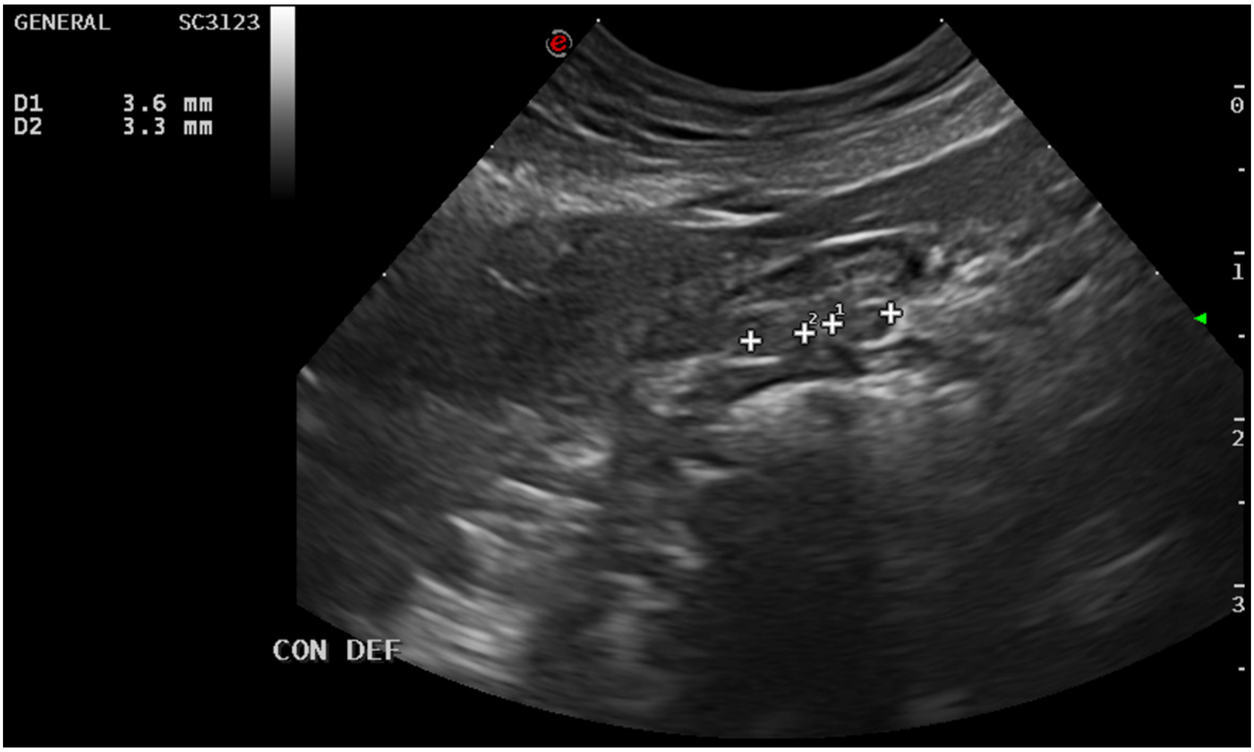

Figure 21: Deferent ducts of animal 2, visualized using a 3-10 MHz microconvex probe.

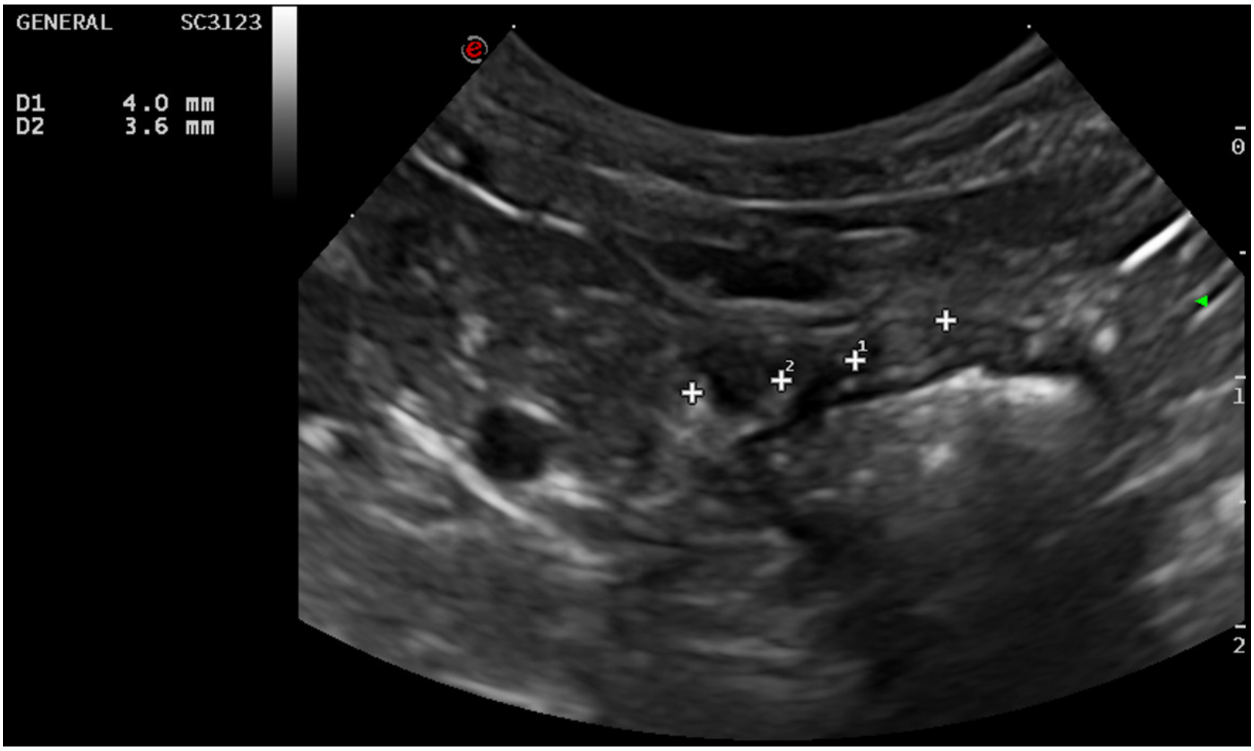

Figure 22: Deferent ducts of animal 3, visualized using a 3-10 MHz microconvex probe.

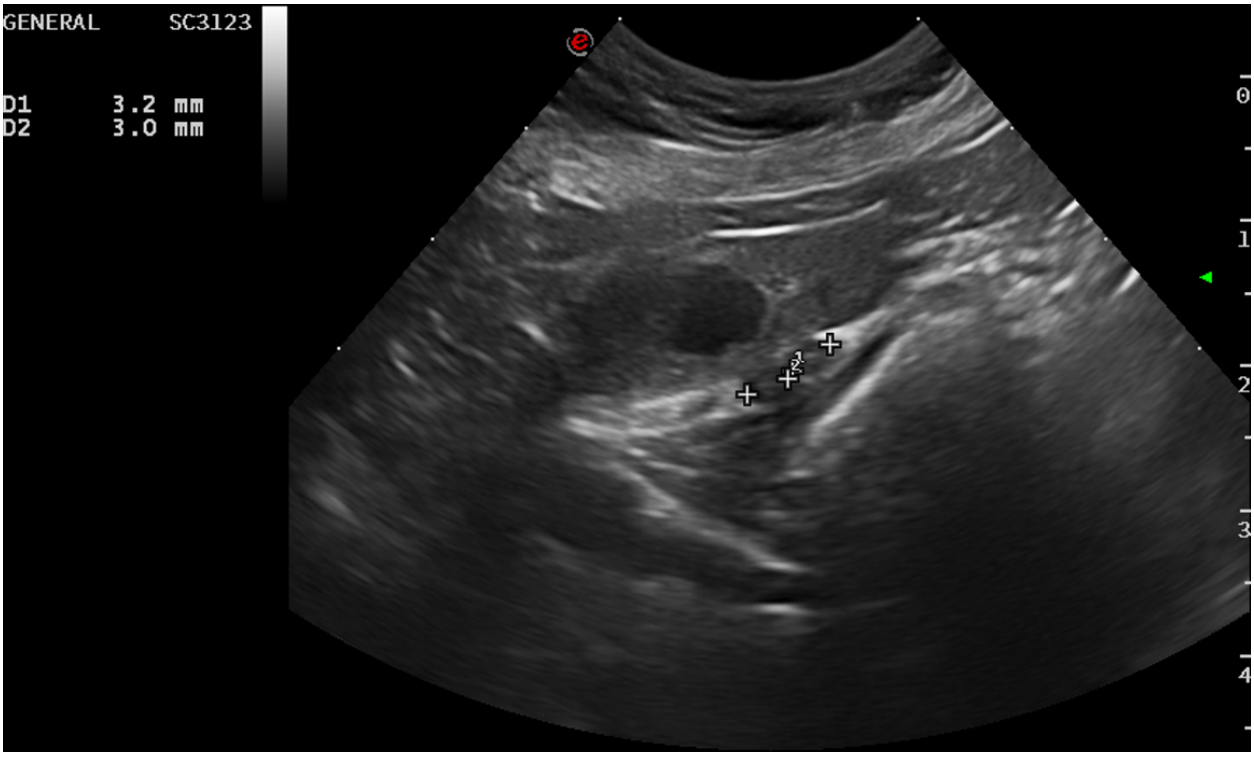

Figure 23: Deferent ducts of animal 4, visualized using a 3-10 MHz microconvex probe.

After verifying the viability of finding the deferent ducts, another goal of this study was to confirm which factors could predict the likelihood and ease of locating the ducts. For this purpose, we first theorized that prostate size could be related to duct size, given that the ducts were being searched for in their entrance to the prostate. As seen in Figures 24 to 25, there appears to be a positive association in our sample between both the length and height of the prostate and mean duct size, where larger prostates are associated with higher duct size.

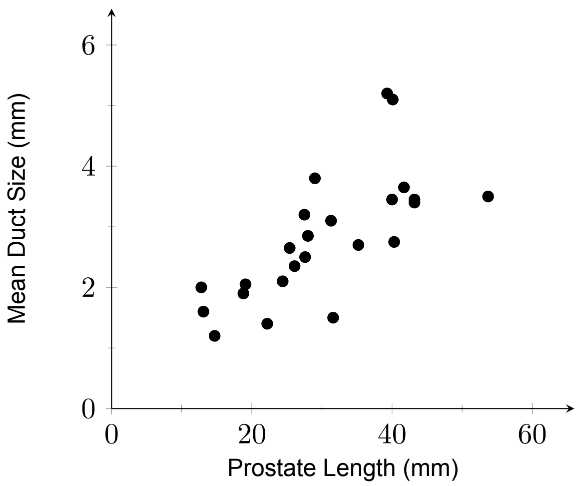

Figure 24: Relationship Between Prostate Length and Mean Duct Size.

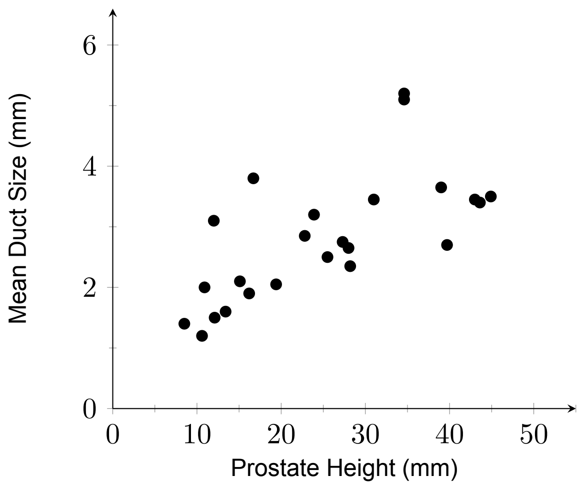

Figure 25: Relationship Between Prostate Height and Mean Duct Size.

A Spearman's test was run to assess these relationships with a sample size of 24 dogs. There was a strong positive correlation between prostate length and mean duct size, which was statistically significant, rs = .772, p < .001. Similarly, the correlation between prostate height and mean duct size was also strongly positive, rs = .712, p < .001.

We also hipothesized that larger animals would present a larger deferent duct. As weight is a measurement that directly relates to animal size, we proposed the theory that heavier animals would have larger and easier to find ducts. Furthermore, weight has been shown to be associated with prostate size (Atalan et al., 1999). To test this, we first compared weight to prostate size, and afterwards to mean duct size.

As seen in Figure 26, there does seem to be a positive association between weight and prostate size, as would be expected given the literature. For this comparison, a smaller number of animals was available, since weight was only collected for 21 dogs.

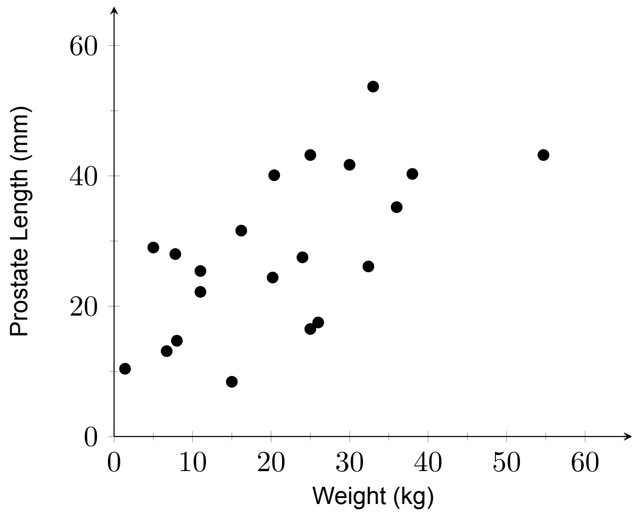

Figure 26: Relationship Between Weight and Prostate Length.

A Spearman's test was run to assess this association. There was a moderate positive correlation between weight and prostate length, which was statistically significant, rs = .626, p = .002.

In Figure 27 however, the association seems less clear, although a tendency for a positive association can be perceived.

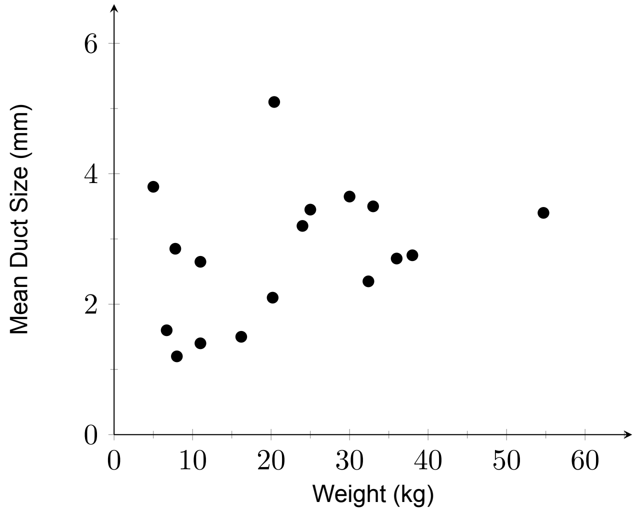

Figure 27: Relationship Between Weight and Mean Duct Size.

With only 17 animals with both weight data and observed ducts, a Spearman's test was run to assess this association. It found this association to not be statistically significant, rs = .293, p = .254.

Lastly, since there is a size variation with age in several organs, namely the prostate (Atalan et al., 1999), we wanted to verify if this variation influenced the duct as well. For this we again compared the age of the animals with both the prostate size and the mean duct size.

In this case, as represented in Figure 28, the association between age and prostate size does not seem to be present in our sample.

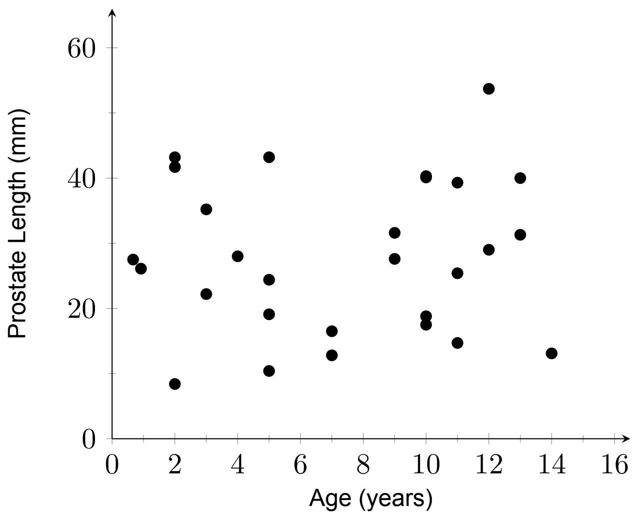

Figure 28: Relationship Between Age and Prostate Length.

As expected, a Spearman's test, with n = 28, indicated no statistical significance in this association, rs = .056, p = .778.

As anticipated given the lack of association between age and prostate size, there also does not appear to be an association between age and mean duct size in this sample, as shown in Figure 29.

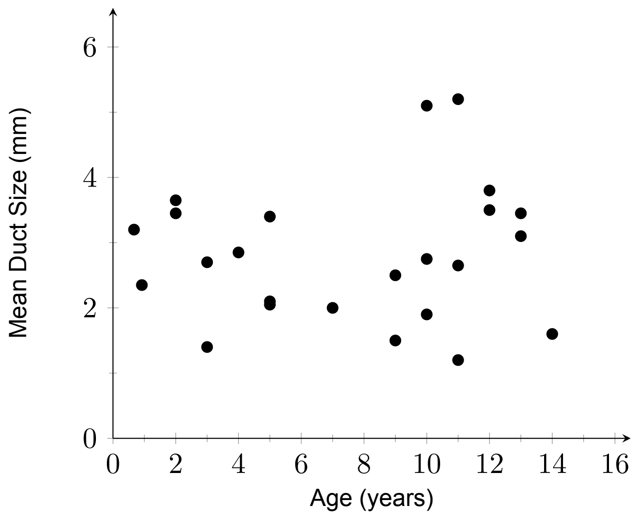

Figure 29: Relationship Between Age and Mean Duct Size.

This is confirmed by the Spearman's test results, with n = 24, which evidence no statistical significance in this association, rs = .037, p = .863.

5 Discussion

The main purpose of this project was to evaluate whether or not the deferent duct is a structure that can be routinely observed using ultrasound – considering that the veterinary literature only references it as uncommonly found and difficult to visualise unless altered (Davidson and Baker, 2009).

The sample used, although small, had the breed distribution and clinical indication for the exams we would expect. The hospital protocol includes routine ultrasounds for animals with neurological complaints, and so we see these as most frequent, followed by gastrointestinal complaints.

Of the 28 animals examined, at least one of the ducts was found in 24 of them. This accounts for 86% of all observed animals. On the 4 animals where no duct was found, the veterinarians reported small, difficult to visualize prostates, and in one case a pelvic prostate, making it challenging to search for the ducts. The prostate sizes of these animals are well below sample average – 13.2 mm average length and 12.75 mm average height, compared to 27.5 mm and 21.1 mm. It is also worth noting that all of these exams were performed by the residents. The experience of the operator, we believe, is a determining factor in the likelihood of locating this structure, since it is a small structure that can easily be missed if not properly searched for.

The mean duct size distribution found in our sample appears to be consistent with the reports in the literature (Evans and de Lahunta, 2012), having a mean of 2.8 mm.

These findings suggest that, contrary to what is reported in the literature, the deferent duct is a structure that can commonly be detected and observed in its abdominal section in routine abdominal ultrasounds.

To evaluate whether certain parameters interfered with the likelihood of finding the ducts, the data collected on age, weight, and prostate dimensions was compared to duct size. We theorize that larger ducts will be more easily seen and therefore more likely to be found. For this reason the mean duct size value was used in these analyses.

When we analysed the possible association between prostate size and duct size, we found a positive correlation between these two parameters. As expected, since the deferent duct was searched for in its entrance to the prostate, duct size appears to be proportional to prostate size in our sample. With this, we can say that animals with larger prostates also have larger deferent ducts.

Aside from prostate size, we also theorized that age and weight of the dog might influence the deferent ducts, as these parameters have been shown to correlate to prostate size (Atalan et al., 1999). A correlation between one or both of these factors would give operators a way of estimating the likelihood of being able to analyse this structure before starting the exam. In this sample however, only a positive correlation was found between weight and prostate size, with this correlation not extending to the association between weight and mean duct size. Similarly, no association was seen between age and prostate or mean duct size. We conjecture that this discrepancy might be explained by the size of the sample, and that a larger sample might give us a significant correlation with one or both of these parameters.

We were also interested in assessing whether an association between the breed of the animal and duct size was evident. However, this was not analysed due to the small number of dogs per breed observed. A larger sample could overcome this obstacle and give us more information on the visualization of the ducts in different breeds of dogs. We also had interest in analysing if the neutering status of the animal would have any relation to duct size – since it will likely affect prostate size –, but again sample size did not permit this analysis.

Finally, another potential point of interest is to determine the viability of observing the deferent ducts in their scrotal segment. Unfortunately, this was beyond the scope of the present work – although an image of the epidydimis was observed in one animal, shown in Figure 30 –, but further research in this area could determine if, similarly to exams performed in men, the deferent duct could be seen by ultrasound exam of the scrotum. This would allow a visualization of a longer portion of the structure, increasing the chance of finding any potential anomaly.

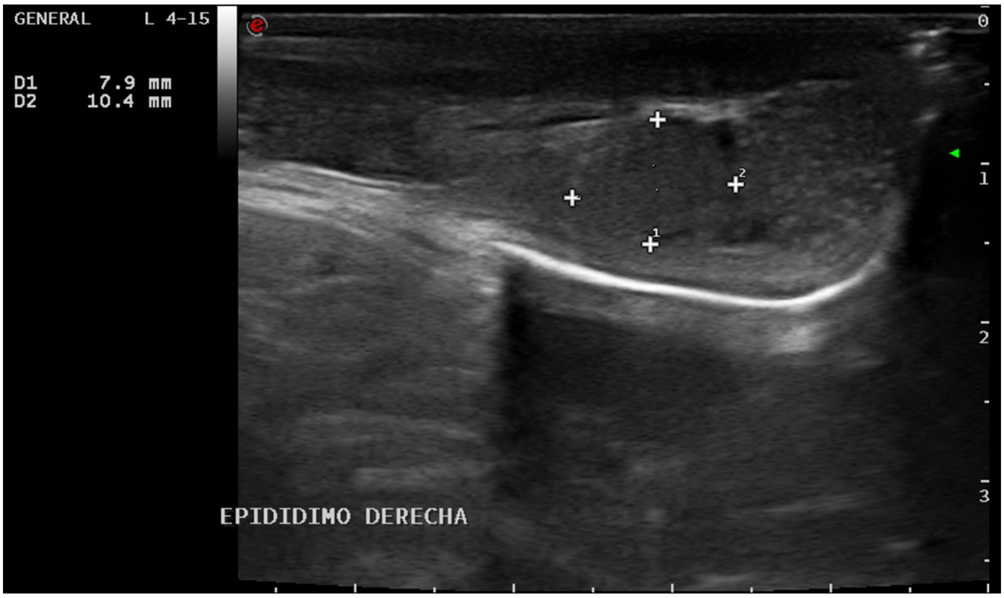

Figure 30: Epidydimis of animal 3, visualized using a 4-15 MHz linear probe.

Although the deferent duct is a structure uncommonly evaluated in veterinary medicine, the idea that its evaluation is not attainable in a majority of dogs appears not to be well grounded. In a reproductive ultrasound evaluation of a male dog performed by an experienced operator, the visualization of the deferent ducts should be considered, as it is a structure that can be observed in most animals and that can have reproductive repercussions if altered.

6 Conclusion

This work was developed to challenge the accepted notion that the observation of deferent ducts via ultrasound is both difficult and rarely possible. As demonstrated, the deferent ducts were visualized in 86% of all animals in our sample. The ones where the visualization was not possible, had very small, sometimes pelvic prostates.

We found that dogs with larger prostates had higher mean duct sizes. The relation between mean duct size and weight or age was not relevant in this sample, however a larger cohort would be required to evaluate this association. A larger cohort would also be able to tell us whether breed or neutering status has an influence in the observation or size of the deferent ducts.

Further work should explore if the visualization of the ducts could be obtained in more sections of its path, such as in the scrotal segment. This might provide us with a larger chance of finding this structure, as well as any pathological presentation associated with it.

It is our opinion that, in a reproductive ultrasound of the male dog, the routine observation of the deferent duct by an experienced operator may be an interesting addition to the exam, since it could reveal problems not seen in other structures.

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