Questionnaire study investigating congenital portosystemic shunts in Deerhounds

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Abstract

A retrospective study to determine the prevalence of congenital portosystemic shunts (cPSS) in Deerhounds, focussing on the UK and the USA.
Worldwide, the prevalence of shunts was found to be 0.8% while the prevalence in the UK and the USA was found to be 1.1% and 0.4% respectively.
71% of breeders worldwide were found to test routinely for cPSS in their puppies while the proportion in the UK and the USA was 96% and 48% respectively.
In conclusion the prevalence of cPSS in Deerhounds found in this study is higher than has been found for mixed-breed dogs, both in the UK and the USA. This suggests a genetic component of the disease in Deerhounds. The lower prevalence of cPSS in the USA could be due to a number of reasons including a lower proportion of breeders testing for shunts. It would be advisable for all breeders to routinely test their puppies for cPSS before sale and to avoid breeding from affected animals.

Introduction

A portosystemic shunt is an abnormal vascular connection which diverts blood from the portal vasculature to the systemic circulation, bypassing the liver. This can be a congenital abnormality, a congenital portosystemic shunt (cPSS), or shunts can be acquired. Acquired shunts are associated with severe chronic hepatic disease such as cirrhosis and there are often multiple, small shunts present. This study is focussing on cPSS in Deerhound puppies.

CPSS shunts can be intra- or extra-hepatic. Extra-hepatic shunts, which connect the portal vein (or one of its contributors) to the caudal vena cava or azygous vein, are usually seen in small dogs such as Yorkshire Terriers. Large breeds, such as Deerhounds, more commonly get intra-hepatic shunts which pass through the liver, but bypass the hepatic circulation. Left-sided intra-hepatic shunts are believed to arise from a persistent fetal ductus venosus (*Berent and Weisse 2010*). In the fetus, this vessel allows oxygenated blood from the placenta to pass from the umbilical vein, directly into the caudal vena cava. The vessel bypasses the liver and contributes to the preferential shunting of oxygenated blood to the fetal brain by the specialised fetal circulation. Blood flow through the mother's liver means that fetal liver function is not required. The vessel usually closes soon after birth however in some animals it remains open creating a shunt. Intra-hepatic shunts may also be right-sided or central. These are thought to have a different embryological origin to a left-sided shunt (*Watson and Bunch 2009*).

Portosystemic shunts can have severe clinical effects. In normal dogs, blood from the gastrointestinal tract passes through the liver where microorganisms, toxins and other substances are removed or neutralised, preventing them reaching the brain and other parts of the body. The presence of a shunt means that these harmful substances are circulated systemically leading to clinical signs, particularly neurological signs due to effects on the brain. In addition, puppies often have stunted growth although this is not always the case. Other clinical signs can include polyuria/polydipsia, apparent blindness, diarrhoea and vomiting. Some animals appear normal and are diagnosed later in life, for example when they have a prolonged recovery time from anaesthesia.

The cause of cPSS is not known. It is likely to be multifactorial, influenced by environmental (including *in utero*) and genetic factors. A genetic influence can be suspected when the prevalence of cPSS is higher in a defined group compared to the general population. The prevalence of congenital portosystemic shunts is higher in pure-breed dogs, particularly in certain breeds, compared to mixed-breed dogs *(Tobias and Rohrbach 2003).*cPSS are considered hereditary certain breeds such as Yorkshire Terriers which have been found to be 35.9 times more likely to get a cPSS than all other breeds combined (*Tobias 2003*). This was studied in the United States (USA) through pedigree analysis and a breeding trial. cPSS are also considered hereditary in Irish Wolfhounds, discussed further below. A higher rate of portosystemic shunts is seen in some other breeds such as Maltese and Australian Cattle Dogs (*Tisdall et al 1994*) therefore it is likely that there is a genetic component in these breeds as well.

Certain genes have been shown to be associated with cPSS in mice (*van Steenbeek et al 2012*), supporting the theory of a genetic influence. It is possible that these genes play a role in canine cPSS although further work is required to investigate this.

Assessing the genetic contribution to the development of CPSS is important for the understanding of the disease. If genetic factors are involved then selective breeding can be used in an attempt to reduce the prevalence of CPSS within.

The Inherited Diseases In Dogs database (http://idid.vet.cam.ac.uk/detail.php?record=1210) describes Scottish Deerhounds as having an increased risk of portosystemic shunts, based on a pedigree analysis. However the reference for this has not been found. A retrospective study *(Tobias and Rohrbach 2003)* of 2400 dogs with cPSS over a 22 year period found that Scottish Deerhounds were one of the 15 breeds with the greatest proportion of diagnoses of cPSS. However, the risk of cPSS in Scottish Deerhounds was not significantly higher than the reference population. Further studies into Deerhounds were recommended since the sample size of Deerhounds in this study was too small to be able to detect a significant

finding as the confidence interval was large. There is also some anecdotal evidence of a high prevalence of shunts in Deerhounds*(https://sdcahealth.wordpress.com/2014/01/03/liver-shunts/).*

Studies on Irish Wolfhounds have suggested that cPSS have a hereditary component (*Meyer et al 1995, Ubbink et al 1998*) and that Irish Wolfhounds are overrepresented in cPSS populations (*Hunt 2004, Tobias and Rohrback 2003*). Irish Wolfhounds are closely related to Deerhounds, the modern Irish Wolfhound was rescued from extinction by the use of Deerhounds in the breed in the 19th century. There is some evidence that Deerhounds get a similar type of shunt (left-sided intrahepatic shunt) to Irish Wolfhounds (White and Burton et al 1998) however this study had a very small sample size. Breed has been shown to have some affect on shunt anatomy (*Hunt 2004*) however other work has found the presence of left and right intrahepatic shunts in Irish Wolfhounds suggesting that the position of the shunt is not linked to breed (*van Steenbeek et al 2012*).

cPSS in can be routinely tested for in puppies using the bile acid stimulation test (BAST), ammonia tolerance tests or ultrasound. Currently there is no data on the proportion of breeders that routinely test for cPSS. Testing for cPSS in Deerhounds is recommended by The Deerhound Club in the UK and the Scottish Deerhound Club of America (*http://www.deerhound.co.uk/Health%20Matters/PSS.htm, https://sdcahealth.wordpress.com/category/recommended-health-tests/*). There is also an ongoing prospective study in the UK looking at post-prandial bile acids which has been advertised via the Deerhound Club since 2012 (*Bryn Tennant, personal communication*).

Method

A retrospective, questionnaire-based approach was used. The questionnaire aimed to find out the prevalence of portosystemic shunts in Deerhounds puppies and to gather more information about testing for shunts (The questionnaire can be seen in Appendix 1).

The questionnaire was based on a previous unpublished questionnaire to Irish Wolfhound Breeders designed by Dr Penny Watson. It passed through ethical review at the Department of Veterinary Medicine, the University of Cambridge, before distribution. The study was conducted with the support and assistance of the breed Health Co-ordinators in the UK and USA.

Questionnaires were sent to members of the Deerhound Club in the UK by post and the study was advertised via the breed society website. Breeders were given the option to return the questionnaire by post or to fill in an online version. The questionnaire could be completed anonymously and was designed such that one questionnaire would be filled in for each breeding bitch owned at that time.

The online version of the questionnaire was also distributed via the Scottish Deerhound Club of America enabling breeders in the USA and other countries to complete it.

Results

Overall, usable responses were provided from 112 bitches. The number of bitches per country were: USA 49, UK 53, The Netherlands 4, Australia 3, Canada 1, Italy 1 and New Zealand 1. All responses are included in the 'Worldwide (WW)' results. There were 23 unusable responses.

Overall, 56 breeders took part. Each anonymous questionnaire was counted as a new breeder since it impossible to say if one owner filled out more than one questionnaire. Therefore the number of breeders may be a slight overestimate.

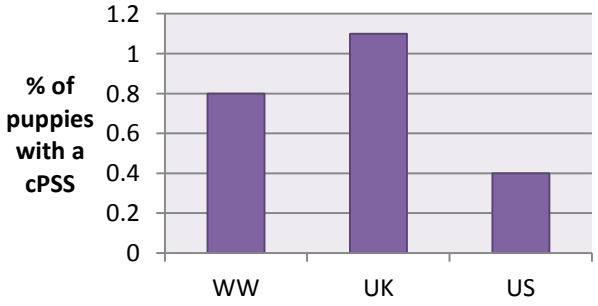
Prevalence of cPSS

The proportion of puppies with cPSS worldwide, in the UK and in the USA can be seen in Tables 1 and 2.
The mean average of the other litters worldwide (7.4) was used for litters where information on litter size was incomplete (Table 1). These results were used in Figure 1. Analysis of the results discounting the incomplete responses is also shown (Table 3).

Shunts were reported in 6 puppies in the UK, 2 puppies in the USA and 1 puppy in The Netherlands. All the shunt puppies were from different litters, no litter was reported to have had more than one puppy with a confirmed cPSS. Worldwide, the percentage of puppies with shunts was 0.8% (Table 1). The percentage of puppies with reported cPSS is higher in the UK than the USA (1.1% and 0.4% respectively, Table 1, Fig 1).

Worldwide, 8% of bitches and 6% of litters had puppies with cPSS. The UK had a higher percentage of bitches and litters with cPSS (11% and 8% respectively) compared to the US (4% and 3% respectively).

Figure 1: Percentage of puppies with cPSS



Testing for CPSS

Analysis found that that 71% of breeders worldwide routinely test for cPSS in their litters (See Table 4, Fig 2).

85% of these breeders test between the ages of 8-12 weeks. The youngest age of testing reported was at 4 weeks with ultrasound in the UK.

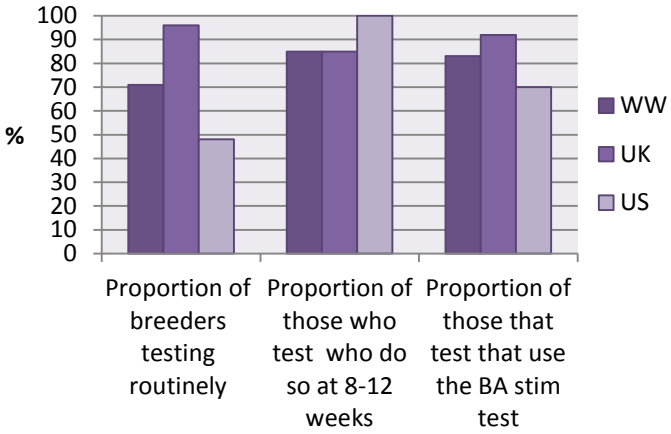
40% of those that routinely test their puppies use the bile acid stimulation test (BAST). Responses that were ambiguous (e.g. 'bile acids', 'starve, blood test, feed & more blood' or 'morning vet test before any food') were not included in this percentage although it is likely that these

are referring to the BAST. These responses were included in the 'Likely to be bile acid stim' column which found that 83% of breeders are likely to be using the BAST. This value is use in Figure 2.

Some other methods of testing were reported. Two breeders from The Netherlands use a blood test for ammonia levels at 8 or nine weeks. Three breeders from the USA do 'blood and urine tests' and 10 -12 weeks (may include BAST). One breeder in the UK reported routine use of ultrasound scanning for detection of cPSS at four weeks.

A higher percentage of breeders routinely test for cPSS in the UK compared to the USA (96% and 48% respectively).

Figure 2: Routine Testing for cPSS

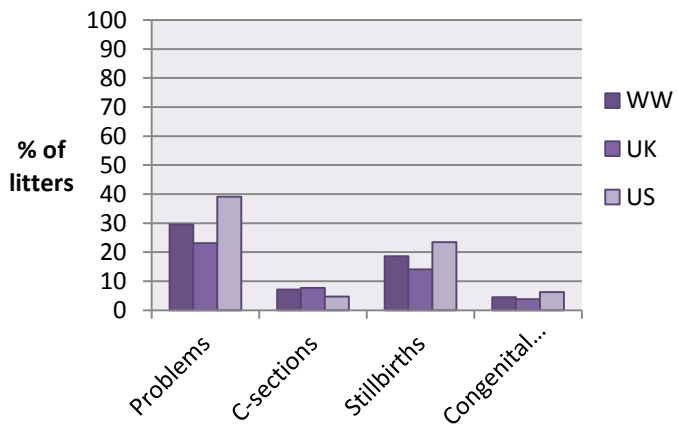


Problems with litters

Worldwide, 29% of litters were reported to have had 'problems' either during pregnancy, parturition or in the neonatal period (Table 5 and Fig 3). 7% of litters required a caesarean section (C-section), 19% had one or more stillborn puppies, 4% had congenital abnormalities (including cPSS) and 6% had neonatal deaths.

The USA had a higher proportion of litters with reported problems than the UK (39% and 23% respectively). A higher proportion of litters in the USA had stillbirths compared to the UK (23% and 14% respectively) and the USA also had a slightly higher proportion of congenital abnormalities and neonatal deaths. A larger percentage of litters in the UK were reported to have been delivered by c-sections (9% compared to 6% in the USA). Statistical tests have not been applied to these results to ascertain their significance.

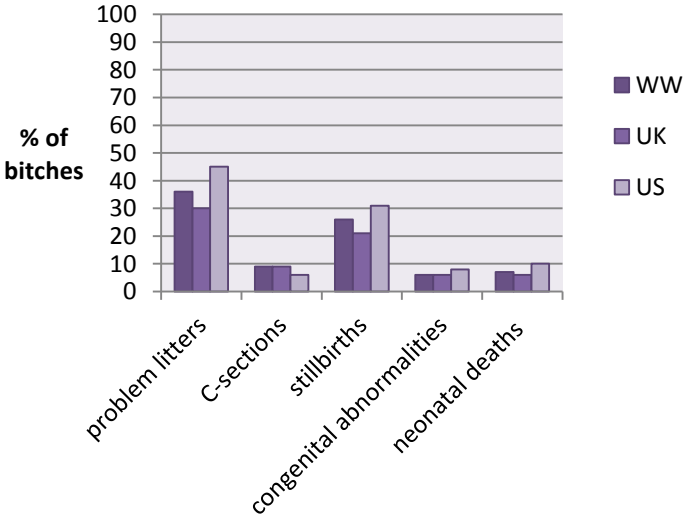
Figure 3: Litters with reported problems



Worldwide, 36% of bitches were reported to have had problems with one or more of their litters (Table 6 and Fig 4). 9% of bitches have had at least one c-section, 26% have had stillborn puppies, 6% have had puppies with congenital abnormalities and 7% have had a litter with neonatal deaths.

The USA had a higher percentage of bitches who have had 'problems' during gestation, parturition or post-natally compared to the UK (45% and 30% respectively). A higher proportion of bitches in the USA had stillborn puppies in at least one litter (31% compared to 21% in the UK) and the USA also had a higher proportion of bitches who have had litters with congenital abnormalities and neonatal deaths. A larger percentage of bitches in the UK were reported to have had c-sections (9% compared to 6% in the USA).

Figure 4: Bitches with reported probelms



Reported cPSS in related dogs

Worldwide, 6% of bitches were reported to have relatives with cPSS (Table 7). The USA had a higher percentage of bitches which had relatives with cPSS (10% compared to 4% in the UK). Only one sire (from the USA) was reported to have sired other puppies with cPSS.

Average litter size

The average litter size was calculated (Table 8). There was no obvious difference between the litter sizes of the first, second and third litters or between the litters in the UK and the USA (no statistical tests performed).

Number of litters

67% of bitches worldwide had 1 litter (Table 9). 28% had 2 litters, 5% had 3 litters and 1% had 4 litters. In the USA, a higher proportion of bitches had had only 1 litter compared to the UK (73% and 60% respectively) (no statistical tests performed).

Table 1: Proportion of puppies with cPSS (using average litter size where data was incomplete)

Country	Breeders	Bitches	Number of litters	Total number of puppies	Number of puppies with shunts	Percentage of shunts
All results (worldwide)	56	112	156	1149	9	0.8
UK	27	53	78	550	6	1.1
USA	21	49	64	483	2	0.4

Table 2: Proportion of bitches and proportion of litters with confirmed cPSS puppies

Country	Bitches with confirmed cPSS puppies	Litters with confirmed cPSS puppies
All results (worldwide)	8%	6%
UK	11%	8%
USA	4%	3%

Table 3: Proportion of cPSS (discounting responses with incomplete data)

Country	Number of breeders	Number of bitches	Number of litters	Total number of puppies	Number of puppies with shunts	Percentage of shunts
All results (worldwide)	38	86	115	846	9	1.1
UK	14	32	43	306	6	2.0
USA	17	45	59	446	2	0.4

Table 4: Testing for cPSS

Country	Breeders who routinely test	Testing between 8-12 weeks	Method of testing	
			Bile acid stim test	Likely to be bile acid stim test
All results (worldwide)	40 (71%)	34/40 (85%)	16/40(40%)	33/40(83%)
UK	26 (96%)	22/26 (85%)	10/26 (38%)	24/26 (92%)
USA	10 (48%)	10/10 (100%)	6/10 (60%)	7/10 (70%)

Table 5: Problems reported in litters

Number of litters reported with… / Country	problems	C-sections	stillbirths	congenital abnormalities	neonatal deaths
All results (worldwide)	46/156 (29%)	29/156 (19%)	9/156 (6%)	11/156 (7%)	7/156 (4%)
UK	18/78 (23%)	11/78 (14%)	3/78 (4%)	6/78 (8%)	3/78 (4%)
USA	25/64 (39%)	15/64 (23%)	6/64 (9%)	3/64 (5%)	4/64 (6%)

Table 6: Problems reported in bitches

Number of bitches reported with… / Country	problem litters	C-sections	stillbirths	congenital abnormalities	neonatal deaths
All results (worldwide)	40/112 (36%)	10/112 (9%)	29/112 (26%)	7/112 (6%)	8/112 (7%)
UK	16/53 (30%)	5/53 (9%)	11/53 (21%)	3/53 (6%)	3/53 (6%)
USA	22/49 (45%)	3/49 (6%)	15/49 (31%)	4/49 (8%)	5/49 (10%)

Table 7: Reported cPSS in related Deerhounds

Country	Bitches with reported cPSS in a relative	Sires with reported cPSS in progeny
All results (worldwide)	7/112 (6%)	1
UK	2/53 (4%)	0
USA	5/49 (10%)	1

Table 8: Average litter sizes (ignoring data from incomplete responses)

Country	Average litter size	Average size of 1st litter	Average size of 2nd litter	Average size of 3rd litter
All results (worldwide)	7	6	6	7
UK	7	5	6	5
USA	8	6	6	8

Table 9: Number of litters

Country	Bitches who have had 1 litter	Bitches who have had 2 litters	Bitches who have had 3 litters	Bitches who have had 4 litters
All results (worldwide)	75/112 (67%)	31 (28%)	5 (4%)	1 (1%)
UK	32/53 (60%)	18 (34%)	2 (4%)	1 (2%)
USA	36/49 (73%)	11 (22%)	2 (4%)	0

Discussion

Prevalence of cPSS

The overall prevalence of cPSS in deerhound puppies was found to be 0.8% in this study. There was no control population to compare this result to therefore it is not possible to assess the significance of this finding compared the general population of dogs.

The proportion of mixed-breed dogs with cPSS was reported to be 0.05% in one study (*Tobias and Rohrback 2003*). This study also found the proportion of Scottish Deerhounds with cPSS to be 0.9%, a similar result to the proportion found in this study.

The figure of 0.8% is based on some incomplete data regarding litter sizes, where an average was used in these cases. Therefore 0.8% may not be a true representation of the prevalence of cPSS. Where litters with incomplete data were discounted, the prevalence of cPSS was found to be 1.1%. This value is likely to be artificially high since some litters with no shunts had to be discounted and none of the discounted litters contained shunts. Therefore the true value probably lies between 0.8-1.1%.

This value may be artificially low for a number of reasons. Some breeders may have been reluctant to report cPSS puppies and did not take part in the study. Some breeders do not test routinely for cPSS in their litters. Therefore the prevalence may be low due to asymptomatic cPSS puppies being missed, or severely affected puppies being euthanased without diagnosis. Neonatal deaths, or 'fading puppies', were reported in both the USA and the UK. These puppies died before the test age therefore it is possible that they had undiagnosed shunts.

The value may also be artificially high if people who had litters with no cPSS puppies did not fill in the survey, perhaps assuming that since they had not had any shunt puppies, their data would be of no interest.

Another limitation with this study is that a time period was not specified; instead it was designed to collect data from breeding bitches that are currently alive. Some responses had to be discounted since it was known that the bitches were no longer alive. However it is likely that some of the responses were from deceased bitches and have been included in the analysis.

A higher percentage of puppies from the UK had shunts compared to the USA. Information sent via email from a breeder in the USA contradicts this apparent low prevalence of shunts in the USA. 8 puppies with cPSS were reported in 7 litters (with several different breeders) since 2000. The email also alluded to other breeders with shunt puppies in the USA.

There are several potential explanations for the USA having a lower percentage of cPSS compared to the UK. It is possible that the population of Deerhounds in the USA, which has a different genetic pool to the UK, has a lower prevalence of cPSS. It is also possible that cPSS are not as well reported in the USA. A smaller proportion of breeders in the USA routinely test their Deerhound puppies for cPSS compared to the UK (see later in the discussion) which could lead to an artificially low prevalence if cPSS puppies are missed. Breeders with confirmed cPSS in the USA may be more reluctant to report cPSS puppies which could be due to many different reasons.

Testing for CPSS

This study found that 71% of breeders worldwide routinely test for cPSS in their Deerhound puppies. Ideally all breeders would test their puppies before they are sold, a practice that is already recommended by The Deerhound Club in the UK and The Scottish Deerhound Club of America (*http://www.deerhound.co.uk/Health%20Matters/PSS.htm, https://sdcahealth.wordpress.com/category/recommended-health-tests/*).

The proportion of breeders that routinely test was higher in the UK compared to the USA. This could be for a number of reasons. Awareness of portosystemic shunts and the need for testing puppies may be higher in the UK. This could be due to the ongoing prospective study that has been running since 2012 and has been advertised through the Deerhound Club, encouraging breeders to test for shunts. It is possible that some breeders in the USA do not perceive it as a problem within the breed. The reasons behind the difference in the proportion of breeders that test for cPSS are likely to be multi-factorial and difficult to define. In both populations, some breeders do not routinely test so it is important that all breeders are encouraged to do so and are given information about how and when to test.

Most breeders that routinely test do so between 8-12 weeks and use the bile acid stimulation test. Some responses seemed to refer to the BAST but did not give the exact name. These were included in the analysis (Table 4, Figure 2) so it is possible that this proportion may be a slight overestimate. Other breeders use post-prandial bile acids only, ammonia levels, urine tests or ultrasound scanning.
The bile acid stimulation test (pre- and postprandial serum bile acids) is the standard test used globally and is thought to be the most appropriate test (Kerr and van Doorn 1999). The test is sensitive but not specific for cPSS as a positive result can be seen with other liver diseases.

Problems with litters

Worldwide, 29% of litters were reported to have had 'problems' either during pregnancy, parturition or in the neonatal period (Table 5 and Fig 3). The USA had a higher proportion of litters with stillbirths and neonatal deaths compared to the UK.

These included stillborn puppies and neonatal deaths. cPSS may contribute to some *in utero* and neonatal deaths, without being diagnosed. However there are many other potential causes of death so it is not possible to say how significant a role cPSS play.

Reported cPSS in related dogs

Interestingly, a higher percentage of bitches were reported to have relatives with cPSS in the USA compared the UK despite the lower prevalence of cPSS in the USA (see earlier discussion). This could further support the hypothesis that there are some breeders in the USA are unwilling to report their cPSS puppies and that the prevalence found in this study is an underestimate.

Number of litters and average litter size

The results show that a higher of proportion of bitches had only one litter compared to the UK. The results also suggest that there is no obvious differences have been found between the litter sizes of the first, second and third litters or between the litters in the UK and the USA.

However no statistical tests have been performed to assess the significance of these findings.

Conclusion

The prevalence of cPSS in Deerhounds found in this study is higher than has been found for mixed-breed dogs, both in the UK and the USA. This suggests a genetic component of the disease in Deerhounds. The lower prevalence of cPSS in the USA could be due to a number of reasons including a lower proportion of breeders testing for shunts. It would be advisable for all breeders to routinely test their puppies for cPSS before sale and to avoid breeding from affected animals.

References

Berent, A. C. and Weisse, C. (2010) Textbook of Veterinary Internal Medicine, 7th Ed. Editors: Ettinger, S. J. and Feldman, E. C. Page 1650

Hunt G. B (2004) Effect of breed on anatomy of portosystemic shunts resulting from congenital diseases in dogs and cats: a review of 242 cases. Australian Veterinary Journal 82(12) 746-9

Hudson, D. E. S. (1981) The Brabyns handbook on Irish wolf hounds. D.E.S. Hudson

Kerr, M. G. And van Doorn, T. (1999) Mass screening of Irish Wolfhound puppies for portosystemic shunts by the dynamic bile acid test. Veterinary Record 144, 693-696

Meyer, H. P., Rothuizen, J., Ubbink, G. J. and van den Ingh, T. (1995) Increasing incidence of hereditary intrahepatic portosystemic shunts in Irish Wolfhounds in the Netherlands (1984 – 1992). Veterinary Record 136, 13-16

Sargan, D. R. (2002-2013) Inherited diseases in dogs database:

http://idid.vet.cam.ac.uk/detail.php?record=1210 (accessed 8th June 2014)

Sargan, D. (2004) IDID: Inherited Diseases in Dogs: Web-based information for canine inherited disease genetics. Mammalian Genome. 15 (6) 503-506

The Deerhound Club (2004) http://www.deerhound.co.uk/Health%20Matters/PSS.htm (accessed on 3rd June 2014)

The Scottish Deerhound Club of America (2014) https://sdcahealth.wordpress.com/category/recommended-health-tests/ (accessed on 3rd June 2014)

The Scottish Deerhound Club of America (2014) https://sdcahealth.wordpress.com/2014/01/03/liver-shunts/ (accessed on 3rd June 2014)

Tillotson, S. (2012) http://www.irishwolfhoundtimes.com/origin.htm (accessed on 3rd June 2014)

Tisdall, P. L. C., Hunt G. B., Bellenger C. R. and Malik R. (1994) Congenital portosystemic shunts in Maltese and Australian Cattle Dogs. Australian Veterinary Journal 71(6), 174–178

Tobias, K. M. (2003) Determination of inheritance of single congenital portosystemic shunts in Yorkshire Terriers. Journal of the American Animal Hospital Association. 39(4), 385-9

Tobias, K. M., and Rohrbach, B. W. (2003) Association of breed with the diagnosis of congenital portosystemic shunts in dogs: 2400 cases (1980-2002). Journal of the American Veterinary Medical Association 223(11), 1636-9.

Ubbink, G. J., van der Broek, J., Hazewinkel, H. A. W., Rothuizen, J. (1998) Cluster analysis of the genetic heterogeneity and disease distributions in purebred dog populations. Veterinary Record 142, 209-213

van Steenbeek, F. G., van den Bossche, L., Leegwater, P. A. J. and Rothuizen, J. (2012) Inherited liver shunts in dogs elucidate pathways regulating embryonic development and clinical disorders of the portal vein. Mamm Genome 23, 76–84

Watson, P. J. and Bunch, S. E. (2009) Small animal internal medicine. 4th Ed. Editors: Nelson, R. W. and Couto, C. G. Page 556

White R. N., Burton C. A. and McEvoy F. J. (1998) Surgical treatment of intrahepatic portosystemic shunts in 45 dogs. Veterinary Record 142, 358-365

Appendix 1:The Questionnaire, distributed with a cover letter explaining the study.

The Queen's Veterinary School Hospital
University of Cambridge
Madingley Road Cambridge CB3 0ES

Tel: 01223 337621 / 01223 337669 Fax: 01223 330848

Deerhound Breeders' Questionnaire

Please return the completed questionnaire **by 1st April 2014** either

- **online** (www.surveymonkey.com/s/FSVBJCM)
- **or by mail** (addressed to Lydia Kerridge at the address above).

Even if you had never had an affected puppy, please fill in the survey to help us get an idea of the overall number of affected and unaffected puppies.

The questionnaire is designed such **that one can be completed *for each breeding bitch***. Please answer as many questions as possible. The information you give is **anonymous** and will be held in the strictest confidence, used only by myself for statistical purposes.

1. How many litters has this dam had and how many puppies were in each litter?

Were they all with you or were any with another owner?

Were all previous pregnancies successful or have there been abortions, still births or other problems? Which litters, if any, had problems (e.g. first, second etc)

2. Do you routinely test for portosystemic shunts in your litters? Yes / No

If 'Yes'

a) At what age do you test puppies for portosystemic shunts?

b) What method do you use to test puppies for portosystemic shunts?

3. Has this dam ever produced puppies with confirmed portosystemic shunts? Yes / No

If "Yes":

a) which litters have had affected puppies (e.g. first, second etc)?

b) how many puppies in each litter were affected?

c) at what age were the shunts diagnosed and by what method?

d) did the affected puppies have the same sire?

4. To your knowledge, is there any history of puppies with portosystemic shunts being born to relatives of this dam? If your answer is yes, please give details of which relatives.

5. To your knowledge, do the sires of the litters of this dam have a history of producing puppies with portosystemic shunts?

6. Do you have any other comments? (please use additional page if needed)

Thank you for your valuable help with this questionnaire. Depending on the results, there may be future studies looking into what may cause the potential increased incidence of portosystemic shunts in Deerhounds.

Please indicate if you would be willing to be contacted in the future by completing your contact information below. Showing interest now puts you under no obligation to take part in future investigations.

Your name (optional)	
Your address (optional)	
Your email address (optional)	
Your phone number (optional)	