TITLE: Survey of surgical specialists' content preferences in radiology reports for extrahepatic portosystemic shunts

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JOURNAL: VETERINARY RADIOLOGY & ULTRASOUND

PUBLISHER: Wiley

PUBLICATION DATE: 8 March 2019 (online)

DOI: http://dx.doi.org/10.1111/vru.12730

# Surgical specialists' content preferences in computed tomography radiology reports of extrahepatic portosystemic shunts

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Keywords: PSS, structured reporting, radiologist, CT

## Abstract

Extrahepatic portosystemic shunts are described in the literature and in practice using a variety of different nomenclature and categorization systems. The aim of this study was to assess the opinions of specialist surgeons as to the preferred content, nomenclature and classification of extrahepatic portosystemic shunts that should be included in the radiology report. This was a descriptive survey study for which specialist surgeons were invited to participate in an online survey. There were 93 respondents. Most respondents agreed that they both review the images themselves (87/92, 95%) and read the radiology report (82/92, 89%) prior to surgery. Most respondents believed that the radiology report should contain a detailed anatomic description of the insertion (83/92, 90%), origin (54/91, 59%) and course (70/92, 76%) of the shunt, as well as a measure of the diameter of the shunting vessel at its insertion (54/92, 59%). Most respondents (70/90, 78%) disagreed that a brief description of shunt type, such as portocaval or portophrenic, was sufficient. Respondents were undecided regarding the use of an alphanumeric classification system (36/92, 39% agree; 32/92, 35% disagree). There was agreement that details of the presence or absence of urolithiasis (91/93, 98%), renomegaly (54/93, 58%), and peritoneal fluid (72/92, 78%), should be included in the report. The results of this study will help to guide the reporting radiologist in providing comprehensive and transparent reports of extrahepatic portosystemic shunt cases that include the information desired by the recipient surgeons.

## Introduction

Congenital extrahepatic portosystemic shunts are associated with clinical signs of hepatic encephalopathy, vomiting and diarrhea, failure to thrive, renal hypertrophy and urate urolithiasis.[1] Surgical ligation of extrahepatic portosystemic shunts is associated with good long term survival.[2] Preoperative diagnostic imaging of potential surgical candidates with a suspected extrahepatic portosystemic shunt is almost universal, however the preferred imaging modality is variable. In recent years, multidetector row computed tomographic angiography (CTA) has superseded abdominal ultrasonography for the diagnosis and characterization of extrahepatic portosystemic shunts in most veterinary referral centers, due to its superior sensitivity.[3] Historically, nuclear scintigraphy[4,5] and intraoperative mesenteric portovenography (IOMP)[6] have also been used for diagnosis, with the latter remaining a common intraoperative tool.[7] Magnetic resonance angiography has also been described for the diagnosis of extrahepatic portosystemic shunts, although is uncommonly used in veterinary practice due to cost, the need for general anesthesia and limits to spatial resolution.[8,9]

Regardless of the modality used, the preoperative imaging study of a suspected extrahepatic portosystemic shunt has several important aims. Firstly, it should identify suitable surgical candidates and, perhaps more importantly, identify those that are unsuitable for surgical intervention, for example, in the presence of multiple acquired shunts.[10–14] The imaging study also aims to describe and classify the type of extrahepatic portosystemic shunt that is present, in order to facilitate and expedite shunt identification during surgery.[15,16] Historically, extrahepatic portosystemic shunts were classified in general terms relating to their origin and insertion, such as

portocaval or portoazygos shunts.[4,12–14,17] In the past decade, with the increasing use of CTA, radiology reports have included more detailed descriptions of the complex vascular anatomy involved. In particular, the use of multidetector row CTA with three-dimensional reconstructions including multiplanar maximum intensity projections and volume rendering, can provide accurate depictions of the origin, course and insertion of the shunting vessel.[18–20] Several different classification systems of extrahepatic portosystemic shunts have since been proposed, most notably from Nelson & Nelson[19] and White & Parry.[21–25] As expected, there is considerable overlap between the anatomy described by each of these classification systems, however their differing and sometimes conflicting nomenclature can make their use in practice ambiguous and confusing (Table 1). As a result, the content of the radiology reports that describe extrahepatic portosystemic shunts, including ultrasonography reports, is very variable, both between and within different veterinary referral centers. The radiology report is a product that should be tailored to convey important and relevant information regarding the clinical question in the most unambiguous way possible.[26] Therefore, it seems appropriate that the opinion of those for whom the report is designed, namely surgeons, should be considered carefully when the report is produced.

The aim of this study is to investigate the opinions of small animal surgery specialists on the content, detail of description, and nomenclature used in radiology reports relating to extrahepatic portosystemic shunts. We hypothesized that surgeons would prefer a report that includes a detailed description of the shunt insertion, categorization of the shunt based on an alphanumeric system, and a description of pertinent concomitant abnormalities.

## Materials and Methods

This was a descriptive survey study. A link to an online survey was sent by email to members of the European College of Veterinary Surgeons (ECVS) and the Association of Veterinary Soft Tissue Surgeons (AVSTS), and was made available on the American College of Veterinary Surgeons (ACVS) web forum and Facebook page. Ethical approval for distribution of the survey was granted by the Social Science Research Ethical Review Board at the Royal Veterinary College (reference SR2017-1461). Results of the survey were anonymous, and each question was non-compulsory. The survey consisted of an initial section comprising demographic data and data regarding the respondents' current estimated extrahepatic portosystemic shunt caseload. Respondents were also asked to select their preferred method of imaging for suspected portosystemic shunts, for which they could select multiple options. A second section included 26 statements regarding the usage of preoperative diagnostic imaging, and the usefulness and preferred content of preoperative radiology reports for cases of suspected extrahepatic portosystemic shunts. Statements were constructed with consensus agreement from both authors, comprising topics that had arisen in the clinical environment. Statements were grouped into five subsections covering the current use and perceived usefulness of radiology reports for extrahepatic portosystemic shunts, the importance of detailed anatomic descriptions of the shunt morphology, the classification system that should be used, the inclusion of measurements of the shunting vessel and associated structures, and the inclusion of a description of associated clinical findings such as the presence of urolithiasis or an assessment of liver size. For each of the statements, respondents were asked to indicate a level of agreement on a 5-point Likert scale, from "disagree entirely" to "agree entirely". A final free-text section allowed

respondents to share any other comments or opinions they had regarding radiology reports of extrahepatic portosystemic shunts. Three board certified small animal soft tissue surgeons reviewed the survey prior to distribution and consented to the content as given. A copy of the survey in full is available in Supplement 1. The survey was made available for six weeks in June and July 2018.

Survey data was collected through a free-to-use online survey tool (Google Forms, Google, Mountain View, CA, USA). Statistical tests were selected and completed by one author (M.P.) using a commercial statistical software program (SPSS 24, IBM, Armonk, NY, USA). In the case of incomplete surveys, skipped statements for non-compulsory questions were not included in statistical analysis. In accordance with previous radiological survey studies,[27,28] results of the 5-point Likert scale were combined into three categories: “agree entirely” and “rather agree” as a total agreement, “disagree entirely” and “rather disagree” as a total disagreement, and “neutral”. A total of more than 50% in one of the three categories was considered the threshold for an overall agreement, disagreement or neutral response to each statement. Statements for which the 50% threshold was not reached in any of the three categories were considered “undecided”. To assess the relationship between responses and categorical demographic data, the two categories of total agreement and total disagreement were used. Comparisons were performed for total agreement and total disagreement values between respondents’ gender, age (over or under 40), diplomate status (yes or no), and university or non-university workplace. When expected cell sizes were >5 a chi-square test was used, when expected cell sizes were <5 a Fishers exact test was used. P-values $<0.05$ were considered statistically significant.

## Results

*Demographic data*

The link to the survey was sent to approximately 2500 email addresses of members of the ECVS and AVSTS. It was also made available online to ACVS members, of which there are 1134 diplomates working in small animal general surgery, and to the 642 members of the AVCS Facebook page. The link was accessed 160 times and there were 93 responses. Of the 93 respondents, 54/93 (58%) worked in a private referral hospital, 33/93 (35%) worked in a university hospital, 3/93 (3%) worked in a first opinion practice and 3/93 (3%) worked as a mobile surgeon. There were 71/93 (76%) diploma holders including 48 ECVS, 15 ACVS, and 7 dual ACVS and ECVS diplomates. One respondent held an unspecified diploma. There were 13/93 (14%) residents-in-training and 6/93 (6%) respondents had completed a residency but not yet received a diploma. There were 3/93 (3%) respondents who held or were studying towards a surgery certificate. Regarding the number of cases of extrahepatic portosystemic shunts assessed for surgical treatment per year, 36/93 (39%) respondents assessed 10 or more cases per year, 29/93 (31%) assessed 5-10 cases, and 28/93 (30%) assessed 0-5 cases per year.

*Current use of imaging and radiology reports*

Either alone or in combination with other diagnostic methods, the most frequently preferred imaging modalities for assessment of suspected extrahepatic portosystemic shunts were CTA (78/93, 84%), abdominal ultrasonography (51/93, 55%), and intraoperative mesenteric portovenography (21/93, 23%). Nuclear scintigraphy was a

preferred method for 3/93 (4%). No respondents selected magnetic resonance angiography as a preferred method of imaging.

Almost all respondents agreed that they both review the images themselves (87/92, 95%) and read the imaging report (82/92, 89%) prior to surgery. There was agreement amongst respondents that preoperative imaging is essential for determining a patient's suitability for surgery (76/93, 82%). Respondents agreed that preoperative imaging helps guide surgical intervention (83/93, 89%) and adds useful information for surgical planning (71/93, 76%). Most respondents (55/92, 60%) agreed that the radiology reports they currently receive contain sufficient detail regarding shunt morphology. Overall, respondents were undecided whether the terminology currently used in radiology reports is consistent (19/92, 21% agree; 41/92, 45% disagree) or ambiguous (27/92, 29% agree; 29/92, 32% disagree).

*Anatomic description in radiology reports*

There was almost universal agreement that the radiology report should contain a detailed anatomic description of the insertion of the shunt (83/92, 90%). There was also agreement that a detailed description of the origin (54/91, 59%) and the course (70/92, 76%) of the shunt should also be included. Most respondents agreed that a detailed anatomic description of the presence of multiple acquired shunts should be included (47/92, 51%).

*Terminology used in radiology reports*

Most respondents (70/90, 78%) disagreed that a brief description of shunt type, such as portocaval or portophrenic, was sufficient. The use of an alphanumeric classification system, such as that used by White and Parry for shunts involving the right gastric vein,[22] was undecided (36/92, 39% agree; 32/92, 35% disagree). Most respondents (58/91, 64%) agreed that the abnormally dilated shunting vessel should be described in terms of the normal vasculature. However, a smaller majority (49/90, 54%) also believed that the shunting vessel should be described as an aberrant vessel without the use of anatomic terminology (Figure 1).

*Measurements provided in radiology reports*

Most respondents (54/92, 59%) were in favour of inclusion of an exact measurement of the shunting vessel at its insertion. Inclusion of other measurements such as the shunting vessel at its origin (31/92, 34% agree; 31/92, 34% disagree), the diameter of the portal vein (41/92, 45% agree; 23/92, 25% disagree) and the diameter of the caudal vena cava (18/93, 19% agree; 31/93, 33% disagree) were undecided.

*Associated findings*

Inclusion of a detailed description of the visible intrahepatic portal branches was thought beneficial by a majority (52/93, 56%). Most respondents (49/93, 53%) agreed that a subjective assessment of liver size should be included, but the inclusion of an objective measure, such as liver volume, was undecided (34/93, 37% agree; 20/93, 22% disagree). There was agreement that the radiology report should include details of the presence or absence of urolithiasis (91/93, 98%), renomegaly (54/93, 58%), and peritoneal fluid (72/92, 78%).

205

206 *Free text comments*

207 Free text comments were provided by 15/93 (16%) respondents. Fourteen of the
208 fifteen commenters (93%) were diplomates. The importance of identifying multiple
209 acquired shunts in the pre-operative imaging study was mentioned by 6/15 (40%)
210 commenters. Identifying the point of insertion was highlighted as being important by
211 4/15 (27%). Distinguishing intrahepatic from extrahepatic shunts was mentioned by
212 3/15 (20%) commenters. Two commenters (2/15, 13%) stated that imaging was most
213 useful for identifying the presence or absence of a shunt, and that its exact morphology
214 would be determined at surgery. Two commenters (2/15, 13%) mentioned that being
215 able to discuss the imaging findings with the radiologist personally was often
216 advantageous for surgical planning.

217

218 *Associations between responses and demographic data*

219 Overall, there were few statistically significant associations between responses and
220 the categorical demographic data supplied. There was a significant association
221 between university status (yes or no) and opinions on the sufficiency of morphological
222 detail provided in radiology reports (P=0.045). Those respondents not working in a
223 university were more likely to agree that radiology reports contained sufficient
224 morphological detail (39/59, 66% vs 16/33, 48%). There was also a significant
225 association between university status and the description of the shunting vessel
226 without the use of anatomic terminology (P=0.020). Those not working in a university
227 were more likely to agree that the shunting vessel should be described as an aberrant
228 vessel without the use of anatomic terminology (37/57, 65% vs 12/33, 36%).

There was a significant association between respondents age and the inclusion of a detailed description for multiple acquired shunts (P=0.017). Younger respondents (≤40 years old) were more likely to agree that a description of multiple acquired shunts was essential compared to older (>40 years old) respondents (32/52, 62% vs 13/37, 35%). There was a significant association between respondents age and the inclusion of a measurement of the origin of the shunt (P=0.048). Younger respondents (≤40 years old) were more likely to agree that the report should include a measurement of the origin of the shunt than older respondents (24/52, 46% vs 7/37, 19%), though overall both age groups remained undecided on this point.

There were no statistically significant associations between any responses and respondents' gender or diplomate status.

## Discussion

Extrahepatic portosystemic shunts can have a variable, often complex morphology, and may be associated with multiple comorbidities. Preoperative imaging of suspected extrahepatic portosystemic shunts is considered essential by nearly all surgeons participating in this survey. This study shows that while CTA is the preferred imaging modality of most surgeons, ultrasonography and intraoperative mesenteric portovenography still play a significant role.

As shown in this study, radiology reports regarding extrahepatic portosystemic shunts are read by the vast majority of surgeons pre-operatively, and most believe that they are useful for surgical planning. However, there appear to be mixed opinions as to the current consistency and clarity of these reports. Surgeons who did not work at a university agreed that the reports they currently receive contain sufficient morphological detail, while those in an academic environment were undecided. The reason for this disparity in satisfaction of current reports has not been further investigated. With the more widespread use of teleradiology services, the radiology report is becoming an increasingly important mode of communication between radiologists and surgeons. Therefore, the clarity of the communication in the written report should be considered paramount in order to prevent miscommunications and clinical errors, especially in complex surgical cases such as extrahepatic portosystemic shunts.

When categorizing extrahepatic portosystemic shunts, most surgeons believe that a very brief description, such as use of the term portocaval or portophrenic, is

insufficient. A concise description such as this does not convey the wide variation that is possible with portosystemic shunts, even amongst those that have similar origins and insertions.[25] Opinions are mixed between surgeons regarding whether an alphanumeric classification system, such as that described by White and Parry for shunts involving the right gastric vein,[22] should be used. While an alphanumeric classification system can convey complex anatomical details with relative brevity, it does rely on the radiologist and the surgeon being familiar with the system. Unfamiliarity with the system by one or other party can lead to confusion, incorrect categorization, or additional time being spent looking up the classification system each time a report is produced or received.

Opinions on the different nomenclature that can be used for shunting vessels remain mixed. In the literature, many publications describe the vessels involved in extrahepatic portosystemic shunts as ‘anomalous vessels’ or ‘shunts’.[17,19] However, more recent studies have shown that these dilated shunting vessels are generally part of the normal portal vasculature, but with an anomalous communication to an adjacent systemic vein.[25] As such, there is a trend to describe these abnormally dilated shunting vessels in terms of the normal vasculature that they represent. For example, for anomalous communications between the splenic vein and the caudal vena cava, Nelson and Nelson[19] describe a ‘shunt’ arising from the splenic vein and inserting onto the caudal vena cava, while White and Parry[24] describe the same extrahepatic portosystemic shunt type as an ‘enlarged left gastric vein’ arising from the splenic vein and entering the caudal vena cava. In this study, most surgeons agreed that the shunting vessels should be described in terms of the normal vasculature. However, a smaller majority also agreed that the shunting vessels

should be described without anatomic terms. This may indicate a genuine overall agreement that both sets of terms are acceptable in radiology reports. This is unexpected, as the authors believed that agreement with one of these statements would lead to disagreement with the other. It is also possible that these two statements were considered ambiguous or that the responses were susceptible to acquiescence bias – respondents being more likely to agree to with the statements than disagree. When comparing workplace environments, those not working in a university were more likely to agree that shunting vessels should be described without anatomic terms, whereas university surgeons were undecided. This may indicate a trend for those working in an academic environment to be less accepting of potentially outmoded nomenclature conventions, than those in private practice.

This study shows that a detailed description of the insertion of the shunting vessel, as well as a measurement of its diameter, is desirable for most surgeons, confirming our original hypothesis. This was also corroborated by several free-text comments that mentioned the importance of the shunt insertion. Most surgeons also agreed that the origin and course of the shunting vessel should also be described, but the inclusion of exact measurements for these was undecided. Surgical occlusion of extrahepatic shunts, whether by ligation or the application of gradual occlusion devices, generally aims to attenuate the shunt as close to its insertion on the systemic venous system as possible.[29] Therefore, it is to be expected that a detailed description of the site and size of insertion would be valuable for surgeons. The preferred surgical technique of the respondents was not considered in the survey; however, this may have influenced the perceived importance of shunt diameter measurements. For example, if the use of an ameroid ring constrictor is preferred,

preoperative measurements of the diameter of the shunt at its insertion may be useful for the selection of the appropriate range of sizes of ameroid ring constrictor, although the definitive decision for this is still likely to be made intraoperatively.[30] Whereas the choice of ameroid ring constrictor size is directly related to the external shunt diameter, other occlusion devices, such as cellophane banding, thrombogenic coils or ligation techniques, are applicable to all vascular diameters.[31] Therefore, the diameter of the shunt insertion may have been considered more important by surgeons that use ameroid ring constrictors, and less important by those that use other occlusion devices. However, in practice, the reporting radiologist may not always know the preferred surgical technique of the surgeon at the time of writing the report. If similar survey studies are repeated in future, the authors suggest including a question regarding the preferred surgical technique in order to assess the influence that this may have on the responses.

This study demonstrates the importance of including additional features, such as urolithiasis, renomegaly and peritoneal fluid, in the imaging report. While we have shown that surgeons commonly assess the imaging studies themselves, a previous survey has shown that veterinary specialists believe that radiologists often report findings that they would not have noticed themselves.[28] These additional findings may have implications for surgical suitability or explain concomitant signs, such as lower urinary tract signs with urolithiasis.

A limitation of this study is the low number of responses, with 93 responses in total. In order to maximize the number of responses received, the survey was distributed

by email to members of the ECVS and AVSTS and made available in two online locations for ACVS members. However, in doing so the survey was inevitably distributed to a proportion of people for whom it is not relevant, namely large animal surgery specialists or orthopedic specialists. Also, some surgeons are likely to be members of either two or three of these groups. Therefore, it was not deemed possible to calculate an accurate response rate percentage, without such a response rate being underestimated. The only other survey of veterinary professionals on radiology reporting also had a low number of responses, with a response rate of approximately 5% from non-radiologists.[28] Similar to that study, the reason for the low number of responses may be due to time constraints of the respondents, lack of incentive for completing the survey, lack of interest in the subject matter, or for the ACVS diplomates, the need to proactively engage in the Facebook group and web forum rather than respond to an email prompt as for the ECVS and AVSTS surgeons. No reminders to complete the survey were sent, which may have improved the response rate.[32,33] The authors opted not to send reminders to reduce the impact on those people for whom the survey was not relevant. The low number of responses will inevitably predispose the results of the study to non-response bias, selecting for those respondents with stronger opinions on the subject matter.

The radiology report is not only a vital part of the patient's medical record but is also a product that should be tailored for its end-user, namely the surgeon, to clearly and precisely explain the imaging findings to facilitate surgical decision-making. In cases of extrahepatic portosystemic shunts, the potential complexity and variety of findings mean that clarity of communication is particularly important. Therefore, the opinions of those end-users regarding the content of the report should be given appropriate

consideration. Overall the opinions of surgeons on certain points, such as the importance of the shunt insertion, the description of concomitant imaging findings, and the need for a more detailed description than for instance the term portocaval, are definitive. For other points, opinions are mixed. This variability of opinions highlights the importance of maintaining a strong, open line of communication between the radiologist and the surgeon. Where possible, radiologists should be encouraged to discuss with the surgeons what they would like included in the imaging report, so that the reports produced can be consistent, clear and clinically-useful. The use of structured checklist-style reports that prompt the radiologist to include such details as the diameter of the shunt insertion, could also be considered to improve reporting consistency.[34] A consensus statement promoting a standard reporting format for extrahepatic portosystemic shunts has not been published, and the results of this study would be helpful to guide its development.

## Author contributions

Category 1

(a) Conception and Design: Plested MJ, Drees R,

(b) Acquisition of Data: Plested MJ, Drees R

(c) Analysis and Interpretation of Data: Plested MJ, Drees R

Category 2

(a) Drafting the Article: Plested MJ, Drees R,

(b) Revising Article for Intellectual Content: Plested MJ, Drees R

Category 3

(a) Final Approval of the Completed Article: Plested MJ, Drees R

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**Table 1**

A summary of the different classifications proposed by Nelson and Nelson[19] and White and Parry[22–24] for common types of extrahepatic portosystemic shunts.

| **Origin of extrahepatic portosystemic shunt** | **Insertion of extrahepatic portosystemic shunt** | **Classification according to Nelson and Nelson[19]** | **Classification according to White and Parry[22–24]** |
|---|---|---|---|
| Splenic vein or left gastric vein | Left phrenic vein | Splenophrenic | Left gastro-phrenic |
| | Azygos vein | Splenoazygos | Left gastro-azygos |
| | Post-hepatic caudal vena cava | Not described | Left gastro-caval |
| | Pre-hepatic caudal vena cava | Splenocaval | Splenocaval (though more accurately described as a left gastrocaval) |
| Right gastric vein | Pre-hepatic caudal vena cava; insertion via left gastric with no left gastric-splenic communication | Right gastric-caval | Right gastric type Ai |

| | | |
|---|---|---|
| Pre-hepatic caudal vena cava; insertion mid-way along left gastric with normal left gastric-splenic communication | Double right gastric-caval | Right gastric type Aii |
| Pre-hepatic caudal vena cava; insertion mid-way along left gastric with normal left gastric-splenic communication | Not described | Right gastric type Aiii |
| Azygos vein; confluence of right gastric vein and left gastric vein prior to insertion | Double right gastric-azygos | Right gastric type Aiv |
| Post-hepatic caudal vena cava | Not described | Right gastric type B |

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**Figure 1**

Stacked bar chart showing the distribution of responses to statements relating to the terminology used in radiology reports. There was overall disagreement that a brief description of the shunt type is sufficient. The use of an alphanumeric classification system was undecided. There was overall agreement that the shunt vessel should be described both in terms of the normal vasculature it represents, and as an aberrant shunting vessel.