EDITORIAL

Does size matter? The continuing riddle of Chiari and syringomyelia

In this issue of *JSAP*, further advances are made toward the necessary understanding of the extremely complex triad of Chiari malformation, cerebellar herniation and syringomyelia. However, it seems that the questions surrounding this triad still vastly outnumber the conclusions that have been drawn over the last 10 years.

Our first question must be: What is a Chiari malformation? Much has been written about this abnormality in people and in dogs. It has become accepted that Chiari malformation type I (CMI) in humans most closely resembles the condition in several breeds of dogs, especially well documented in the cavalier King Charles spaniel (CKCS). We have come to know this disease as Chiari-like malformation (CLM) or as caudal occipital malformation. Unfortunately, there is no accepted definition of CMI in human medicine, which makes discussion of the condition and its treatment difficult and magnifies our own confusions in veterinary medicine as to what we should define as CLM. Chiari malformations are structural defects of the hindbrain defined by the atypical (smaller) development of the posterior or caudal fossa, the degree of associated cerebellar herniation into the foramen magnum, and the presence of other anomalies such as hydrocephalus and syringomyelia. When the human cerebellum partially protrudes through the foramen, it is called a CMI. Without such protrusion, posterior fossa abnormalities are often termed Chiari malformation type 0. Both types can be asymptomatic and non-progressive as has been shown in a recent human study (Novegno and others 2008). Occipital bone malformations, particularly hypoplasia, are seemingly the principle abnormality in dogs.

Without a clear definition of CLM in veterinary medicine, philosophical problems often arise with respect to patient treatment - leading to a "watchful waiting" approach in the absence of compelling clinical signs. Could this be the correct approach in veterinary medicine when we have only moderate success with surgical therapy? This approach may be taken despite the fact that the most of the recognisable clinical signs are due to the associated development of syringomyelia, which may represent irreversible structural damage to the nervous system. Ideally, we should be able to recognise affected veterinary patients earlier in the disease process. This would help with breeding programmes and would allow us to implement potential treatment strategies aimed at reducing progression beyond an irreversible state. However, the signs associated with CMI in humans and CLM in dogs can be mild and vague.

In breeds at risk, such as the CKCS, breeding programmes have benefited from MRI screening programmes but such programmes hinge on the identification of a structural abnormality of the caudal fossa which can be subjective. In addition, we recognise that the vast heterogeneity in skull morphology between the multiple breeds makes the determination of normal versus abnormal extremely complicated. Essentially, what is normal for one breed may be abnormal for another. Two papers in this issue (Cross and others 2009, Rusbridge and others 2009) have looked

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to address this problem by evaluating the caudal fossa dimensions of large and small breed dogs, including the CKCS and investigating skull radiograph dimensions in a new breed affected by CLM, the Griffon Bruxellois (GB), respectively. It appears that the CKCS actually may have a caudal fossa which is suitable for the size of the breed, but have too much parenchyma when compared to a similar sized dog; truly a situation where bigger is not better!

This is a fascinating finding and it is in line with many human studies (Noudel and others 2009). Does this finding make radiography obsolete in the investigation of CLM? Certainly, radiography can help identify bone abnormalities associated with the condition, such as occipital hypoplasia. As Rusbridge and others (2009) have shown in this issue, radiographic measurements can be a worthy initial screening pursuit for "at risk" breeds. The authors propose that CLM in the GB is characterised by a shortening of the basicranium, a deficiency of the supraoccipital bone and a compensatory lengthening of other bones in the skull; in essence, a small caudal fossa size in this breed is associated with a similar situation to that of the CKCS and bigger would be better! However, we will wait to see whether the GB brain is also 'too big' when compared to other small breed dogs. As the authors of this particular paper state, all imaging judgments would be better replaced by a genetic test, for which the work is now ongoing. Obviously, MRI investigations are superior for the assessment of the CNS parenchyma and for the assessment of tissue displacement (cerebellar herniation) and destruction (syringomyelia; a fluid filled cavity originating in spinal cord tissue) in patients manifesting neurological signs with CLM. Carruthers and others (2009) in this issue demonstrated that 2D measurements may be insufficient in the evaluation of dogs with CLM and syringomyelia and hence more accurate 3D assessments are necessary. The MRI assessment of such volume now takes a new turn with the use of 3D technology most recently described by Cross and others (2009) in this issue. Volume analysis has been contentious in the human literature but several studies have demonstrated a significant difference in the posterior fossa volume in patients

with CMI to those without (Vega and others 1990). The authors of the current veterinary study caution that volumes alone cannot be used to assess the clinical significance in a particular patient as yet but this work does lay the foundation for this to be possible.

A logical follow-up question is: "is cerebellar herniation a necessary component of CLM in dogs for the development of syringomyelia (the ultimate destructive consequence of this disease)?" It is well recognised in both the human and veterinary literature that there is a strong association between CLM and syringomyelia, resulting from abnormal CSF flow between the cranial and spinal compartments (Oldfield and others 1994, Rusbridge and others 2007). However, syringomyelia has been found in association with CMI in humans related to hydrocephalus, and inflammatory disease. Both of these conditions are commonly recognised in breeds of dog with occipital hypoplasia and we have yet to determine the normal ventricular size in all of the dog breeds. Again, furthering our understanding and yet fuelling our inquisition of the syringomyelia debate, Rusbridge and others (2009) have found that some of the GB dogs in their study did not have any such herniation yet exhibited either syringomyelia or at least central canal dilation. Cross and others (2009) in this issue found that the percentage of the cerebellum herniated is not related to caudal fossa parenchymal volume measurements in dogs. Previous studies (Lu and others 2003) have suggested that there is no correlation between caudal displacement of the cerebellar vermis and the presence of syringomyelia but there is correlation with the size of the foramen magnum (Cerda-Gonzalez and others 2009).

Lastly, does the cervical vertebral column and cervical spinal cord contribute to CLM? In this issue, Carruthers and others (2009) investigated the role of the cervical spinal canal dimensions in CLM. While not convinced, the authors identified some involvement of a larger cranial cervical canal size with the presence of syringomyelia. Whether causally related or a secondary effect, remains to be proven. Ultimately, the resulting questions remain; 'in cases without obvious cerebellar displacement, what causes syringomyelia? And when is central canal dilation alone a concern?' With the latter, we return back to the breed heterogeneity issue. Dilation above 2mm is considered by many to represent syringomyelia, and, the larger the syrinx, the more evident the clinical signs (Rusbridge and others 2007); it is clear then that bigger is not better relating to syringomyelia! For the purposes of guiding breeding programs, we need a better marker than size and we await a genetic awakening. Ongoing studies in the human and veterinary fields continue to investigate the role of CSF dynamics in the development of syringomyelia and clinical signs. Recent work by multiple groups highlights the need for further investigation into CSF dynamics. Not only will studies of CSF dynamics lead to a greater understanding of the complicated triad but also such investigations may lead to more appropriate long term monitoring parameters for those dogs awaiting treatment decisions as well as provide valuable assessment of therapeutic interventions.

With the valuable insights established by the studies presented in the current issue, the authors have opened many new avenues of investigation. So, we remain with more questions than answers to this confusing triad of CLM, cerebellar herniation and syringomyelia, but we should commend the authors of the papers in this issue for the painstaking work they have put forth to advance our knowledge that much further.

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