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Short Communication

Hydrated nucleus pulposus herniation in seven dogs

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ABSTRACT

The clinical signs, magnetic resonance imaging (MRI) findings, treatment and follow-up in seven dogs with hydrated nucleus pulposus extrusion (HNPE) are reported. All dogs had tetraparesis or tetraplegia. T2-weighted MRI revealed extradural hyperintense homogeneous material compressing the cervical spinal cord. After conservative treatment (five dogs) or surgical decompression (two dogs), all dogs returned to ambulatory function within 1 month. Follow-up MRI in conservatively treated dogs revealed complete disappearance of the extruded material. Histopathological examination of surgical specimens confirmed that the retrieved material was extruded nucleus pulposus with evidence of early degeneration.

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Hydrated nucleus pulposus extrusion (HNPE) is a cause of cervical myelopathy in non-chondrodystrophic and chondrodystrophic dogs (Beltran et al., 2012). The diagnosis has been largely presumptive, although supported in some cases by findings at surgery. The clinical outcome is generally favourable with either medical or surgical management, but follow-up magnetic resonance imaging (MRI) findings have not been reported.

In this study, medical records of dogs presented to the Veterinary Teaching Hospitals in Utrecht, The Netherlands, and Sassari, Italy, were screened for cases of HNPE. The signalment, history and presenting neurological deficit score (Sharp and Wheeler, 2005) were recorded. All dogs underwent MRI of the cervical vertebral column using a low field magnet (Siemens Magnetom 0.2 T in the Netherlands and Paramed 0.23 T in Italy). HNPE was assumed if there was extradural compression associated with material isointense in all sequences to normal nucleus pulposus (NP) lying immediately dorsal or adjacent to an affected intervertebral disc. In all cases, the dorsal annulus of the affected intervertebral disc was ill-defined, with reduction of NP volume and narrowing of the intervertebral disc space. The percentage of spinal cord compression was calculated as described by Ryan et al. (2008).

Affected dogs were treated medically or surgically based on clinical status, severity of spinal cord compression observed on MRI and consideration of owner factors. Conservative treatment consisted of non-steroidal anti-inflammatory drugs and restricted or controlled physical activity for the following 4 weeks. Surgical treatment consisted of a standard ventral slot decompression, followed by post-operative management similar to that for conservatively treated animals. The extradural material compressing the spinal cord was

collected during surgery and submitted for histological examination. Clinical follow-up was performed 1 and 6 months after each treatment. MRI was repeated if possible and images were evaluated for evidence of HNPE, severity of spinal cord compression and evidence of spinal cord injury.

History, clinical signs, HNPE localisation and percentage of spinal cord compression of the seven affected dogs are listed in Table 1. Spinal cord hyperintensity on T2-weighted MRI was observed in one dog (case 2). In all dogs, cervical intervertebral discs other than the HNPE-affected space showed variable evidence of degeneration (Fig. 1).

Five dogs were treated conservatively and two dogs surgically; all regained ambulatory status within 1 month (Table 1). Case 2 had slower improvement of neurological status; this dog also had concurrent disease (diabetes mellitus) and spinal cord hyperintensity on T2-weighted MRI. Clinical follow-up at 1 and 6 months revealed no neurological deficits in 6/7 dogs; case 2 had persistent mild neurological impairment. Follow-up MRI was performed in two dogs that were treated conservatively. At 6 months, HNPE had disappeared and the spinal cord appeared normal (Fig. 2). Histological examination of surgical specimens taken from within the vertebral canal revealed intact lamellar layers in the annulus fibrosus with signs of chondroid metaplasia. Material removed from the spinal canal consisted of NP material with necrotic notochordal cells and small clusters of chondrocyte-like cells (Fig. 3). Both findings are suggestive of early intervertebral disc degeneration.

In this series, both chondrodystrophic and non-chondrodystrophic dogs were included. Clinical signs appeared acutely, were rarely associated with intense physical exercise and cervical pain was uncommon. This is in agreement with a recent study suggesting that dogs with HNPE have more severe clinical neurological deficits and less severe cervical pain than dogs with other compressive cervical myelopathies (Hamilton et al., 2014).

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Table 1

Signalment, clinical signs, imaging findings, treatment and outcome in seven dogs with hydrated nucleus pulposus extrusion.

Dog	Age (years)	Sex	Neurological grade at presentation	MRI lesion	Cervical pain at presentation	Spinal cord compression (%)	Treatment	Ambulatory (days)	Neurological grade at 6 months
Yorkshire terrier	10	M	4	C3-C4	No	36	Medical	3	0
Yorkshire terrier	10	F	4	C5-C6	No	22	Medical	30	0
Maltese terrier	9	F	3	C4-C5	No	38	Medical	3	0
Yorkshire terrier	9	M	3	C4-C5	No	48	Medical	3	0
Beagle	8	M	3	C3-C4	No	23	Medical	4	0
Whippet	11	M	4	C4-C5	Yes	60	Surgical	7	0
King's poodle	9	M	4	C4-C5	No	60	Surgical	3	0

MRI, magnetic resonance imaging; C, cervical vertebra; M, male; F, female.

The findings of notochordal and chondrocyte-like cells in nucleus pulposus and of chondroid metaplasia in annulus fibrosus confirm that the affected discs were in an early stage of degeneration (Bergknut et al., 2013a, 2013b; Kranenburg et al., 2013). This suggests that HNPE is an atypical presentation of disc extrusion in which an 'almost healthy' nucleus pulposus extrudes through the dorsal annulus. The acute herniation of HNPE into the epidural space leads to a mixed compressive and contusive lesion responsible for acute neurological dysfunction (Jeffery et al., 2013).

However, given that HNPE retains its characteristic jelly-like texture resembling a healthy disc, it causes a low intensity

compression of the spinal cord and, because of its biochemical characteristics, can be quickly resorbed. This hypothesis is corroborated by the rapid neurological recovery following surgical removal of the herniated material and its complete resorption on follow-up MRI

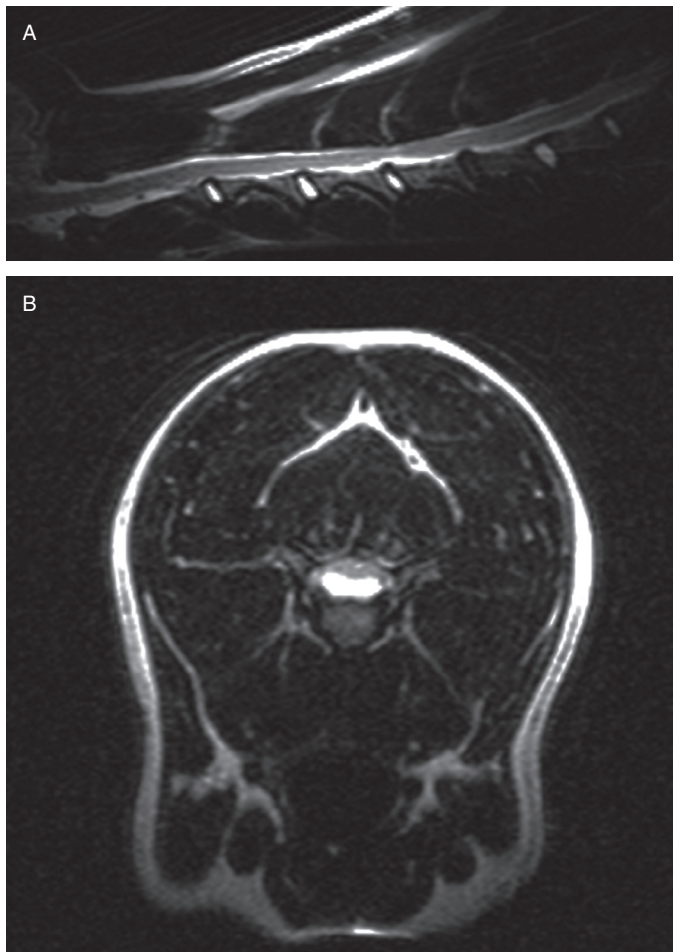


Fig. 1. Sagittal (A) and transverse (B) fast spin echo T2W images of case 7. Severe hydrated nucleus pulposus extrusion (arrow) in C4-C5 can be noted. On transverse images, the extruded hydrated nucleus pulposus material had a 'seagull' appearance. Different degrees of intervertebral disc (IVD) degeneration in the cranial and/or caudal IVDs can be observed.

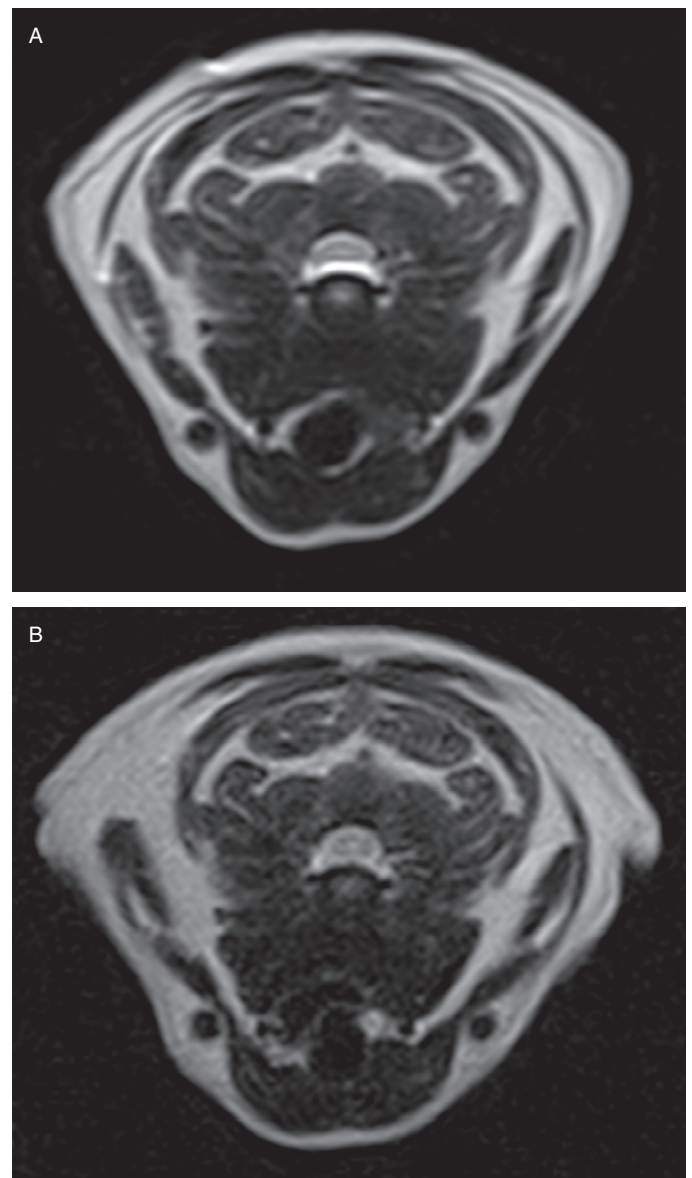


Fig. 2. Transverse fast spin echo T2W images of case 4. (A) Magnetic resonance imaging (MRI) showing ventral extradural hyperintensity (arrow) and severe spinal cord compression in the C4-C5 cervical intervertebral space. (B) Follow-up MRI after 2 months shows no ventral extradural hyperintensity and elimination of spinal cord compression.

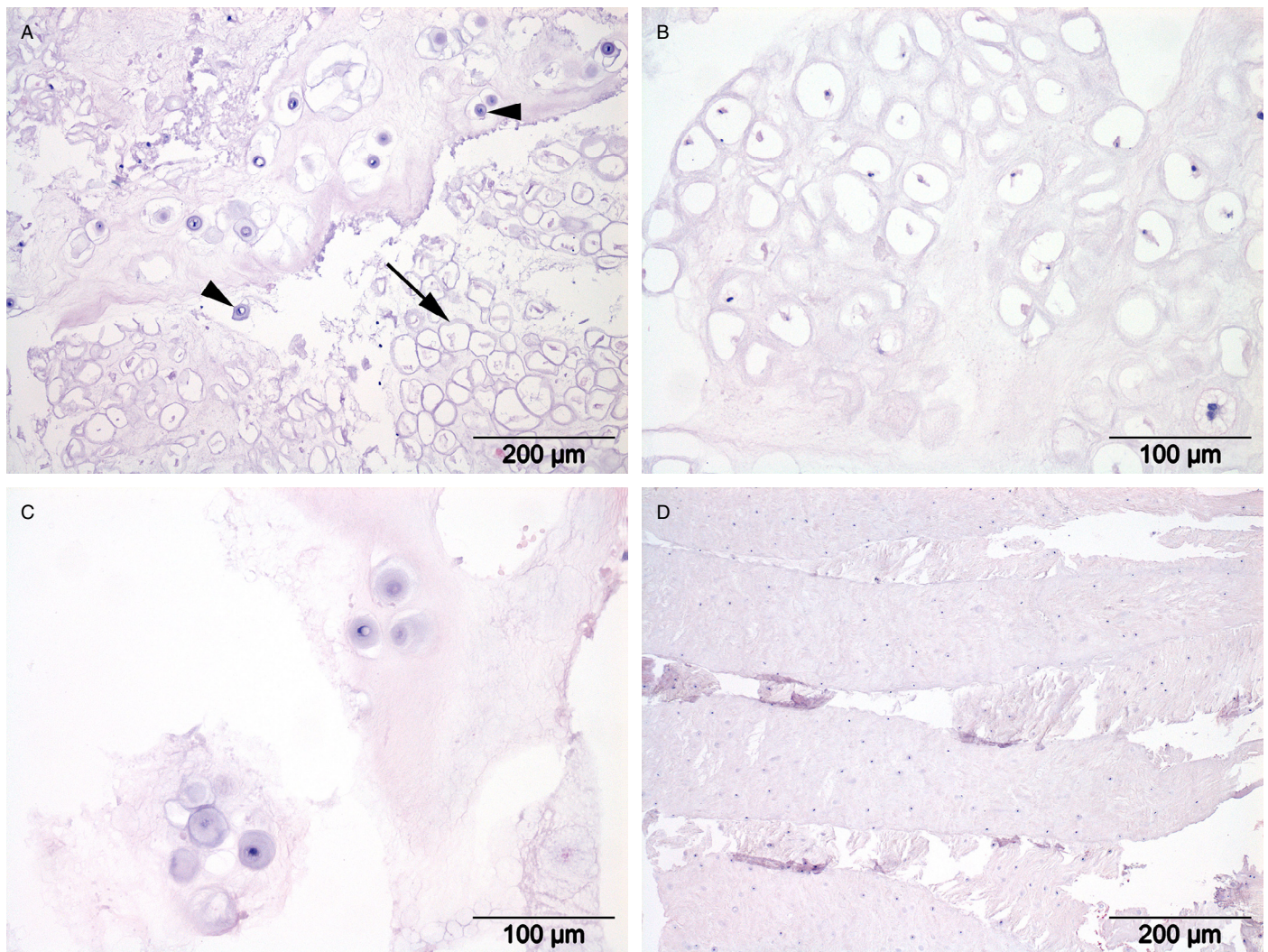


Fig. 3. Nucleus pulposus containing groups of notochordal cells (arrow), and chondrocytes (arrowheads) (A). Most of the notochordal cells are markedly shrunken with a small amount of eosinophilic cytoplasm and contain pycnotic nuclei (B). The chondrocytes are embedded in a variable amount of finely reticular and slightly eosinophilic intercellular matrix (C). Lamellae of the annulus fibrosus contain numerous chondrocytes within a fibrillary eosinophilic matrix (D). Haematoxylin and eosin staining.

in conservatively-treated dogs. Conservative management should therefore be considered as an alternative treatment in dogs with this specific type disc extrusion.

Conflict of interest statement

None of the authors of this paper has a financial or personal relationship with other people or organisations that could inappropriately influence or bias the content of the paper.

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