Detection of myocardial degeneration with point-of-care cardiac troponin assays and histopathology in lambs with white muscle disease

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Abstract

The aim of this study was to evaluate the use of human cardiac troponin-I (cTn-I) and cardiac troponin-T (cTn-T) kits for the detection of myocardial degeneration in lambs suffering from white muscle disease (WMD). Cardiac troponin (cTns) analyses and necropsy were performed on 12 lambs with acute WMD. Only cTns analyses were tested in six healthy lambs. cTn-I and cTn-T tests were positive for all lambs with WMD, but negative in healthy lambs. Necropsy revealed that the cardiac and skeletal muscles of lambs with WMD had chalky white lesions, which appeared as necrosis and calcification in histopathology. The histopathological findings of the heart muscle and increased cTn in lambs with WMD suggested that marked myocardial degeneration may be detected by point-of-care cTn assays in lambs.

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Short Communication

White muscle disease (WMD) induces hyaline degeneration and severe necrosis in myocardial and skeletal muscle (Van Vleet and Ferrans, 1986), leading to death secondary to acute heart failure. The acute form of the disease may have a mortality rate of 95% in affected flocks. In addition to clinical signs, some biochemical parameters, such as creatine kinase (CK), lactate dehydrogenase (LDH) and aspartate aminotransferase (AST) activities, have been used for diagnosis in the lambs with clinical and sub-clinical WMD (Or et al., 2003).

Clinical trials have indicated that serum cardiac troponins (cTns) are the earliest appearing biochemical markers in acute coronary disease of humans and that cardiac troponin-T (cTn-T) and cardiac troponin-I (cTn-I) are valuable biochemical indicators of myocyte degeneration. cTns are released into the blood circulation as a result of acute myocardial degeneration and necrosis (Azzazy and Christenson, 2002). Troponin is one of the major regulatory components of thin filament in the heart muscle. It is located at regular interval along the strands and is a protein complex consisting of three subunits (troponin-I, troponin-T, troponin-C) (Cardinet, 1997). As the sequence of amino acids in these proteins is highly conserved between species (O’Brien et al., 1997), reagents used in human medicine have been validated for use in the cow (Gunes et al., 2008), calf (Gunes et al., 2005; Tunca et al., 2008) and lambs (Tunca et al., 2009). It may therefore be possible to diagnose myocardial degeneration in domestic animals that has resulted from various causes. The aim of this study was to assess the diagnostic value of human cTn-I and cTn-T immunochromatographic strip assays in the detection of cardiac muscle damage in lambs with WMD.

This study was approved by Institutional and Animal care and Ethics Committee of Kafkas University.

The study group consisted of 12 lambs (2–8 weeks old) with suspected acute WMD. The lambs were admitted to the Internal Diseases Clinic at the Faculty of Veterinary Medicine, from flock farms in Kars district between the years 2002 and 2003. A control group of six healthy lambs (4 weeks old) was obtained from the University research farm. Routine physical examination was carried out and blood was collected from the jugular vein into heparinised and plain tubes for cTn analyses. cTn-T was measured in heparinised blood using a rapid cTn-T kit (Tropt Sensitive Rapid Assay, Roche) and cTn-I was tested in serum samples using a semi-quantitative cTn-I kit (Card-I Kit Combo Test, Aboatech), following the manufacturers’ instructions. Lambs that had died from WMD were necropsied by the Department of Pathology. Samples of cardiac and skeletal muscles were collected during necropsy and fixed in 10% buffered formalin. All samples were embedded in paraffin, sectioned at 5 μm thickness and stained with haematoxylin and eosin (H and E).

Anorexia, recumbency, ataxia, stiffness of hind limbs were seen in those lambs admitted to the clinic. Tachycardia, tachypnoea and shallow respiration were also observed, while arrhythmias and murmurs were recorded on auscultation of the heart. The lambs in the control group had no clinical abnormalities. Both cardiac Tn-I and cTn-T were positive (indicated by two purple lines in the test chamber; Fig. 1) in lambs with WMD, while cTn-I and...
cTn-T were negative for the control group (Fig. 2). On macroscopic examination of the heart, chalky white patches and streaks were observed on the epicardial and endocardial surfaces, and on the left and right ventricular walls (Fig. 3). On microscopic examination, hyaline degeneration and necrosis were noted in the sub-endocardial and sub-epicardial regions of the myocardium (Fig. 4).

The cTn-I and cTn-T kits indicated the presence of myocardial degeneration and/or necrosis in lambs with WMD. The use of cTn assays to detect nutritional or other myopathies in small ruminants has been reported previously (Charles et al., 2000; Tunca et al., 2009), with marked increases found in CK and cTn-T levels in sheep with experimentally induced myocardial infarction, with or without reperfusion (Charles et al., 2000). Our results agreed with these findings and, importantly, may explain the positive cTn assay results as circulatory cTn-I and cTn-T levels increased secondary to myocardial degeneration during WMD (Charles et al., 2000; Tunca et al., 2009).

The ability to diagnose myocardial degeneration in farm animals, such as may occur with vitamin E-selenium deficiency or traumatic injury, (Van Vleet and Ferrans, 1986) is important because these animals could then be immediately slaughtered before sudden death occurs. The diagnosis of myocardial degeneration in lambs with WMD previously relied on clinical signs and confirmatory histopathology, whereas the present study demonstrated that cTn kits designed for human use can effectively determine myocardial degeneration in these animals.

In conclusion, practical cTn assays appear to be a sensitive and specific marker for myocardial injury in small ruminants and can be used by veterinarians to confirm cardiac damage. Diagnosis of WMD has previously relied on clinical and microscopic findings of lesions consistent with the disease (Van Vleet and Ferrans, 1986) and the current study has demonstrated that results from the positive cTn kits were consistent with pathological findings.

Conflict of interest statement

None declared.

References


