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Tufail Hussain
Department of Veterinary Medicine Guru Angad Dev Veterinary and Animals Sciences University, Ludhiana, Punjab, India

Ashwani Kumar
Department of Veterinary Medicine Guru Angad Dev Veterinary and Animals Sciences University, Ludhiana, Punjab, India

Baljinder Kumar Bansal
Department of Veterinary Medicine Guru Angad Dev Veterinary and Animals Sciences University, Ludhiana, Punjab, India

Sikh Tejinder Singh
Department of Veterinary Medicine Guru Angad Dev Veterinary and Animals Sciences University, Ludhiana, Punjab, India

Correspondence
Tufail Hussain
Department of Veterinary Medicine Guru Angad Dev Veterinary and Animals Sciences University, Ludhiana-141 004, Punjab, India

Retention time of magnets in reticulo-rumen of cattle and buffaloes for prophylaxis of foreign body syndrome

Tufail Hussain, Ashwani Kumar, Baljinder Kumar Bansal and Sikh Tejinder Singh

Abstract
This study was conducted on two dairy farms during April 2013 to April 2014. A total of 30 healthy adult female bovines were taken up for the study. Fifteen animals were selected from each farm. Reticular magnets were administered orally to each of them using a balling gun and its settlement within the reticulo-rumen was ascertained by ferroscopy. The magnet settled in the reticulum immediately after administration in all but one animal. Ferroscopy revealed that magnet was detectable on left side in 17 animals, right side in 8 animals and on mid-ventrum in 5 animals. Most of the animals had magnet within a distance of 4 inches caudal to xiphoid. All the 30 animals retained the magnet during the study period of one year indicating that a readministration is not required up to a period of 1 year. No complications were observed in any animal after feeding of magnets and no clinical signs of foreign body syndrome were reported. The ferroscopic deflection ranged from 10 to 30 µA, with a mean of 16.47±1.01 µA without showing any significant variation throughout the study period.

Keywords: Magnet, foreign body syndrome, Ferroscope, intercostal space, bovines

1. Introduction
India is largely an agrarian country with more than 50 percent of the population dependent on agriculture. Economy of rural India is solely dependent upon agriculture which has animal husbandry as an integral part. Cattle and buffaloes are an integral part of livestock in subcontinent since thousands of years, producing meat, milk, hides and draft power [1]. Majority of livestock is held by small marginal farmers and organized sector is still poorly developed in India unlike western countries where organized farms are a norm. Hence economic viability of livestock sector is possible only when farmers don't have to spend much on disease management which can be achieved by proper prophylaxis. Among various diseases, foreign body syndrome is one of the most common reasons for attendance of bovines at veterinary hospitals [2]. Foreign body syndrome is caused by ingestion and migration of metallic foreign bodies in reticulum and has been considered an economically important disease of cattle since the mid-1950s [3]. It is still a matter of concern in different veterinary practices all over the world [2] due to severe loss of production, production ability and sometimes death of the animal. Also the importance of this disease is not only due to its higher prevalence [4], but also due to the difficulty in early diagnosis and prognosis by physical examination [5]. Furthermore diagnostic conformation of foreign body syndrome requires relatively expensive and advanced diagnosis facilities like radiography and ultrasonography [6] which are available only at referral units throughout the country. The incidence rates reported by various authors from different parts of country are relatively variable ranging between 23% [7] to 87% [8]. An increasing trend is being seen in its incidence which could be attributed to both animal and human factors such as indiscriminate feeding habits of bovines, bad nutritional management, heavy industrialization, human habitations and mechanization of agriculture [9, 10]. Devastating economic losses due to striking reduction in milk and meat production, treatment costs, potential fatalities and fetal losses in affected pregnant animals [6] drive researchers to go deep investigating the different aspects of this syndrome.
For prevention of foreign body syndrome in bovines administration of a cylindrical magnet orally at age of one year is recommended [11].

Like any other foreign body, after administration most magnet drops into the rumen then move to the desired location in the reticulum following ruminoreticular contractions [11]. Although this method of prophylaxis is popular in most veterinary practices all over world, little is known about the time period for which magnet is retained in reticulum. Therefore this study was designed to find the retention time of reticular magnets in bovines for its prophylactic and therapeutic use.

2. Material and methods

2.1 Selection of animals

A total of 30 healthy adult female bovines including 6 buffaloes and 24 cattle were taken up for the study. The study was conducted in two dairy farms viz., GADVASU dairy farm and a private enterprise (Hara dairy farm), Ludhiana between April 2013 to April 2014. Fifteen animals were selected from each farm. Among animals selected from GADVASU dairy farm six were buffaloes and 9 cattle. All the animals selected from private enterprise were cattle. Neither of them had a foreign body in reticulum which was ascertained by ferroscope (Ferroskop 3 - H. Haupner und Richard Herberholz GmbH - Solingen - Germany) (Fig. 1).

Fig 1: Ferroscope

2.2 Magnet administration and its settlement in the reticulo-rumen

The selected animals were restrained in trevis and a reticular magnet (Fig. 2) with rounded edges (7cm in length and 1 cm diameter) was administered orally to each of them using a balling gun. Animals were closely monitored for 2 hours to check for regurgitation of magnet. The settlement of the magnet within the reticulo-rumen was ascertained with ferroscope. Ferroscopy was done by placing the probe of the instrument against left as well as right sides of body wall from 5th to 8th intercostal space and on mid ventrum 4 inches cranial and caudal to 6th intercostal space. The location of magnet within the reticulum was indicated by maximum deflection on ammeter of ferroscope and relative position was determined by estimating its distance from 6th intercostal space on longitudinal and lateral axes. For long-term retention ferroscopy was done for a period of one year at three months interval. The faeces of the animals were closely examined for two days for the presence of magnet.

Fig 2: Reticular magnet

3 Results and Discussion

The results are summarized in Table-1 and Table-2. The age of animals studied ranged between 2-7 years. Twenty four out of 30 animals were non pregnant while remaining six animals were non-pregnant. The administered magnet settled in the reticulum immediately after administration in all but one animal, in which it was first detectable over the left flank indicating its presence in rumen and was subsequently in reticulum within 10 minutes of administration. Regurgitation after settlement of magnet in reticulum was observed in one animal, which was readministered on subsequent day without any complications. Schneider [12] also observed that magnet settled in reticulum immediately and was retained by 96% of animals after oral administration. Braun *et. al.*, [13] also observed that 85% cows retained administered magnet in the reticulum, 10% cows had magnet in cranial aspect of the dorsal sac of the rumen and in remaining 5% cows, magnet wasn't detectable on radiography. Faeces of all the animals were closely examined for two days after the administration of magnet, and it was found that none of the animals passed it along with faeces. So, it can be inferred that administered magnet is less likely to pass along with faeces.

Ferroscopy revealed that magnet was detectable on left side in 17 animals, right side in 8 animals and on mid-ventrum in 5 animals. Distribution on longitudinal axis revealed that magnet was present 2, 4 and 6 inches caudal to 6th intercostal space in 11, 15 and 4 animals respectively indicating their presence in reticulum. On subsequent examination with ferroscope at 3, 6 9 and 12 months, magnet was detectable invariably on the left side. No complications were observed in any animal after feeding of magnets and no clinical signs of foreign body syndrome were reported.

Table 1: Position of magnet in the reticulo-rumen as detected by ferroscope

	Caudal to xiphoid						**On xiphoid (5)**	
Side	**Right (8)**			**Left(17)**				
Distance (inches)	2"	4"	>6"	2"	4"	>6"	2"	4"
No of animals	5	2	1	3	11	3	3	2

The ferroscopic deflection of these 30 animals ranged from 10 to 30 µA, with a mean of 16.47±1.01 µA (Table 3). All the 30 animals retained the magnet during the study period of one year, as observed by ferroscopy at an interval of three months. The minimum, maximum and mean ferroscopic deflections obtained on first day and subsequent examination are presented in Table 2. Analysis of variance revealed that with the passage of time, there was no significant difference in

ferroscopic readings. Although there was no statistical difference in ferroscopic readings of different time periods, it is worth mentioning that in most of the animals there was no definite pattern for the readings.

Table 2: Ferroscopic deflection on various days of experiment in cattle and buffalo

Time of ferroscopy	Mean ± SE (µA)	Minimum (µA)	Maximum (µA)
First day	16.47±1.01[a]	10	30
3 months	15.97±0.91[a]	9	27
6 months	16.07±0.77[a]	11	26
9 months	16.17±.92[a]	9	28
12 months	15.47±1.2[a]	8	30

Values with similar superscripts do not differ significantly ($P<0.05$)

Also as all the animals retained the magnet in reticulum during the study period it can be recommended that a readministration is not required up to a period of 1 year. Similarly Radostits *et. al.,* [6] reported that when small, cylindrical and bar magnets with rounded ends are given orally to normal healthy animals the magnets locate in the reticulum within a few days and settle there. There is paucity of literature on the duration of retention time of magnet in reticulorumen of cattle and buffalo. One recent study by Al-Abbadi *et. al.,* [14] on magnet usage to prevent hardware disease in buffaloes recommended that administration of a new rumen magnet every 4 years is necessary to permanently prevent hardware disease in buffaloes at high risk. However, the occurrence of a hardware disease in buffaloes with a rumen magnet was not due to loss of magnetic power but to complete filling of cage magnet with foreign bodies thereby obscuring the magnetic power.

Radostits *et al.* [6] mentioned that extensive prophylactic use of magnets in dairy animals has reduced the incidence of foreign body syndrome and its complications by 90-98%. Another study by Carroll [3] on control of traumatic gastritis in cattle by use of magnets reported that 57% (33 out of 58) of the control heifers required rumenotomies for foreign bodies in the first 6 months of study period while only 5% (2 out of 42) of heifers with magnets required rumenotomies for the same cause. Carroll [3] also reported that in one test heifer rumenotomy was done after 6 months for evaluating the efficacy of magnet in holding metallic foreign bodies and it was found that no foreign bodies other than those attached to magnet was present in the reticulum.

4. Conclusion

Foreign body syndrome, one of the most common disorders of cattle and buffalo can be prevented by reticular magnets which are effectively retained by the animal in reticulum for at least one year. Hence readministration isn't needed at least for 1 year. No complication was seen in any of the animals fed magnets and hence is a safe device for prophylaxis. Also it is less likely that the animal will pass the administered magnet along with faeces.

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