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Deafness evaluation and brainstem auditory evoked response (BAER) testing in dogs

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Abstract
BAER assessment and deafness evaluation were conducted in dogs presented for medical care during a 12 month period from November 2016 to November 2017. In this study a total of 12 dogs were evaluated for deafness and brainstem auditory evoked response (BAER) testing using a modern computerized BAER system. Apparently healthy dogs were selected and grouped in to two groups, each of which consisted of six dogs (group I and group II). The mean latency for I, II, III, IV and waves V were 1.78±17, 2.74±0.10, 3.70±0.19, 4.69±0.11, and 5.75±0.15 ms in group I, and 1.79±0.17, 2.79±0.18, 3.62±0.18, 4.77±0.14, and 5.69±0.17 ms in group II, respectively. The mean inter peak latencies for the I-III, III-V and I-V intervals were 1.91±0.27, 2.04±0.35, and 3.99±0.22 ms in group I and 1.89±0.20, 2.01±0.26, and 3.87±0.24 ms in group II, respectively. On BAER analysis all the dogs were found to be healthy and free from deafness.

Keywords: BAER, latency, inter peak latencies, disc electrode, dogs

1. Introduction
Deafness evaluation is important for dogs and puppies that are to be deployed as detective dogs and sniffer dogs by security agencies [1]. It is equally important for breeding purposes, as it helps to identify and exclude deaf animals from specific breeding programmes [2]. Many times the deafness is associated with genetic background and such animals may have other genetic abnormalities too. Hence such affected animals are generally not included in selective breeding programmes. The brainstem auditory evoked response (BAER) is one of the proven useful auditory function testing method in both humans and as well as animals and is also useful for evaluating hearing and to detect inner ear, 8th cranial nerve, or brainstem lesions [3, 4]. The brainstem auditory evoked response (BAER) is a recording of the electrical activity of brain that travels along the auditory pathways in response to application of specified external stimulus [5]. BAER is simple, noninvasive, widely available, easy to perform, safe and cost effective method [3, 6]. Congenital hereditary deafness is a common problem occurring in around 80 breeds of dogs [7]. The use of BAER to diagnose congenital sensorineural deafness has been extensively studied in dogs over the past thirty years [8]. High prevalence of congenital deafness observed dog breeds includes Australian Cattle Dog, Australian Shepherd, Bull Terrier, Catahoula, Dalmatian, English Cocker Spaniel, English Setter and West Highland White Terrier [9]. This present paper describes about the normative study of BAER in dogs, which were initially presented with suspicious for reduced response to owners call and were proved normal on clinical examination.

2. Materials and Methods
2.1 Study population
The present study was conducted at the Canine Cognition Lab of Department of Veterinary Medicine, Veterinary College and Research Institute, Orathanadu, Thanjavur over a period of one year during November 2016 to November 2017. The study comprised of clinical assessments, deafness evaluation and BAER Testing in dogs, which were presented with complaints of reduced response to owners call. A total of 12 dogs were included in this study of brainstem auditory evoked response (BAER). Dogs were grouped in to healthy and diseased. Six dogs were apparently healthy (group I) and another six dogs were brought for some other medical investigations (without ear impairment) assigned to group II. None of the dogs were sedated or anaesthetized for this study.

2.2 Deafness evaluation
Hearing evaluation in the dogs of this study was assessed by behavioral responses to external stimuli and history of the owner. Though behavior response based assessment of hearing can indicate to some extent, it is not a very effective method for identification of deafness in canines, because it may respond the visual, vibrotactile or olfactory senses. Besides these the behavioral tests does not evaluate each ear separately. For this purpose the brainstem auditory evoked response (BAER) testing, which is being used as one of the effective testing method in both humans and animals, was used in this study.

2.3 BAER measurement
For BAER measurement each un-anaesthetized dog was positioned in the sternal recumbency and three non invasive electrodes were placed. The recording electrodes were placed in respective place ground- mastoid; reference- fore head; active: contra lateral mastoid and earphone positioned over the dogs ear (Fig.1). For BAER recording were done by using a standard computerized electro diagnostic machine (RMS Salus 4C, Electromyography). The ear canals were examined and cleaned in order to deliver the stimulus correctly. The broad band frequencies were set at 100 Hz and 3 Khz, the sensitivity was set to 0.5µV/cm and the analysis time to 30ms/cm. The headphone was positioned manually over the external auditory meatus of the dog. Rarefaction clicks were applied at 10 Hz, recording was made at 85 dB intensity. Contralateral ear noise masking done by using 40 dB. An average recording of 1000 sweeps for each ear of each dog was recorded and was stored for later measurement and analysis. In each test, the absolute latencies of waves I, II, III, IV and V, and the I-III, III-V and I-V intervals for each side were measured. The mean and standard deviation of various latencies were evaluated.

3. Result and Discussion
BAER is the most commonly practiced electro diagnostic testing for assessment of deafness in dogs [3]. In the present study of 12 dogs, which were divided in to two groups and each group consisted of six dogs. All the dogs were subjected to recording of parameters with digital BAER system. The mean latency for I, II, III, IV and waves V were 1.78 (±17), 2.74 (±0.10), 3.70 (±0.19), 4.69 (±0.11), and 5.75 (±0.15) ms in group I, and 1.79 (±0.17), 2.79 (±0.18), 3.62 (±0.18), 4.77 (±0.14), and 5.69 (±0.17) ms in group II, respectively. The mean inter peak latencies for the I-III, III-V and I-V intervals were 1.91 (±0.27), 2.04 (±0.35), and 3.99 (±0.22) ms in group I and 1.89 (±0.20), 2.01 (±0.26), and 3.87 (±0.24) ms in group II, respectively. Mean and standard deviation values of wave latencies and inter peak latencies are depicted in Table 1. In the current assessment of BAER results, all the dogs were found to be free from deafness. The observed mean latencies were in concurrence with the previous report of Kemper *et al*.[1].In a Brazilian normative study on BAER conducted by Palumbo *et al*.[8], they reported that out of 40 boxer dogs examined, 3 dogs were found deaf (1 unilateral deafness and 2 bilateral deafness). Another study conducted by Palumbo *et al*. [10], revealed 16.7% unilateral deafness and 3.3% bilateral deafness in Dalmation dogs. The prevalence of deafness in different breeds of dog reported by different researchers are Dalmation (21.8% unilateral and 8.0% bilateral), Bull terrier (10.3% unilateral and 0.8% bilateral), Australian cattle dogs (12.2% unilateral and 2.4% bilateral) [7], English Setters (12.7% unilateral and 2.4 bilateral) and English Cocker Spaniels (7% unilateral and 1.8% bilateral) [9] and Border Collies (2.3% unilateral and 0.5% bilateral) [11]. Plonek *et al*. [12] reported unilateral and bilateral deafness in various breeds dogs Bull Terriers (14.5%), Australian Cattle Dogs (4.8%), English Setters (21.9%), and Dogos Argentinos (37.5%).
These BAER parameters of healthy dogs will serve as base line reference values for further studies. BAER is the best electromagnetic testing protocol for assessment of dogs for hearing impairments and BAER can be very effectively utilized in selection of deafness free animals for dog breeding purposes. Deafness free dogs are essential for security, detective and military works. So, the evaluation of such dogs is essential for part of their selection, medical care and routine assessments.

Table 1: Mean and standard deviation values of wave latencies and inter peak latencies (ms) in group I and group II

Groups	Wave I latency	Wave II latency	Wave III latency	Wave IV latency	Wave V latency	Wave I-III latency interval	Wave I-V latency interval	Wave III-V latency interval
Group I	1.78±17	2.74±0.10	3.70±0.19	4.69±0.11	5.75±0.15	1.91±0.27	3.99±0.22	2.04±0.35
Group II	1.79±0.17	2.79±0.18	3.62±0.18	4.77±0.14	5.69±0.17	1.89±0.20	3.87±0.24	2.01±0.26

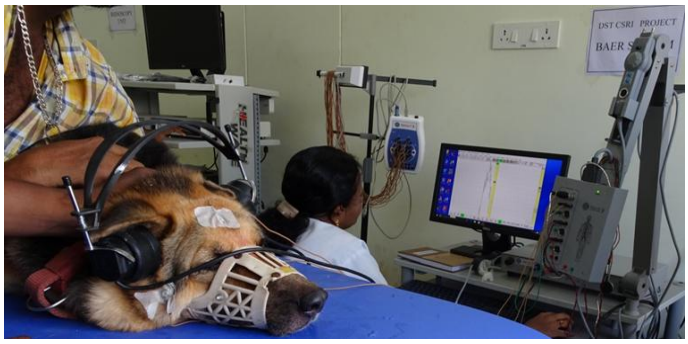

Fig 1: BAER Examination in a Dog

4. Conclusion
In the current study all the 12 dogs assessed were found to be deaf free. The mean latency for I, II, III, IV and waves V observed in healthy dogs were 1.78 (±17), 2.74 (±0.10), 3.70 (±0.19), 4.69 (±0.11), and 5.75 (±0.15) ms in group I, and that of other dogs presented for medical illness were 1.79 (±0.17), 2.79 (±0.18), 3.62 (±0.18), 4.77 (±0.14), and 5.69 (±0.17) ms in group II. These values can serve as base line reference values for future studies.

5. Acknowledgement
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