

MITRAL VALVE E POINT TO VENTRICULAR SEPTAL SEPARATION IN THE DOG

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ABSTRACT

Mitral valve E point to septal separation (EPSS) was measured ($\bar{x}=3,27 \pm 1,29\text{mm}$) in healthy non-anaesthetised Beagle and German Shepherd dogs ($n=50$). The minimum and maximum values recorded were 1 and 6mm respectively. Breed, age, sex, mass and heart-rate had no significant effect on the EPSS value.

Key words: Mitral E point septal separation, dog, M-mode echocardiography

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INTRODUCTION

Originally M-mode echocardiography was the only echocardiographic technique available for studying cardiac pathology. During the last decade, however, two-dimensional (2-D) and Doppler echocardiography have been developed. These are now used routinely together with M-mode echocardiography. The latter still remains the most accurate method of anatomical cardiac mensuration as well as determining subtle changes of valvular or wall motion⁷. The mitral apparatus and inter-ventricular septum can readily be displayed by means of 2-D echocardiography using described techniques^{1,7}. By using M-mode echocardiography the phasic motions of these structures can be displayed over time at a specific anatomical location within the heart (Fig. 1). The various openings and closings of the anterior mitral leaflet are labelled (Fig. 2). The end of systole, immediately prior to the opening of the valve, is point D. Initial rapid diastolic inflow through the mitral valve results in peak opening of the anterior leaflet at point E. The nadir of mid-diastolic closing is F. This is followed by atrial

contraction with a second peak flow at A. The valve begins to close with atrial relaxation and complete closure occurs at the start of ventricular systole at C⁷. Echocardiographic measurement of the minimum separation between the anterior mitral leaflet E point and the left ventricular septal surface is known as the E point to septal separation (EPSS). This is a useful, practical and easily reproducible clinical index of left ventricular inflow of blood and consequently left ventricular function⁴. The major virtue of EPSS as a clinical measurement is its simplicity¹⁰.

This study was designed to determine EPSS values in the normal dog. Factors which influence EPSS during cardiac

disease will be discussed briefly.

MATERIALS AND METHODS

Beagles ($n=21$) and German Shepherd dogs (GSD) ($n=29$) of both sexes were used (Table 1). They were divided into 10 groups according to age and breed. The dogs were housed under similar conditions and were routinely vaccinated and dewormed. Dogs were allocated into 5 age groups according to availability, attempting to have equal numbers of sexes, breeds and dogs of different litters in each group. No dog was evaluated more than once. All dogs underwent a clinical examination, lead II electrocardiogram, clinical-pathological evaluation¹⁴ [red blood cell count, haematocrit, haemoglobin, white blood cell count, thrombocyte count, total plasma proteins (measured by refractometer)] and a 2-D echocardiographic examination². The results of these examinations were all found to be within normal range.

The dogs were manually restrained in right lateral recumbency and scanned from below using a specially constructed table¹⁵. The right parasternal long axis view was used to take all measurements. A real time, multipurpose, linear and sector scanning, diagnostic ultrasound unit was used (Aloka SSD 630, Aloka Co., Japan). A 7,5 MHz electronic convex sector probe with dynamic frequency scanning or a 3 MHz cardiac mechanical sector probe was used. The choice of probe depended on the size of

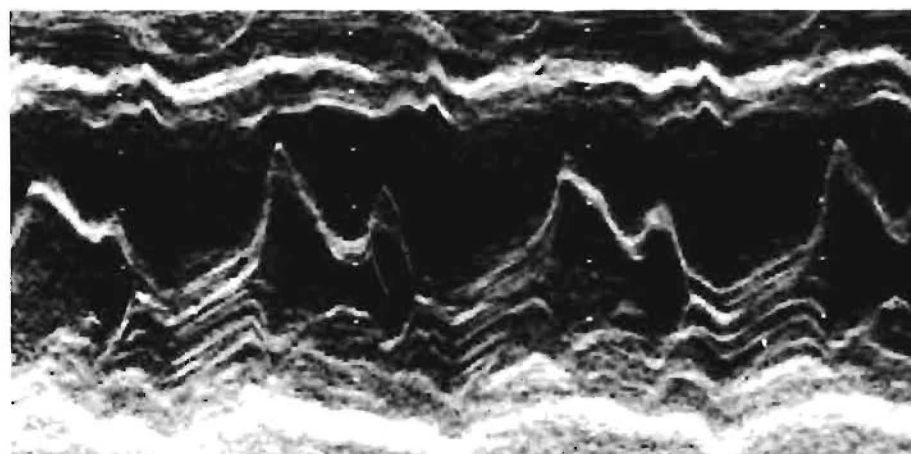


Fig 1: M-mode echocardiogram of normal motion of the anterior mitral valve leaflet

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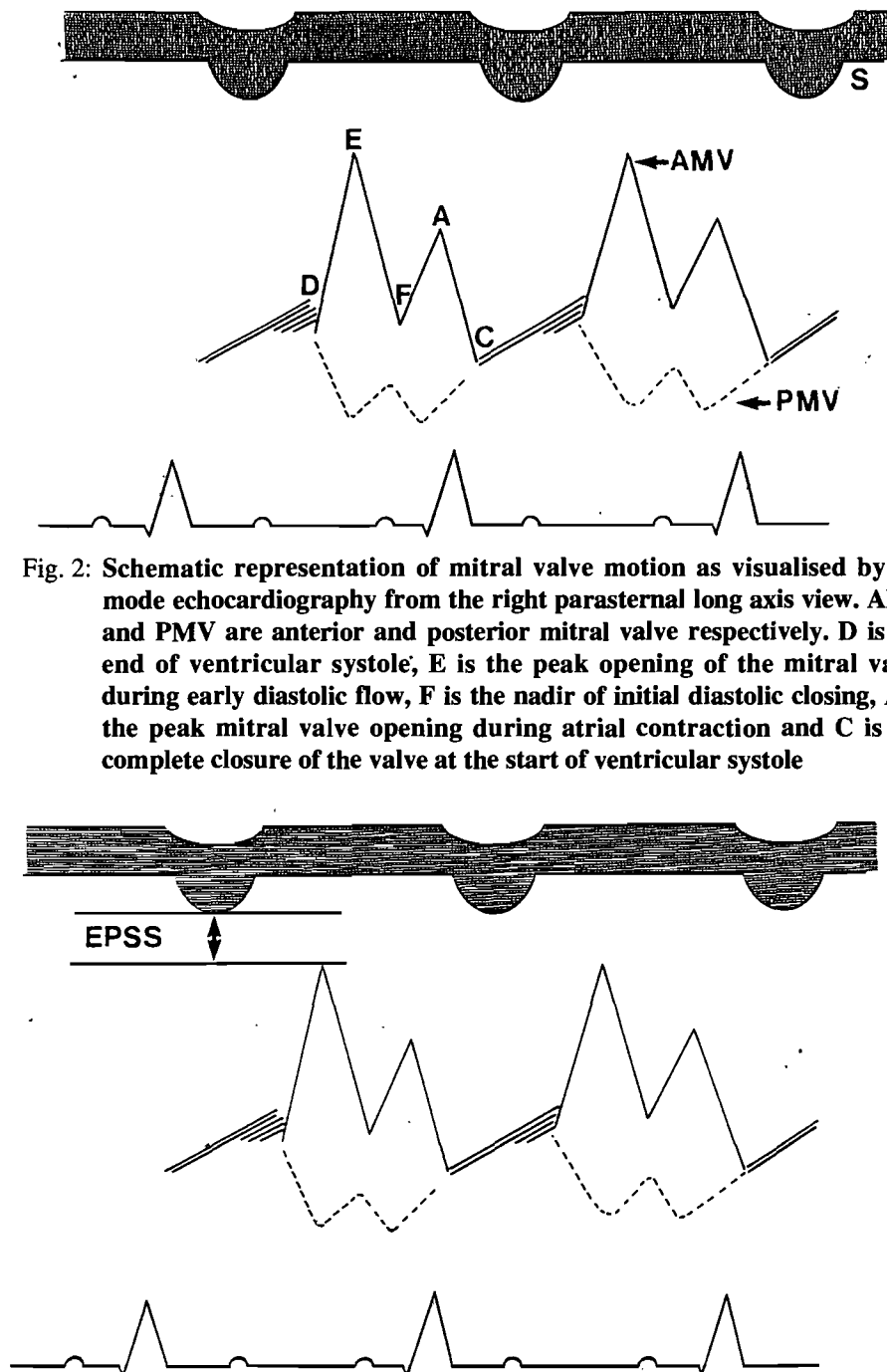


Fig. 2: Schematic representation of mitral valve motion as visualised by M-mode echocardiography from the right parasternal long axis view. AMV and PMV are anterior and posterior mitral valve respectively. D is the end of ventricular systole; E is the peak opening of the mitral valve during early diastolic flow, F is the nadir of initial diastolic closing, A is the peak mitral valve opening during atrial contraction and C is the complete closure of the valve at the start of ventricular systole

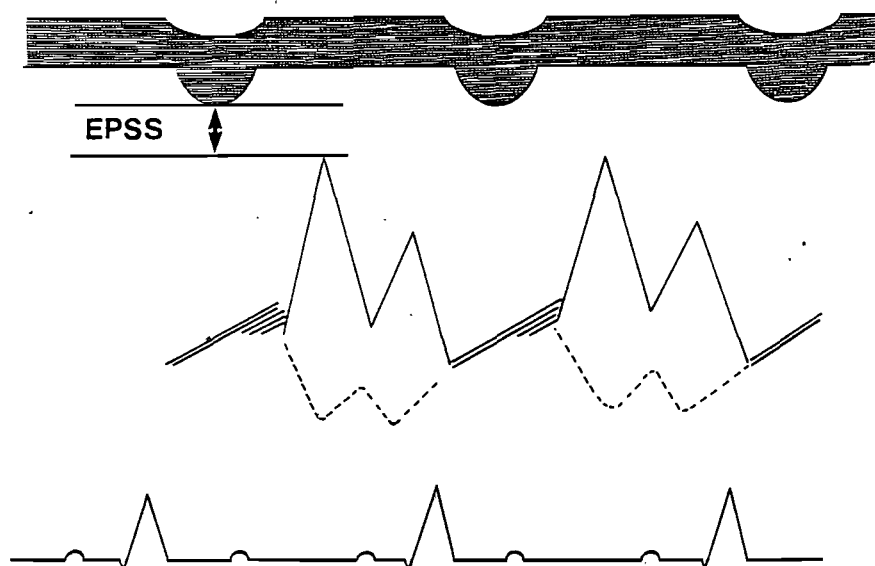


Fig. 3 Schematic representation of the measurement of EPSS

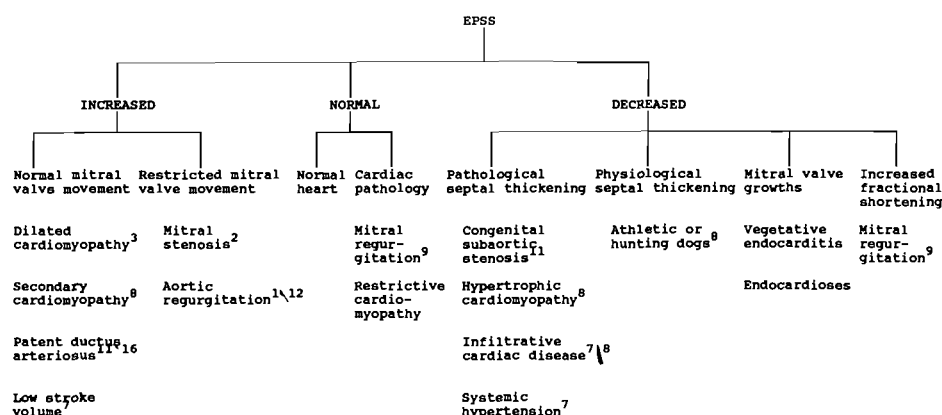


Fig. 4: Flow diagram of some possible conditions that may alter EPSS in dogs

the patient. Paper speed was set at 150 cm per min.

EPSS was measured by taking the perpendicular distance between the E point and a tangent drawn to the most posterior point reached by the interventricular septum within the same cycle¹⁰ (Fig. 3). Heart rate was determined simultaneously from a lead II electrocardiogram. An alternative method, which measures the distance from the E point to the septum directly opposite to it, has been described but was not evaluated⁵.

The influence of the following was investigated by undertaking an analysis of variance (ANOVA)¹³:

- Breed, age, and sex as main factors. The ages were grouped into dogs ≤ 22 weeks, dogs 32-43 weeks and dogs ≥ 97 weeks old.
- Heart-rate and individual body mass as co-variants.
- Interactions of breed with sex, breed with age, sex with age and mass with age. Age was grouped as above. Mass was taken as 3 groups; dogs < 10 kg, dogs 10-25 kg and dogs > 25 kg.

This study was approved by the ethical committee of the Veterinary Faculty of the University of Pretoria

RESULTS

Measurements were obtained in 49 dogs. One measurement could not be obtained due to the presence of particularly thick chordae tendinae. The mean EPSS value was 3,27 mm with a standard deviation of 1,29. The minimum and maximum values recorded were 1 and 6 mm respectively. The EPSS values for the various subgroupings are given in Table 2.

Breed, age, sex, mass, heart-rate and interactions of breed with sex, breed with age, sex with age as well as mass with age had no significant effect on the EPSS value ($P < 0,05$). P values are recorded in Table 3.

DISCUSSION

Increasing age and increasing mass as indicated by mass groupings, males versus females or the larger breed tended to result in increasing EPSS values (Table 2). There was however, no statistical significant difference between the various groupings, although mass did have the lowest P value (0,3102).

In patients with cardiac pathology, EPSS may be increased, normal or decreased. The latter may be a negative value as the E point and the most posterior movement of the septum do not necessarily occur at the same time⁷. In man, normal EPSS values are thought to be less than 5 mm and it has been found to be a reliable indicator of left ventricular function⁷. EPSS has a strong negative correlation to ejection fraction, providing aortic regurgitation and mitral

Table 1: Subgroupings of experimental dogs from which E point to septal separation was determined

Group	Breed	Age weeks	Sex	Mass kg
1	Beagle	8-9	2m;3f	3,6-3,95
2	GSD*	10	2m;3f	7,0-10,0
3	Beagle	22	2m;2f	7,5-9,80
4	GSD	22	3m;3f	12,5-18,1
5	Beagle	32-34	2m;3f	6,3-11,8
6	GSD	34	2m;3f	21,5-26,0
7	Beagle	43	2m;0f	15,4-15,7
8	GSD	43	5m;3f	20,4-32,0
9	Beagle	116-121	1m;4f	10,2-14,2
10	GSD	97-112	2m;3f	20,9-29,3

*German Shepherd dog

Table 2: Mean EPSS values of Beagle and German Shepherd dogs of different sexes, ages and body masses

Subgroup	Mean EPSS value	Number of dogs
Females	3,19	26
Males	3,35	23
Beagle	2,86	21
German Shepherd dogs	3,57	28
<u>Mass</u>		
<10 kg	2,50	16
10-25 kg	3,42	26
>25 kg	4,57	7
<u>Age group</u>		
≤22 weeks	2,55	20
32-43	3,74	19
≥97 weeks	3,80	10

Table 3: P values of main factors, co-variants and interactions influencing EPSS values in normal dogs

Breed	0,8425
Sex	0,6978
Mass	0,3102
Age group	0,9818
Heart-rate	0,9411
Breed * sex	0,8578
Breed * age group	0,7798
Sex * age group	0,9005

stenosis are absent^{5 10}. This valid predictor of ejection fraction was found to be independent of left ventricular size⁴. EPSS is, however, only a qualitative and not a quantitative indicator of left ventricular function⁴. The above findings also apply to children and EPSS is used in pediatric echocardiography to assess left ventricular function⁶.

In dogs, a variety of conditions may influence EPSS and ventricular function (Fig. 4). An increased EPSS value can occur with a dilated left ventricular chamber due to volume overload, or as result of a reduced fractional shortening. A decreased mitral valve excursion will also result in an increased EPSS value.

Decreased EPSS values may occur as result of a thickening of the septum or of the anterior mitral valve leaflet. It must be emphasised that a normal EPSS value may also occur in the presence of severe cardiac disease.

EPSS is a simply determined cardiac measurement, which, if altered, should alert the examiner to the possibility of a cardiac problem. This is particularly the case where the examiner does not routinely do echocardiography and is not familiar with other signs of cardiac disease that can be visualised by echocardiography. EPSS can guide the clinician in the right direction and, with the use of the other echocardiographic means available, a definite diagnosis can be made.

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