

～復習できる wet lab～
**MMVD症例での
 心エコー検査の精度を高める**

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1.LVIDDn

2.LA/Ao

3.E velocity

4.VTI-Ao

Journal of Veterinary Internal Medicine

ACVIM

Standard Article

Effect of Pimobendan in Dogs with Preclinical Myxomatous Mitral Valve Disease and Cardiomegaly: The EPIC Study—A Randomized Clinical Trial

■ 心拡大のあるMR犬

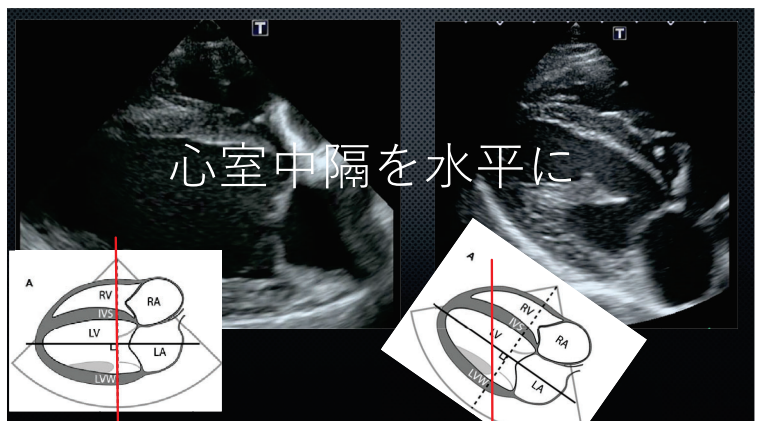
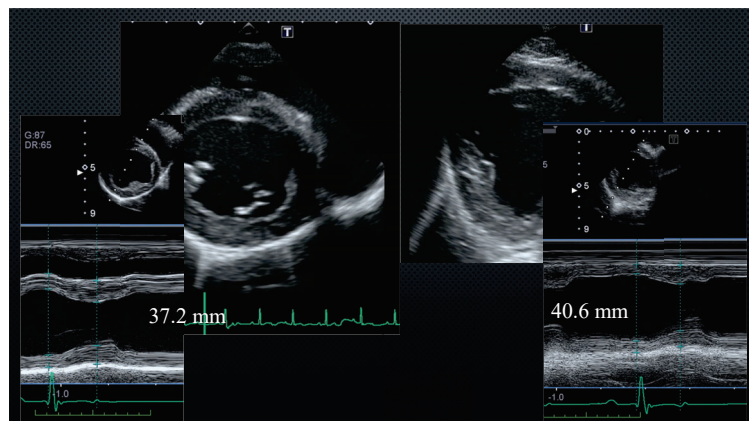
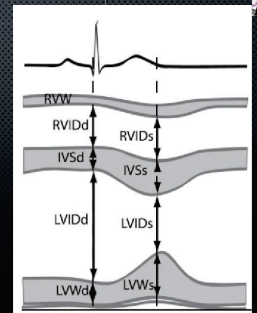
✓ LA/Ao>1.6

✓LVIDDN>1.7

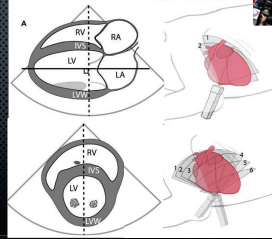
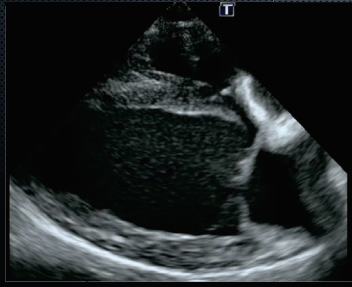
標準化左室拡張末期径

LVIDD：左室拡張末期径

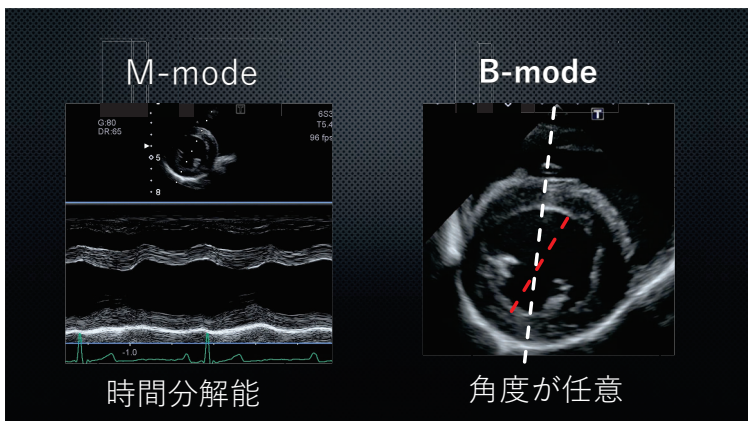
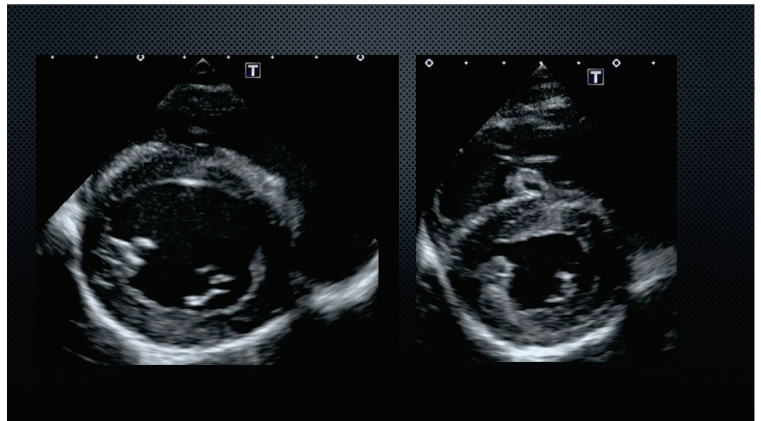
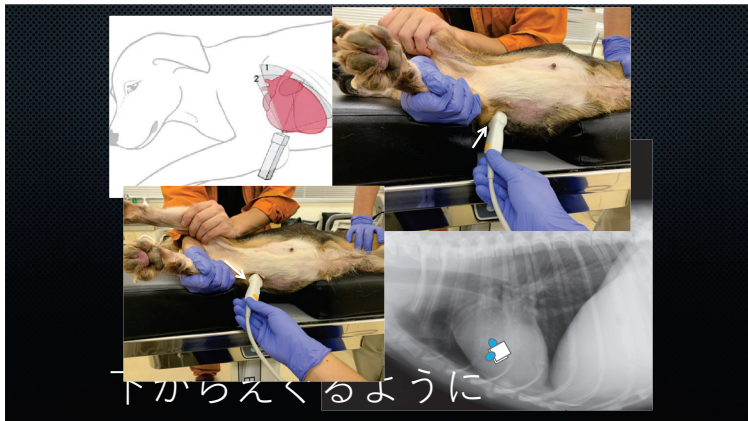
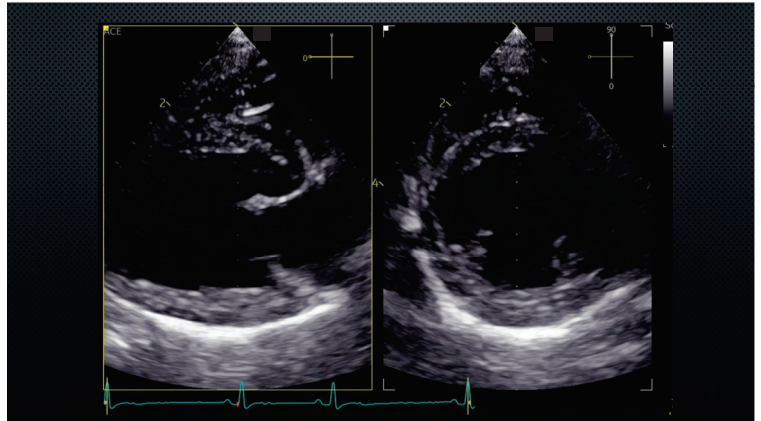
拡張末期：QRS開始点



長軸からの短軸



右側短軸断面腱索レベル
左右（前後）対称



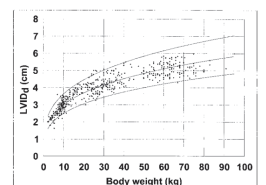
標準化左室拡張末期径

$$\text{Normalized LVIDd} = \text{LVIDd} / \text{BW}^{0.294}$$

J Vet Intern Med 2004;28:1011-1021

Allometric Scaling of M-Mode Cardiac Measurements in Normal Adult Dogs

Craig C. Cornell, Mark D. Kittleson, Paul Della Torre, Jon Haggstrom, Christophe W. Lombard, Henrich D. Pedersen, Andrea Vollmar, and Aaron Wey

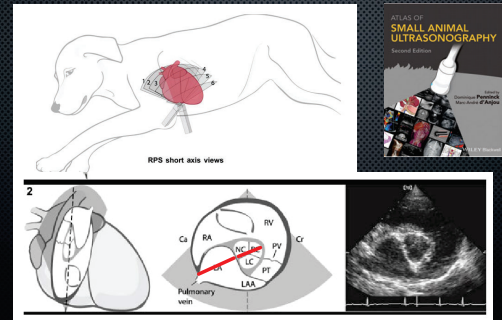


Measurement	97.5 Percentile	95 Percentile	75 Percentile	50 Percentile	25 Percentile	5 Percentile	2.5 Percentile	Exponent
LVID _d	1.85	1.73	1.63	1.53	1.43	1.35	1.27	0.294

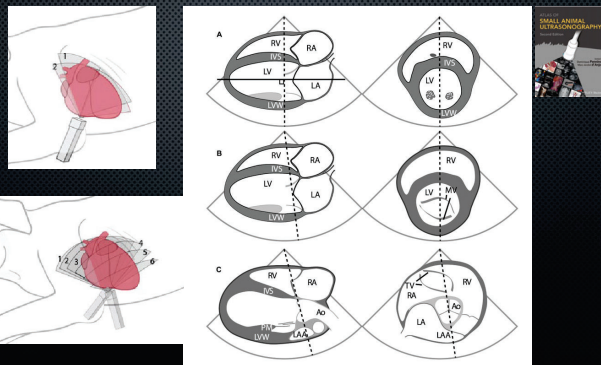
■ 心拡大のあるMR犬

✓ LA/Ao > 1.6

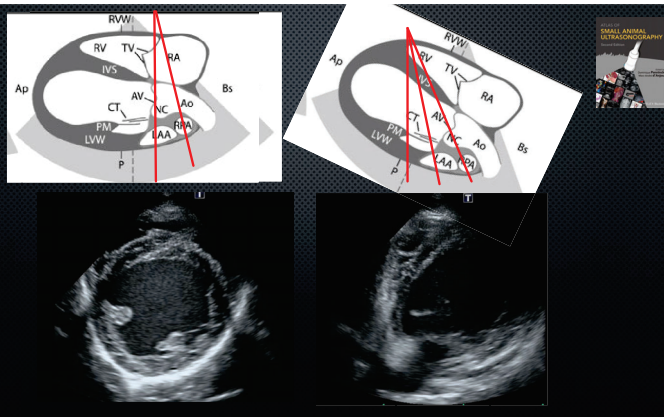
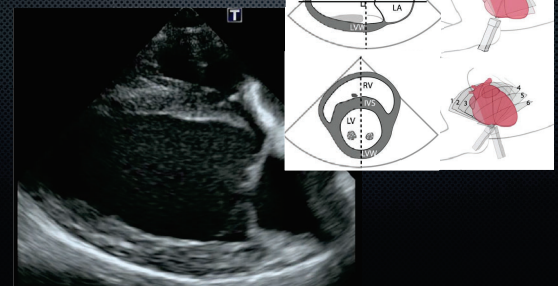
✓ LVIDD > 1.7



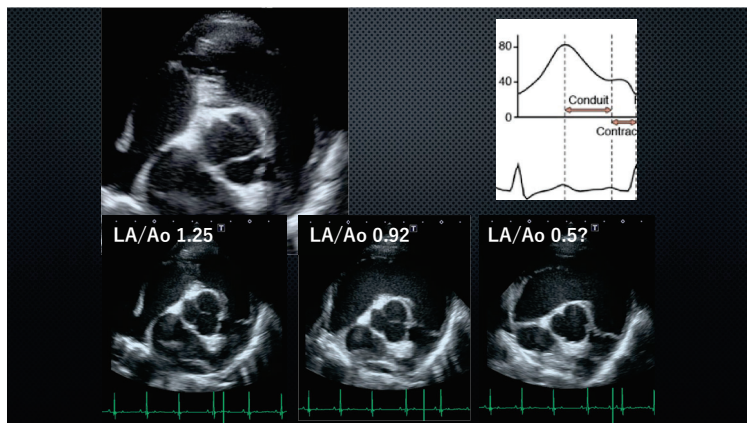
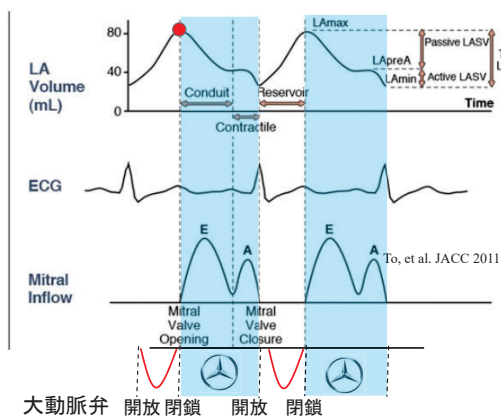
右側傍胸骨短軸断面大動脈レベル



長軸から短軸



いつ測ってます??



LA/Ao=
Left atrium to
Aorta?

LEFT ATRIAL TO AORTIC ROOT INDICES USING TWO-DIMENSIONAL AND M-MODE ECHOCARDIOGRAPHY IN CAVALIER KING CHARLES SPANIELS WITH AND WITHOUT LEFT ATRIAL ENLARGEMENT

KERSTIN HANSSON, DVM, JENS HAGSTRÖM, DVM, PhD, CLARENCE KVART, DVM, PhD, PETER LORD, BVSc, FRCVS

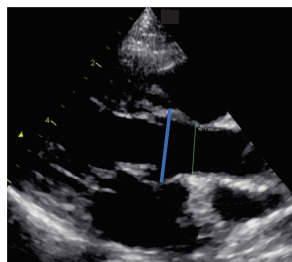
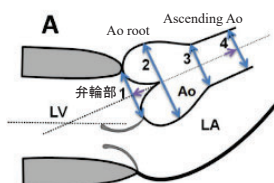
Two-dimensional (2-D) echocardiographic measurement of the left atrium (LA) has the potential to be more accurate than the standard M-mode method, because the LA body can be measured. We evaluated a 2-D method for measuring LA and aorta (AO) in a right parasternal short-axis view and compared it to the M-mode method. An index for LA size (LA/AO) was calculated in 166 cavalier King Charles spaniels, 56 normal and 110 dogs with mitral regurgitation (MR) of varying degrees secondary to chronic valvular disease. In normal dogs, the AO-2-D and LA/AO-2-D did not correlate to body weight (BW) or BW²; whereas, all M-mode values and the LA-2-D were significantly ($p < .05$) related to both BW parameters. In normal dogs, there was no difference between M-mode and 2-D indices. For all dogs (normal and dogs with MR) there was an 11% bias between the M-mode and 2-D index with the LA/AO-2-D being higher than the LA/AO-M. The association between the mean and the difference of the indices demonstrated a quadratic relationship. Dogs with a mean LA/AO of 2.0-2.5 showed the largest difference between the two indices. Small values for the 2-D coefficients of variation for respiration and stage of diastole were found; 3.4 and 3.1%, respectively. The 2-D index is more sensitive to LA enlargement than the M-mode index. *Veterinary Radiology & Ultrasound*, Vol. 43, No. 6, 2002, pp 568-575.

Aortic Root

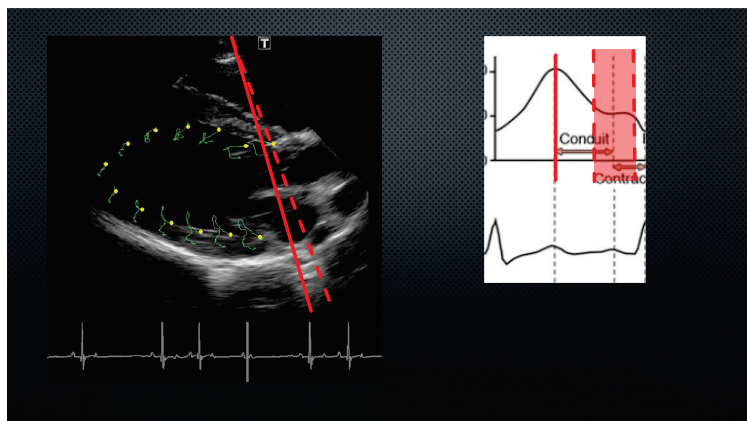
GUIDELINES AND STANDARDS

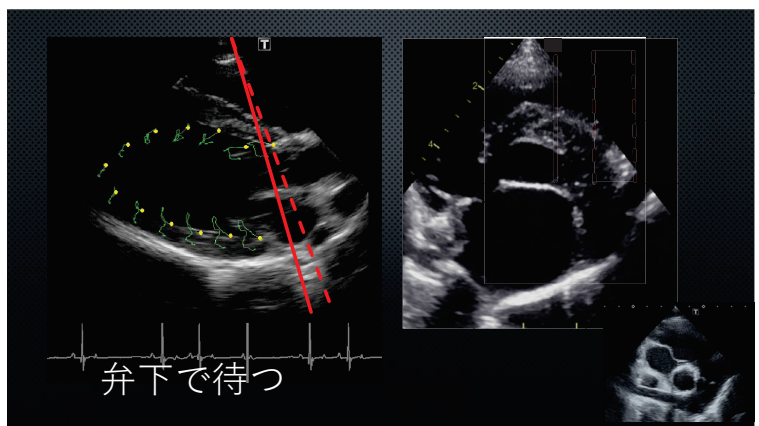
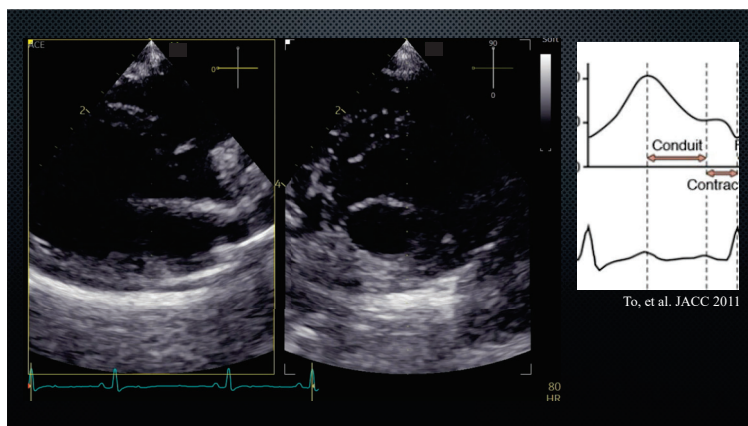
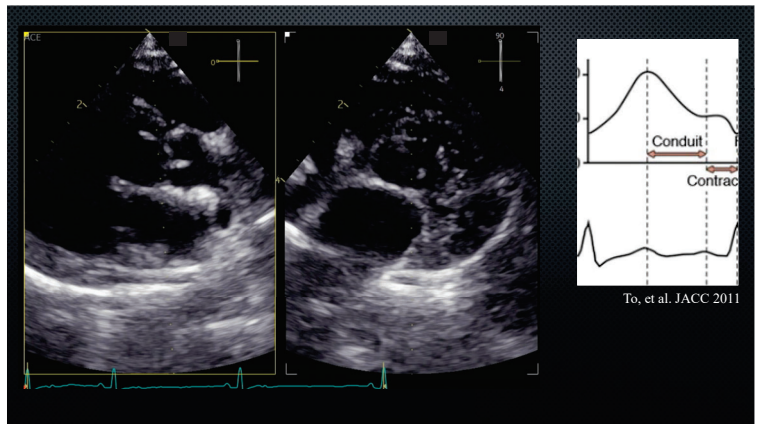
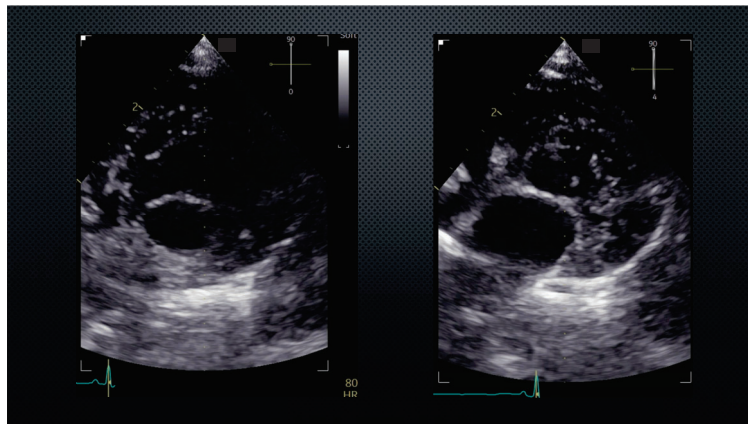
Recommendations for Cardiac Chamber Quantification by Echocardiography in Adults: An Update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging

Journal of the American Society of Echocardiography January 2011

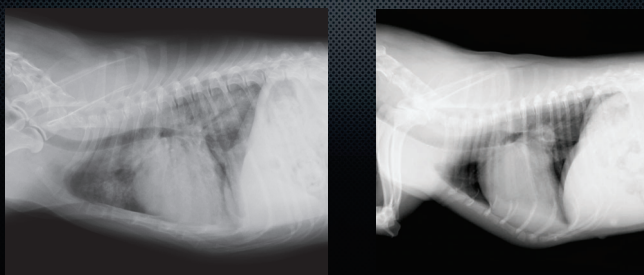


Ao root/Ao = 1.4





Stage C うっ血性心不全（心原性肺水腫）



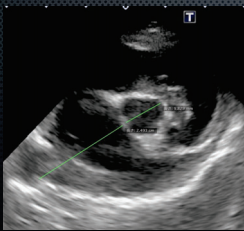
Forrester分類

高	正常	うっ血 CHF
低	低灌流 LOS	CHF & LOS
	肺動脈楔入圧 (≡左室拡張末期圧≡左房圧)	
	低	高

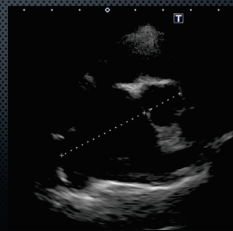
前方不全
(心拍出量 $< 2.2 \text{ L/min/m}^2$)

後方不全
うっ血性心不全CHF
(左房圧 $> 18 \text{ mmHg}$)

どっちがCHF？



LA/Ao 2.55

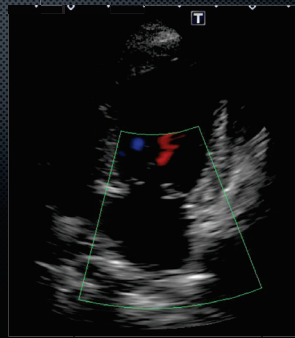
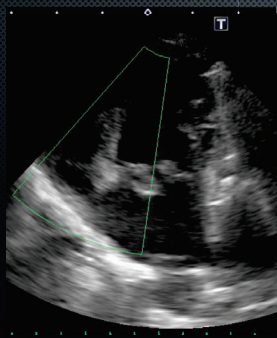


LA/Ao 2.76

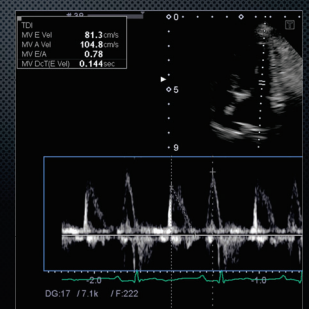
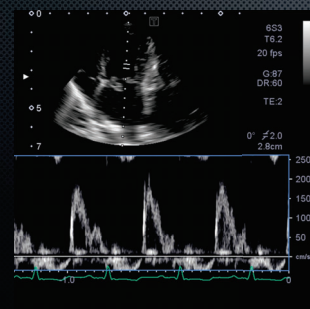
- Echocardiography with Doppler studies also is useful in the diagnosis of dogs with MMVD that have advanced to Stages C and D. Cardiac ultrasound examination can confirm the presence of MMVD, quantify chamber enlargements and cardiac function, provide general estimates of LV filling pressures, and identify comorbidities and complications of chronic MR. These might include

Echo with Doppler

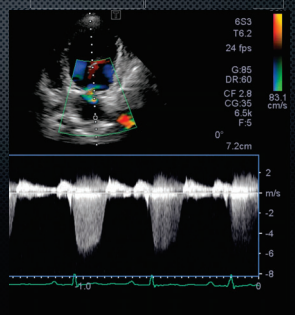
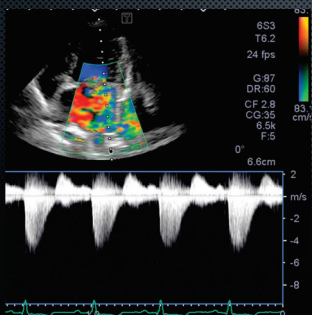
Color Doppler: どっちがCHF？



Pulsed wave doppler : どっちがCHF？



Continuous wave doppler : どっちがCHF？



Journal of Veterinary Internal Medicine

ACVIM

Standard Article
J Vet Intern Med 2017;31:316-325

Left Atrial Strain at Different Stages of Myxomatous Mitral Valve Disease in Dogs

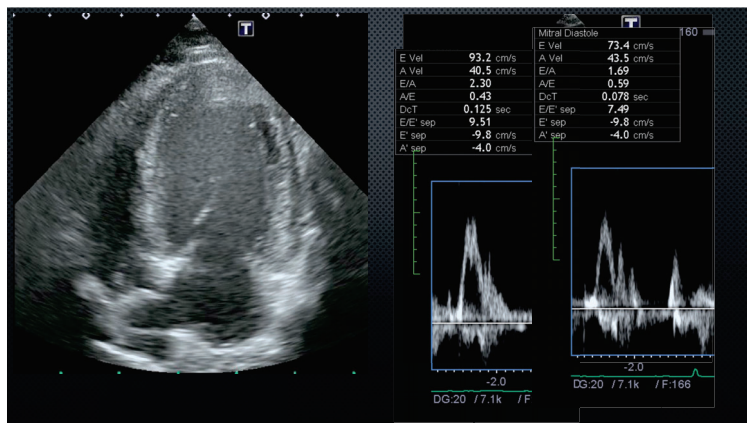
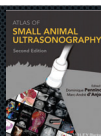
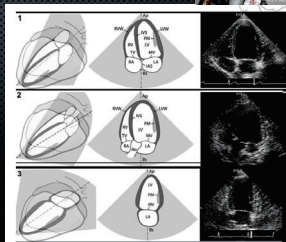
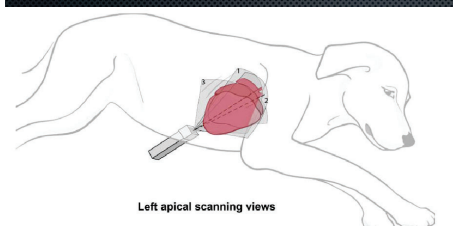
K. Nakamura, S. Kawamoto, T. Osuga, T. Morita, N. Sasaki, K. Morishita, H. Ohta, and M. Takiguchi

Table 3.

Variable	Cut		I C/D.
s_A (%)	11.		Specificity
E (cm/s)	114		AIC
Active FAC (%)	26.1		
LA/Ao	2.1		
SR_A (s) ^a	1.4		
s_s (%)	28.4		
Total FAC (%)	46.1		
LVIDd inc%	21.3	0.899 [0.78-0.96]	1.00
LVIDs inc%	-6.12	0.852 [0.69-0.94]	0.92
E/A	1.53	0.842 [0.61-0.95]	0.77
E_m (cm/s)	8.3	0.840 [0.66-0.93]	0.92

E波 >1.14 = 肺水腫
 感度100%、特異度90%
 LA/Ao >2.16 = 肺水腫
 感度92%、特異度93%

左心尖部四腔断面

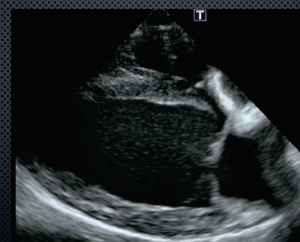


Forrester分類

高	正常	うっ血 CHF
低	低灌流 LOS	CHF & LOS
低	肺動脈楔入圧 高 (≒左室拡張末期圧≒左房圧)	

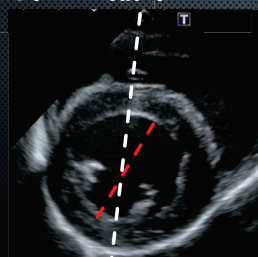
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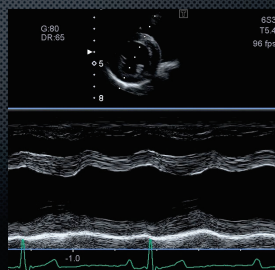


心エコーによる
拍出量評価

左室内径短縮率FS



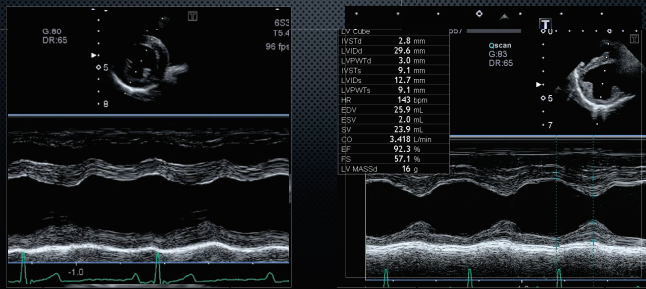
カーソルは左室を
線対称に



心臓は画面左に

Author	Breed	BW	n	FS
Morrison	M. Poodle	3.0±2.0	20	47±6
Yamato	M. Poodle	4.5±1.4	30	41±4
Cornell	CKCS	8.9±1.4	57	33±5
Gooding	E. Cocker	12.2±2.4	12	34±5
Morrison	G. R	32.0±4.8	20	39±7
Koch	Great Dane	62.0±6.6	15	25±5

どっちが低拍出？



J Vet Intern Med 2010;24:1393-1399

Pulmonary Blood Volume in Mitral Regurgitation in Cavalier King Charles Spaniels

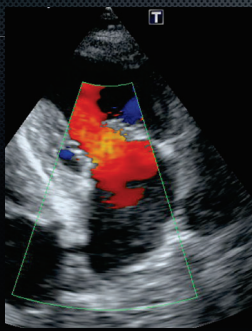
A. Eriksson, K. Hansson, J. Häggström, A.-K. Järvinen, and P. Lord

Variable	Normal (N = 11)	NYHA I (N = 4)	NYHA II (N = 11)	CHF (N = 7)	P-value
FSV/EDV (ratio)	0.82 ± 0.2 ^{*,†}	0.57 ± 0.09 ^{*,#}	0.39 ± 0.14 [†]	0.25 ± 0.07 ^{†,#}	<.0001
CI (L/min/m ²)	29 ± 3	18 ± 5	22 ± 3	31 ± 4	.14
HR (beats/min)	111 ± 6 [*]	98 ± 10 [#]	112 ± 6 [*]	140 ± 8 ^{*,#}	.00013
FSVI (mL/m ²)	67 ± 3	65 ± 5	59 ± 3	53 ± 4	.10
Total SVI (mL/m ²)	56 ± 9 ^{#,†}	77 ± 15	113 ± 9 [#]	152 ± 12 [†]	<.0001
nPTT	4.6 ± 0.6	4.4 ± 1.0	6.3 ± 0.6 [†]	11.6 ± 0.8 [†]	<.0001

MRだと総心拍出量TSVは上がります。

何故でしょう？

僧帽弁逆流



1. 収縮した分の何割かが逆流
2. 前方拍出量低下
3. そのままだと死んじゃう
4. いつも以上に収縮する
5. 前方拍出量維持

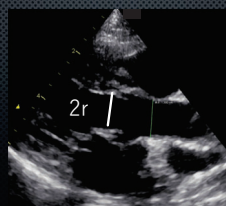
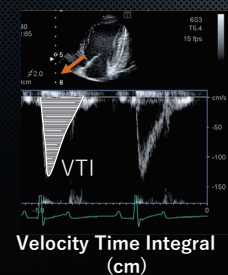
J Vet Intern Med 2010;24:1393-1399

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MRだと総心拍出量は上がりますがFSVはあまり下がりにません（代償期は）

前方一回拍出量
Forward Stroke Volume= VTI × 左室流出路断面積 (cm³)

J Vet Intern Med 2010;24:1393-1399

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Haemodynamic changes during propofol induction in dogs: new findings and approach of monitoring

Andrea Cattal¹, Roberto Rubozzi^{2*}, Heidi Fersini³, Maurizio Iola³ and Paolo Franci³

Results

Eight mixed breed dogs (2 males and 6 females) were included in this study. Median age and median body weight were 54 months (18–120 months) and 17 kg (6–35 kg).

Table 1 Haemodynamic variables in dogs ($n = 8$) receiving a bolus of 5 mg/kg of propofol, administered over 30 s IV, at different time points

	Pre-induction	30 s	Tpeak 55 (50–60) sec	90 s	120 s	150 s	300 s
HR	65 (50–120)	76 (50–130)	105 (70–148)**	87 (54–162)	91 (55–154)*	106 (50–146)*	82 (53–135)
MAP	88 (72–97)	88 (71–99)	61 (51–69)***	70 (50–79)*	71 (59–82)	75 (49–90)	68 (61–88)*
VTI	13.3 (9.4–16.5)	12.2 (8–18)	11.9 (8.1–17.3)	11.5 (8.5–13.5)	11.8 (7.9–13.3)*	11.6 (7.7–14.3)*	10.9 (7.5–14.7)*
VTI*HR	1002 (630–1159)	899 (537–1705)	1172 (806–1554)	952 (629–1377)	1053 (678–1262)	1082 (593–1516)	950 (616–1254)

Tpeak, moment of maximum haemodynamic depression; HR, heart rate (beats minute⁻¹); MAP, mean arterial pressure (mmHg); VTI, velocity time integral (centimetres).
Data expressed as median (range).
Values significantly different from pre-induction
*0.01 < p < 0.05
**0.001 < p < 0.01
*** p < 0.001

Usefulness of focused cardiac ultrasonography for predicting fluid responsiveness in conscious, spontaneously breathing dogs

AJVR • Vol 80 • No. 4 • April 2019

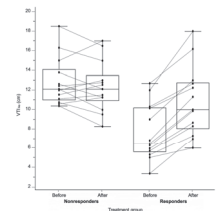
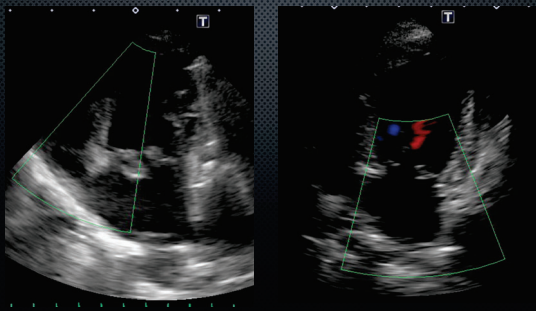
心疾患と内分泌疾患を有さない犬 (2-35kg)
4ml/kgの輸液でFSVが15%以上↑ = responder

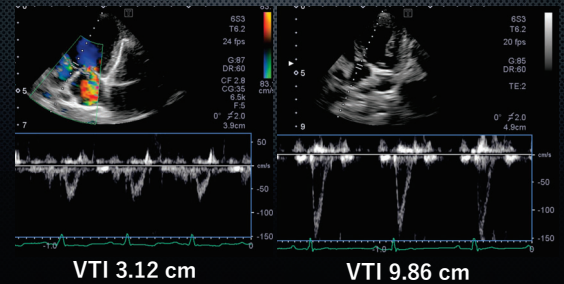
Table 2—Median (range) hemodynamic and echocardiographic values for dogs with various clinical conditions that responded ($n = 13$) or had no response (13) to IV administration of a bolus of lactated Ringer solution (4 mL/kg) over a 1-minute period.

Variable	Before bolus			After bolus		
	Responders	Nonresponders	P value*	Responders	Nonresponders	P value*
HR (beats/min)	148 (72 to 191)	74 (59 to 161)	0.002	137 (81 to 182)	90 (55 to 216)	0.02
MAP (mm Hg)	98 (70 to 129)	105 (70 to 125)	0.07	91 (75 to 113)	110 (82 to 145)	0.26
LVVS	−1 (−1 to 0)	0 (0 to 1)	—	0 (−1 to 0)	0 (0 to 1)	—
LVIDDn (cm/kg ^{0.25})	1.08 (0.67 to 1.69)	1.53 (1.48 to 1.89)	0.01	1.30 (0.77 to 1.77)	1.63 (1.31 to 1.94)	0.002
EDVI (mL/m ²)	33 (9 to 93)	76 (61 to 124)	0.003	50 (15 to 105)	83 (55 to 128)	0.004
VTI _{LV} (cm)	6.5 (3.4 to 12.7)	12.1 (10.4 to 18.5)	< 0.001	9.9 (6.0 to 18.0)	12.1 (8.3 to 17.0)	0.22
Vmax _{Ao} (m/s)	0.81 (0.65 to 1.55)	1.08 (0.79 to 1.82)	0.03	0.97 (0.76 to 1.89)	1.11 (0.75 to 1.69)	0.54

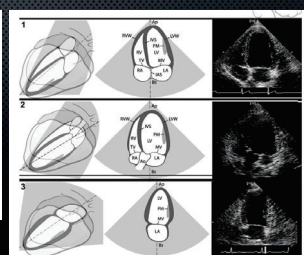
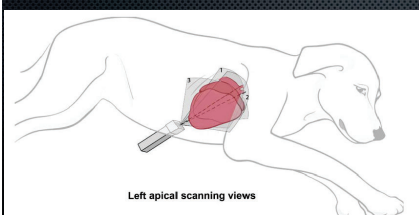
どっちが低拍出？



どっちが低拍出？



左心尖部五腔断面



SAMPLE VOLUMEの位置

