# **Strain in My Daily Practice**

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# Strain

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l	Iwo-dimensional strain schosardiography-derived left ventricular ejection fraction, volumes, an     global systolic dyssynchrony index. Comparison with three-dimensional echocardiography,     Valdya GN, Salgado BC, Badar F, John A, Stoddard MF,     Echocardiography, 2019 Jun;36(6):1054-1065. doi: 10.1111/echo.14362. Epub 2019 May 31.     PMID: 31148242     Similar andeles	d Cownload CSV

#### Seventeenth Annual Toronto Perioperative TEE Symposium

November 2-3, 2019

MaRS Auditorium 101 College St. Toronto, M5G 1L7

**3D TEE Course sold out!** 

November 1, 2019

Toronto General Hospital 200 Elizabeth St. Rm 1-EN-441 Toronto, MSG 2C4

Daily practice ???

DOI: 10.1111/echo.13879

REVIEWS

WILEY Echocardiography

Speckle tracking analysis in intensive care unit: A toy or a tool?

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- Severe MR
- Moderate TR
- LV EF = 35%
- RV dysfunction
- Planned MV, TV repairs
- Surgeon requests ECMO standby





#### **Case: RV Assessment ?** *Visual estimate? Quantitative?*





#### RV Global Longitudinal Strain = - 13%





#### **Strain:** myocardial "deformation"



# One Minute Strain Review <u>Strain</u>: myocardial deformation

# **<u>Strain</u>: measurement of myocardial lengthening or shortening**



# One Minute Strain Review Strain: myocardial Adeformation

#### **Strain: measurement of myocardial lengthening or shortening**

Strain = ∆ Length Length





#### Myocardial fiber orientation:

- Longitudinal (subendocardial)
- Circumferential (middle layer)
- Oblique (subepicardial)







Chong et al. JCVA 2014



Lengthening, shortening most commonly measured by speckle tracking throughout cardiac cycle



#### Why use strain?

- Assess both global and regional function
- Detects abnormalities before EF declines
- Less intra- and inter-observer variability compared with EF
- Relatively easy





#### **One Minute Strain Review** *What's Normal ?*

Supplemental Table 6         Normal LV strain values from meta-analysis and individual recent publications using specific equipment and software         Global longitudinal strain					ific vendors'	
vendor	Software	n	Mean	SD	LLN	Reference
Varying	Meta-analysis	2597	-19.7%		NA	26
GE	EchoPAC BT 12	247	-21.5%	2.0%	-18%	31
	EchoPAC BT 12	207	-21.2%	1.6%	-18%	*
	EchoPAC BT 12	131	-21.2%	2.4%	-17%	+
	EchoPAC 110.1.3	333	-21.3%	2.1%	-17%	32
Philips	QLAB 7.1	330	-18.9%	2.5%	-14%	32
Toshiba	Ultra Extend	337	-19.9%	2.4%	-15%	32
Siemens	VVI	116	-19.8	4.6	-11%	197
	VVI	82	-17.3	2.3	-13%	198
Esaote	Mylab 50	30	-19.5	3.1	-13%	199

LLN, Lower limit of normal range.

\*T. Kouznetsova and J. Staessen, Department of Cardiology, Catholic University Leuven, personal communication.

<sup>†</sup>P. Barbier, University Milano, personal communication.

#### ASE Chamber Quantification. J Am Soc Echocardiogr 2015;28:1-39.

#### **One Minute Strain Review** *What's Normal ?*

#### **Right Ventricle**

- RV GLS slightly more negative (greater absolute value) than LV GLS
  - Greater longitudinal contribution to ejection
- RV free wall strain (FWS) more negative (greater abs

Normal RV FWS: Normal: - 29 to - 30% Lower limit of normal: - 23%



#### One Minute Strain Review Limitations

- Range of normal values
  - Vendor differences
- Intra- and inter-observer variability exists
- Load dependent
- RV measurements using LV templates
- RV measurements using limited RV views (4C)





# LV Strain in the OR























# **See the Unseen...Especially in the OR**



#### Strain See the Unseen...Especially in the OR Pericardial Constriction





# **Strain** Pericardial Constriction



## Strain Pericardial Constriction



# Strain

#### Pericardial Constriction











#### Strain Pericardial Constriction

Dark red = good Pink, blue = bad

**Preserved septum** 

Decreased Ant, Inf, Lat





# Strain Pericardial Constriction

#### **IMAGE FOCUS**

doi:10.1093/ehjci/jey031 Online publish-ahead-of-print:23 February 2018

Longitudinal strain by speckle tracking echocardiography in constrictive pericarditis

Edith Jottrand<sup>1</sup>, Thomas Serste<sup>2</sup>, Jean-Pierre Mulkay<sup>2</sup>, Charlotte Vandueren<sup>1</sup>, and Philippe Unger<sup>1</sup>\*

<sup>1</sup>Department of Cardiology, CHU Saint-Pierre, Université Libre de Bruxelles (ULB), 322 rue Haute, Brussels B-1000, Belgium; and <sup>2</sup>Department of Gastroenterology, CHU Saint-Pierre, Université Libre de Bruxelles (ULB), 322 rue Haute, Brussels B-1000, Belgium

\* Corresponding author: Tet + 32 2 535 33 51, Fax + 32 2 535 33 62. E-mail: punger@ulb.ac.be Eur Heart J – CV Imag 2018

- Preserved strain in septum
- Decreased strain elsewhere due to pericardial tethering



# **RV Strain in the OR**





# **RV Strain in the OR**







## **RV Strain in the OR**





#### **Quantitative and Semi-quantitative Methods**



FAC



TAPSE



Tissue Doppler / S'



#### **Quantitative and Semi-quantitative Methods**



FAC







#### Tissue Doppler / S'











Adjust tracking, change labels, deselect septum



The way of the second

#### **Bad Example**



#### Bad

Better









#### **Tissue Motion Annular Displacement**









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- Speckle tracking length changes
  - Angle independent TAPSE



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Perioperative Echocardiography and Cardiovascular Education

Section Editor: Nikolaos J. Skubas

#### Assessment of Tricuspid Annular Motion by Speckle Tracking in Anesthetized Patients Using Transesophageal Echocardiography

Tao Shen, MBBS,\* Michael H. Picard, MD,† Lanqi Hua, RDCS,† Sara M. Burns, MS,\* and Michael N. Andrawes, MD\* Anesth Analg 2018;126:62–7

#### Compared lateral TMAD (TEE) with TAPSE (TTE)



Figure 3. Correlation of Mroode transmit areadar plane system system (SMNE) and basis restors areadar displacement (TMAD) (LL r = 0.67,  $P < D_2$ .

Perioperative Echocardiography and Cardiovascular Education

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#### Compared lateral TMAD (TEE) with TAPSE (TTE)

Table 2. Summary of Hemodynamic Data		
	Mean ± SD	
TTE M-mode TAPSE, mm	19.8 ± 4.9	
TMAD (L), mm	17.4 ± 5.2	
TMAD (S), mm	10.2 ± 4.8	
TMAD (M), mm	$14.2 \pm 4.8$	
Heart rate, beats/min		
At TAPSE measurement	69 ± 12	
At TMAD measurement	68 ± 20	
RV FAC, %	37.8 ± 9.7	
CVP, mm Hg	12 ± 4.4	
Cardiac index, L/min/m <sup>2</sup>	2.3 ± 0.5	
PAP mean, mm Hg	29.5 ± 9.2	

#### Medicine (2018) 97:30

Observational Study

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OPEN

#### Tricuspid annular displacement measured by 2-dimensional speckle tracking echocardiography for predicting right ventricular function in pulmonary hypertension

#### A new approach to evaluating right ventricle dysfunction

Yidan Li, MD<sup>a.\*</sup>, Yidan Wang, MD<sup>a</sup>, Yuanhua Yang, MD<sup>b</sup>, Mingxi Liu, MS<sup>c</sup>, Xiangli Meng, MS<sup>a</sup>, Yanping Shi, MS<sup>a</sup>, Weiwei Zhu, MS<sup>a</sup>, Xiuzhang Lu, MD<sup>a.\*</sup>

#### TMAD (TTE) correlates with RV EF by CMR (lateral > septal)

Parameter	Group I (n = 182)	Group II (n=43)	P
Conventional parameters			
TAPSE, mm	$15.12 \pm 3.95$	$19.50 \pm 2.88$	<.00
150WP	0.7 0 ± 0.4.0	0.00120.00	<.00
BVFAC, %	$33.40 \pm 9.32$	50.12±7.96	<.00
s', cm/s	$10.98 \pm 2.95$	$12.99 \pm 3.05$	<.00
e'/a'	$0.51 \pm 0.04$	$0.74 \pm 0.29$	.30
TMAD parameters		10.004-0000000000	6000
TMAD1, mm	13.82±4.18	$17.10 \pm 3.52$	<.00
DWPMAG, UILI	6	11.00 ± 6.07	<.00
TMADm, mm	$11.78 \pm 3.25$	$14.37 \pm 2.83$	<.00
TMADm%	$15.48 \pm 4.81$	$21.76 \pm 4.31$	<.00

#### Medicine (2018) 97:30

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#### TMAD tends to be 2 – 3 mm less than TAPSE

Parameter	Group I (n = 182)	Group II (n=43)	P
Conventional parameters			
TAPSE, mm	$15.12 \pm 3.95$	$19.50 \pm 2.88$	<.00
Page	Mar 1 (Mar 1) Mar 401	10-000 PM (0-000)	<.00
RVEAC, %	$33.40 \pm 9.32$	50.12±7.96	<.00
s', cm/s	$10.98 \pm 2.95$	$12.99 \pm 3.05$	<.00
e'/a'	$0.51 \pm 0.04$	$0.74 \pm 0.29$	.30
TMAD parameters			6.761
TMAD1, mm	$13.82 \pm 4.18$	$17.10 \pm 3.52$	<.00
TWPALSE, THU		11.00 2 2.00	<.00
TMADm, mm	$11.78 \pm 3.25$	$14.37 \pm 2.83$	<.00
TMADm%	$15.48 \pm 4.81$	$21.76 \pm 4.31$	<.00













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# **Take Home Points**



# Strain in Daily TEE Practice

- Thousands of strain papers
  - Mostly TTE, many prognostic
- LV strain in OR
  - Reveal abnormalities suspected but difficult to see

#### • RV

- Great quantitative tool
- Angle independent
- Easy
- Reasonably well validated
- TMAD (angle independent TAPSE)







# **Questions**?

