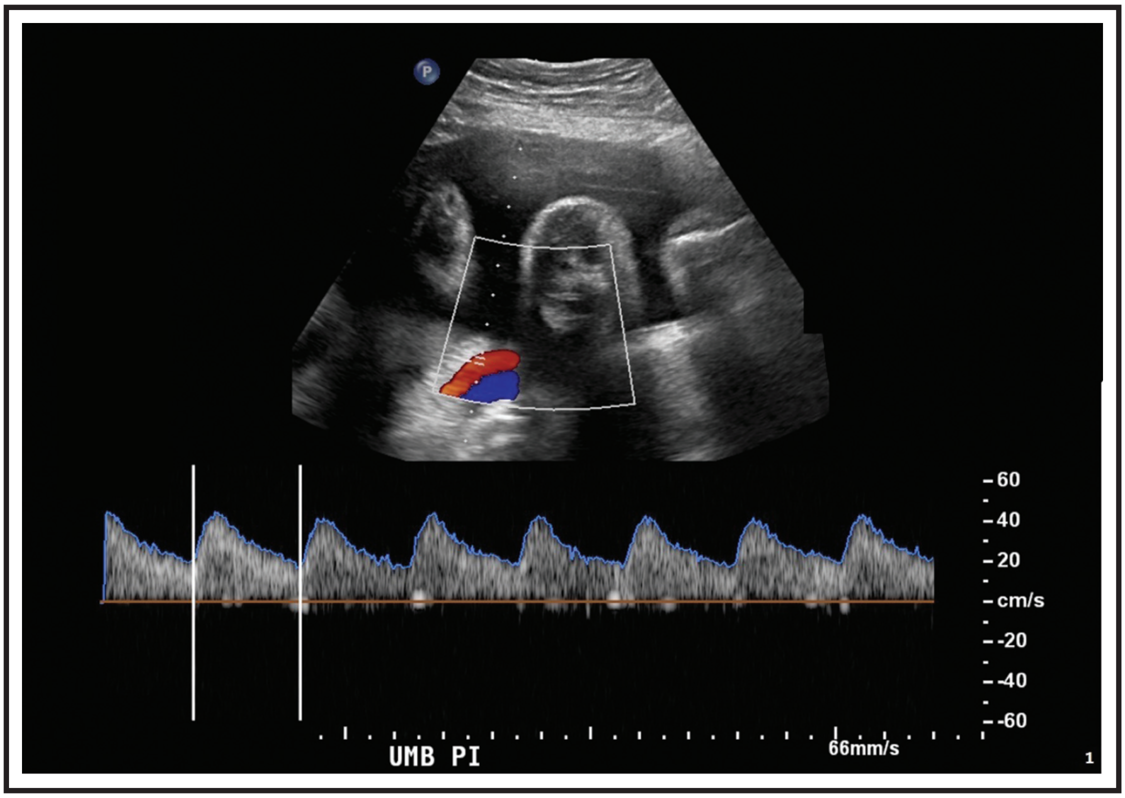
Volume 11, Issue 1 ▪ 2020

CJMS

Sonography Canada Échographie® Canada

Canadian Journal of Medical Sonography



Sonography Canada Échographie® Canada

Volume 11, Issue 1 • 2020

Publications Agreement Number 40025049

For Instructions to Authors, please visit https://sonographycanada.ca/about-us/publications

Return undeliverable Canadian Addresses to:

The Dougmar Publishing Group Inc.

115 King St W., Suite 220, Dundas, ON L9H 1V1

Canadian Journal of Medical Sonography is published four times a year by Dougmar Publishing Group Inc., with offices located at 115 King Street West,Suite 220, Dundas, ON L9H 1V1.

•••••

table of contents

Volume 11, Issue 1• 2020

About the Cover

This issue's cover image is from Amanda Cook's article: "Twin Reversed Arterial Perfusion (TRAP) Sequence: A Rare Case Report of an Acardiac Twin." case Figure 1. Pump Twin. Umbilical Artery Doppler PI 0.97 (normal <1.25).

Message from the Editor-in-Chief

Welcome to our first issue of 2020. I can recall the excitement of regulation of our profession and since that is now in place, we should be thinking of another step forward in achieving advanced practice for Canadian sonographers. There are examples of Canadian sonographers conducting thyroid biopsies, hysterosonogram's, checking off normal cases and participating in research (with the knowledge & skills) and under delegation from supervising radiologists. Should this advanced practice be formally recognized as another level of responsibility?

This issue of *CJMS* brings to you the first part of three articles on Strain Imaging, which I understand is the latest practice in cardiac sonography. Babitha Thampinathan and her team have created the three-part series to enable Cardiac Sonographers to easily digest the vast amount of information on this topic and to enjoy the reading.

Author Mengling Chen showcases a scanning protocol on including the Triangular Fibrocartilage Complex Tear and its Sonographic Features in wrist ultrasound imaging; as we build our skills in MSK practice.

Amanda Cook presents her findings on a rare Case Study on an Acardiac Twin demonstrating TRAP Sequence; this article has excellent images and information for the generalist sonographer and will add to their professional practice.

The *CJMS* is your platform to advance the knowledge of sonographers. Published authors invest their time writing, revising and submitting their findings so that they may be shared with others. We are looking for your submissions to the *CJMS* on any original research, on rare findings reported as a case study or pictorial essays about new protocols such as MSK protocols', or guidelines such as BiRADS or TiRADS so that sonographers can visualize the images that apply to these guidelines. Systematic & literature reviews can give sonographers valuable information to enhance their knowledge.

As sonographers, we concentrate on the imaging aspect of our profession; let us not forget that the patient is at the centre of our care and from a holistic viewpoint, the emotional and mental aspects of patient care can educate us on optimizing our communications, improving conflict management and practicing collaboration in an inclusive manner to maximize compassionate care. We are all learners and educators so scholarly articles on education would also enhance our knowledge.

The publishers and I are at your service to answer questions or to provide mentoring to help you publish your manuscripts. The following link will take you to the *CJMS* authors guidelines and manuscript submissions page. https://sonographycanada.ca/about-us/publications

You can also reach me directly at editor CJMS@sonographycanada.ca

Pushing the boundaries

Sheena Bhimji-Hewitt MAppSc, DMS, CRGS, CRVS, RDMS, RVT

Editor-in-Chief

*The opinion in this editorial is that of the Editor-in-Chief and not that of Sonography Canada or the Sonography Canada Board of Directors.

Message de la rédactrice en chef

Bienvenue dans notre premier numéro de 2020. Je me souviens de l'enthousiasme suscité par la réglementation de notre profession et, puisque celle-ci est maintenant en place, nous devrions envisager une nouvelle étape dans la réalisation d'une pratique avancée pour les échographistes canadiens. Il existe des exemples d'échographistes canadiens qui effectuent des biopsies de la thyroïde, des hystérosonogrammes, cochent des cas normaux et participent à la recherche (avec les connaissances et les compétences) et sous la délégation de radiologues superviseurs. Cette pratique avancée devrait-elle être officiellement reconnue comme un autre niveau de responsabilité ?

Ce numéro du CJMS vous présente la première partie de trois articles sur l'imagerie des contraintes, qui, si j'ai bien compris, est la pratique la plus récente en échographie cardiaque. Babitha Thampinathan et son équipe ont créé cette série en trois parties pour permettre aux échographistes cardiaques de digérer facilement la vaste quantité d'informations sur ce sujet et d'en apprécier la lecture.

L'auteur Mengling Chen présente un protocole de balayage sur l'inclusion de la déchirure du complexe fibrocartilagineux triangulaire et de ses caractéristiques échographiques dans l'imagerie échographique du poignet; alors que nous développons nos compétences dans la pratique du MSK.

Amanda Cook présente ses conclusions sur une étude de cas rare sur un jumeau cardiaque démontrant la séquence TRAP ; cet article contient d'excellentes images et informations pour les échographistes généralistes et viendra compléter leur pratique professionnelle.

Le CJMS est votre plateforme pour faire progresser les connaissances des échographistes. Les auteurs publiés consacrent leur temps à écrire, réviser et soumettre leurs conclusions afin qu'elles puissent être partagées avec d'autres. Nous recherchons vos soumissions au CJMS sur toute recherche originale, sur des résultats rares rapportés sous forme d'étude de cas ou d'essais illustrés sur de nouveaux protocoles tels que les "protocoles MSK", ou des lignes directrices telles que BiRADS ou TiRADS afin que les échographistes puissent visualiser les images qui s'appliquent à ces lignes directrices. Les analyses systématiques et documentaires peuvent fournir aux échographistes des informations précieuses pour améliorer leurs connaissances.

En tant qu'échographistes, nous nous concentrons sur l'aspect imagerie de notre profession ; n'oublions pas que le patient est au centre de nos soins et, d'un point de vue holistique, les aspects émotionnels et mentaux des soins aux patients peuvent nous apprendre à optimiser nos communications, à améliorer la gestion des conflits et à pratiquer la collaboration de manière inclusive pour maximiser les soins prodigués avec compassion. Nous sommes tous des apprenants et des éducateurs, aussi des articles savants sur l'éducation amélioreraient-ils nos connaissances.

Les éditeurs et moi-même sommes à votre service pour répondre à vos questions ou pour vous fournir un encadrement afin de vous aider à publier vos manuscrits. Le lien suivant vous mènera à la page des directives aux auteurs et des soumissions de manuscrits de la CJMS. https://sonographycanada.ca/about-us/publications

Vous pouvez également me contacter directement à l'adresse editor CJMS@sonographycanada.ca

Repousser les limites

Sheena Bhimji-Hewitt MAppSc, DMS, CRGS, CRVS, RDMS, RVT

Editor-in-Chief

*L'opinion exprimée dans cet éditorial est celle du rédacteur en chef et non celle de Sonography Canada ou du conseil d'administration de Sonography Canada.

Case Report

Amanda Cook MRSc, DMS, CRGS, RDMS, RMSKS

Twin Reversed Arterial Perfusion (TRAP) Sequence: A Rare Case Report of an "Acardiac" Twin

About the Authors

Amanda Cook has a Bachelor in Medical Radiation Sciences, with an Ultrasound specialty from McMaster University, Mohawk College. She is a sonographer at Brant Community Healthcare.

Correspondence can be directed to: amanda.cook@bchsys.org

ABSTRACT

A 32 year-old-pregnant female, presented to the labour and delivery department with contractions and leaking fluid. A vaginal mass was noted on digital examination. Obstetrical ultrasound demonstrated a twin pregnancy with a normal male fetus and a dysmorphic fetus with cardiac activity. Cesarean section was performed due to premature rupture of membranes (PROM) and ultrasound findings. A normal live male infant was delivered, required minimal neonatal care, and is healthy to date. A non-viable anomalous twin and the shared placenta was sent for autopsy. Pathology diagnosis was twin reversed arterial perfusion (TRAP) sequence and hemiacardius twin. TRAP sequence was a prenatal differential diagnosis but seemed unlikely with uncharacteristic findings and rare incidence. This case report emphasizes the importance of early and accurate ultrasound detection of multiple pregnancies, fetal autopsy, and the complexity of TRAP sequence.

Keywords: monochorionic pregnancy; acardiac twin; pump twin; twin reversed arterial perfusion (TRAP) sequence; ultrasound

Twin reversed arterial perfusion (TRAP) sequence, or acardiac twinning is a rare anomaly unique to monochorionic (MC) twin pregnancy.[1–6] This is a severe variant of twin-twin transfusion syndrome.[1,4] The incidence is 1 in 35,000 pregnancies, and 1% of monozygotic twin pregnancies.[1–6] Pathogenesis is uncertain, but widely considered to be a result of abnormal vascular events early in embryology, resulting in a sequence of anomalies and poor prognosis.[1–6]

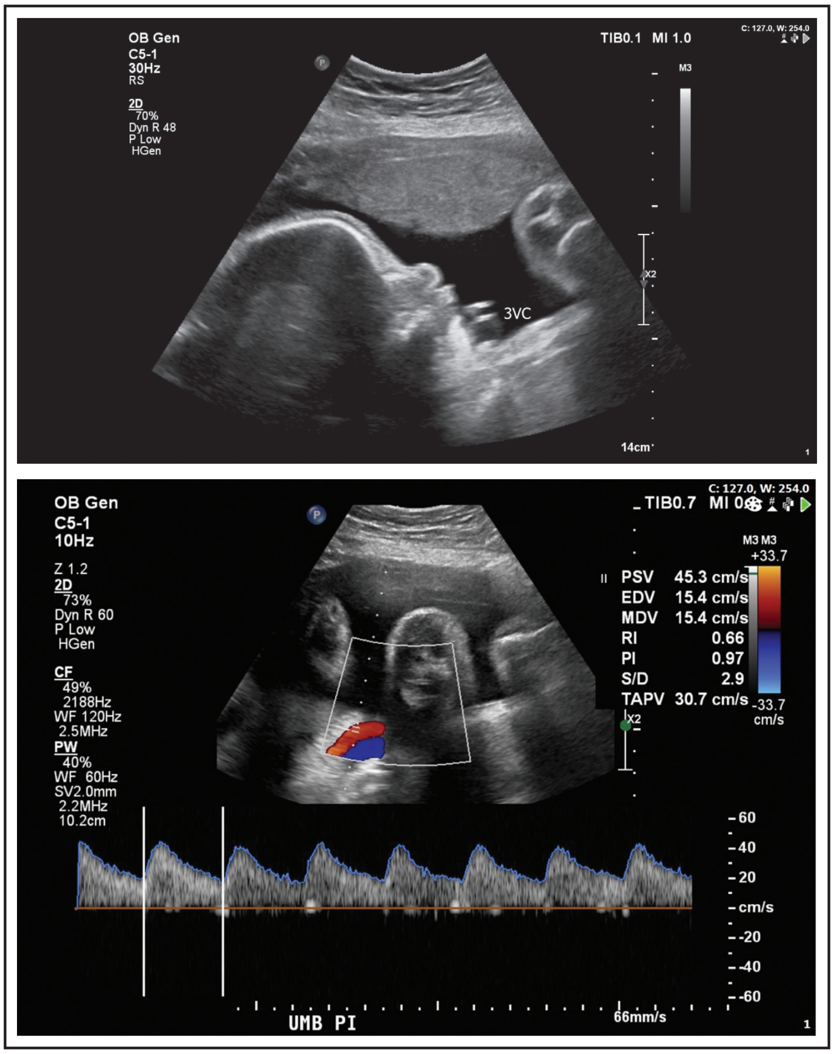
TRAP sequence is characterized by the coexistence of an anatomically normal "pump" twin, and a non-viable malformed and mass-like "acardiac" twin.[1–6] The pump twin is responsible for all circulation and feeds the co-twin through vascular anastomoses in the placenta. Perfusion of arterial blood in the acardiac twin is reversed in direction, hence the term "TRAP." Poorly oxygenated blood impairs development of the acardiac twin, and commonly the upper body fails to form with an absent, rudimentary, or non-functioning heart.[1–6] The pump twin is at high risk of complications and mortality from organ failure, PROM, and preterm birth.[1–6]

Ultrasound plays a vital role in early and accurate detection of multiple pregnancies, fetal anatomy, well being and growth. Ultrasound follow-up and treatment in cases of TRAP sequence can improve the survival rate of the pump twin. Diagnosis of TRAP sequence is confirmed by demonstrating a normal fetus along with an abnormal acardiac fetus, as well as Doppler evidence of reversed flow in the umbilical artery (UA) of the acardiac twin.[1–6] This study reports on a case of TRAP sequence and an acardiac twin, highlighting variable ultrasound findings, pitfalls, diagnosis, and outcome.

Case Description

A healthy 32-year-old female, gravida 2, para 2, presented to the labour and delivery department at 32 weeks pregnant with acute onset of contractions and leaking fluid with blood. Previously, this was an uncomplicated pregnancy with normal outside singleton ultrasounds and normal blood work. On digital examination, a 7-cm vaginal mass was noted. This was assumed to be a prolapsing or degenerative fibroid, versus anomalous fetal head or buttock. An urgent obstetrical ultrasound was ordered to investigate.

After obtaining informed consent, a transabdominal ultrasound was performed with a curvilinear C5-1, C9-2 and V6-2 transducers on a Philips EPIQ 7



A

B

Figure 1. Pump Twin. (A) Fetal Profile, 3VC and anterior placenta (B) Umbilical Artery Doppler PI 0.97 (normal <1.25).[10]

machine. A structurally normal male fetus was seen measuring 32 weeks gestational age, in a footling breech presentation. Detailed biophysical profile, amniotic fluid volume, and Umbilical Artery Doppler were all within normal limits (Figure 1).

To diagnose the vaginal mass a transperineal scan using a C5-1 probe was done. A 9 cm heterogeneous mass filled the endocervical canal extending to the level of the vagina (Figure 2). Within this irregular area, pulsatile vascularity was present and was favoured to reflect the cardiac activity of a dysmorphic fetal heart with pericardial fluid (Figure 3A). M-mode detected a low heart rate at 82 bpm (normal 100–180 bpm)[7] (Figure 3B). Multiple echogenic structures were also seen, resembling vertebrae and long bones. Measurement of a suspected femur corresponded to 20 weeks gestational age (Figure 4). A thick hydropic placenta with normal vascularity appeared to be surrounding the structure, this finding is also associated with partial molar pregnancies. No communication was identified between the two fetuses. Ultrasound findings suggested a previously undiagnosed dichorionic-diamniotic twin gestation with an anomalous twin and hydropic placenta. Differential diagnoses included a normal fetus coexisting with partial molar pregnancy and amorphous fetus, as well as TRAP sequence.

Immediately after the ultrasound the patient went into active labour. A cesarean section was performed due to PROM. A normal-appearing premature, live, male infant was delivered weighing 2.2 kg and transferred to the special care nursery. A still-born anomalous twin fetus was easily dislodged with a significantly abnormal appearance, weighing 374 g (Figure 5A). Clinically, there appeared to be one umbilical cord

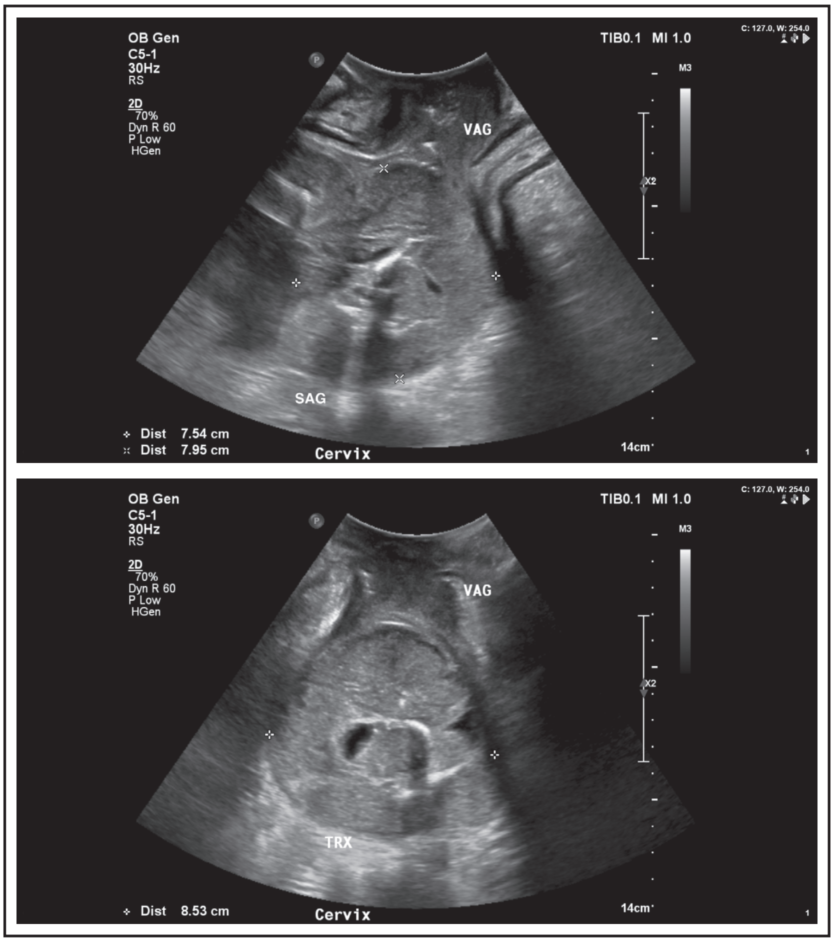


Figure 2. Acardiac Twin. (A) Longitudinal and (B) Transverse transperineal images of the acardiac twin appearing as a heterogeneous mass filling the endocervical canal.

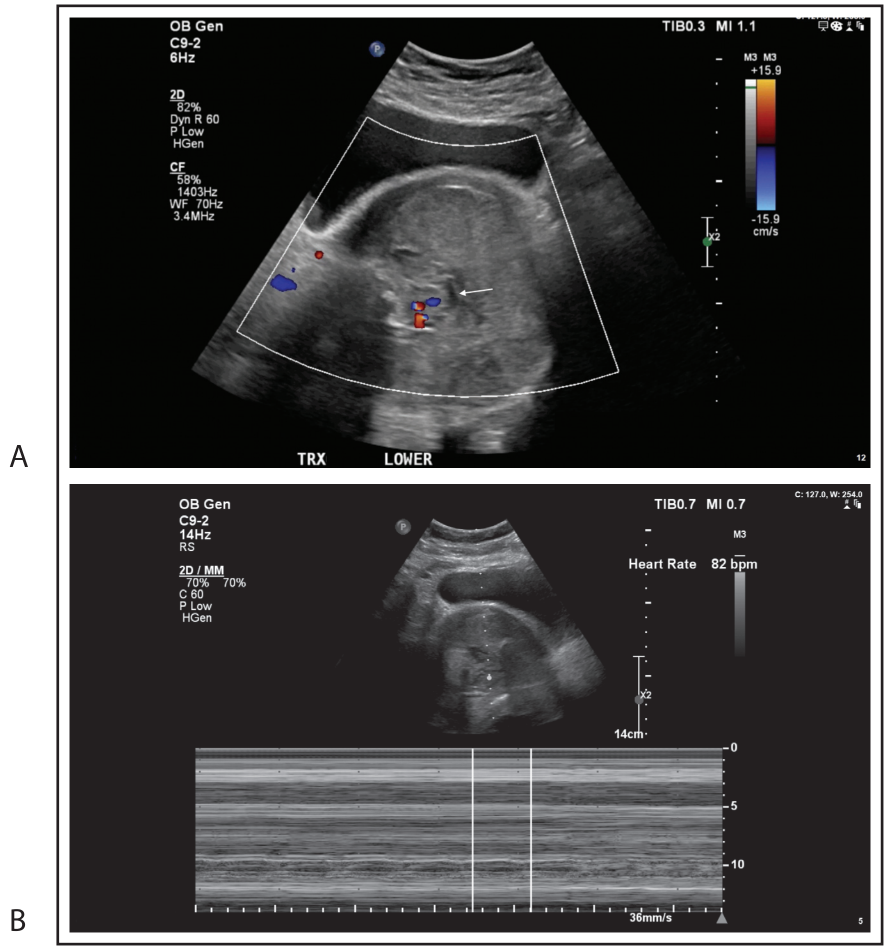


Figure 3. Acardiac Twin. (A) Colour Doppler of a functional rudimentary fetal heart, pericardial fluid shown by the arrow (B) M-mode tracing with a low heart rate at 82 bpm (normal 100–180 bpm).[7]

inserting into the placenta with no visible membrane separation, suggesting a shared placenta. Radiographs after delivery demonstrated an amorphous, irregular soft tissue mass with a malformed skull, vertebrae, and limb with two long bones (Figure 5B).

Pathology and genetic testing were done on the placenta and the attached anomalous fetus. This confirmed one placenta with ruptured membranes, and one shared umbilical cord insertion (Figure 6). Converging at the base was a large three-vessel cord (3VC) from the live-born twin and a significantly smaller two-vessel cord (2VC) from the anomalous twin. Dissection revealed vascular anastomoses with direct communication between the two cords. There was one amniotic sac with no evidence of dividing membranes. The final diagnosis was a monochorionic-monoamniotic TRAP sequence. The anomalous or acardiac fetus was a normal male karyotype (46, XY), with no chromosomal abnormalities detected. Incomplete primitive brain, lung, heart and bone formation was documented. Disorganized bones included skull, vertebrae, and limb with two long bones, confirming diagnostic imaging findings (Figure 4, and Figure 5B). This acardiac case did not fit into one of the four featured subtypes outlined for the degree of maldevelopment (Table 1).[6,8] With partial development of the head and thorax it could fit into acardius anceps, except that form usually lacks even the rudimentary type. The presence of a rudimentary heart can, however, be broadly classified as hemiacardius.[3]

The mother recovered well, received counselling, and was discharged after two days. The male infant (pump twin) experienced respiratory distress after birth, A

B

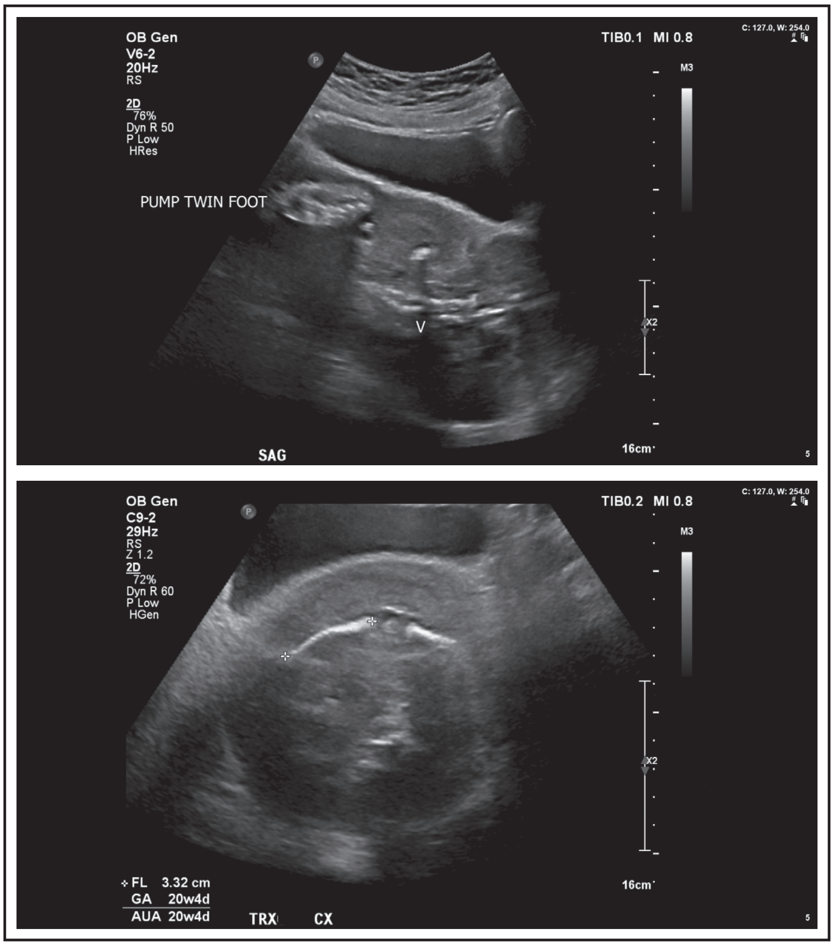
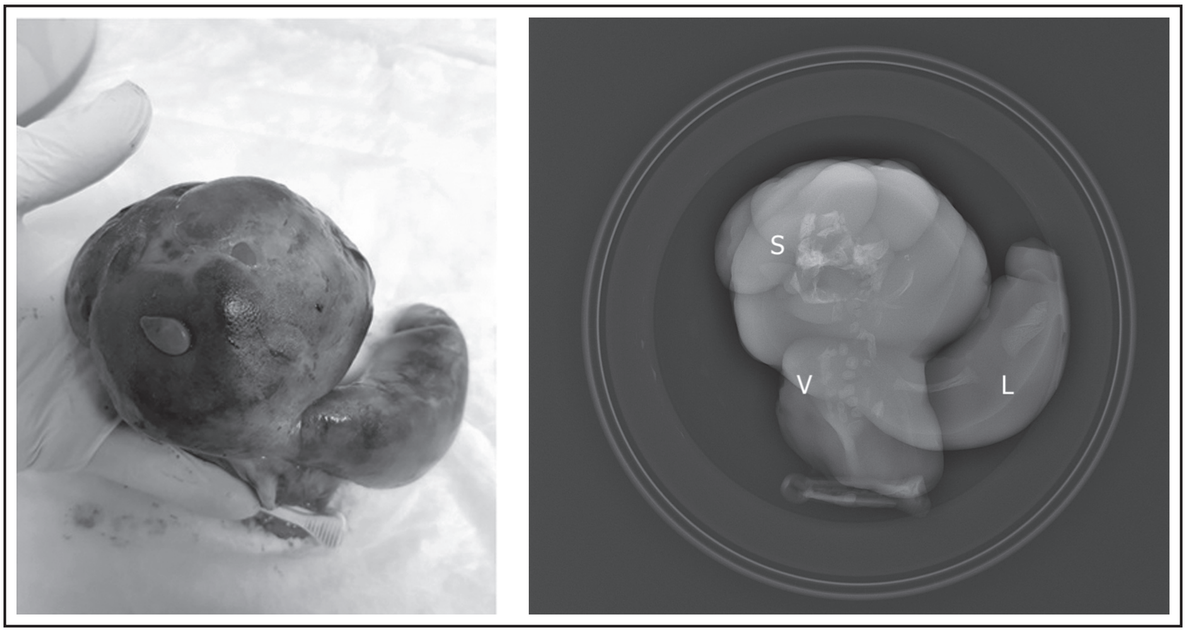


Figure 4. Acardiac Twin. Echogenic disorganized and incomplete bone formation. (A) Vertebrae (V). (B) Limb with two long bones. Measurement of a suspected femur corresponds to 20 weeks gestational age.

A



B

Figure 5. Acardiac Twin, Post Delivery. (A) Anomalous fetus, weighing 374g. The examiner's finger is showing the umbilical cord clip. (B) Radiograph of irregular soft tissue mass with the malformed skull (S), vertebrae (V), and limb (L) with two long bones.

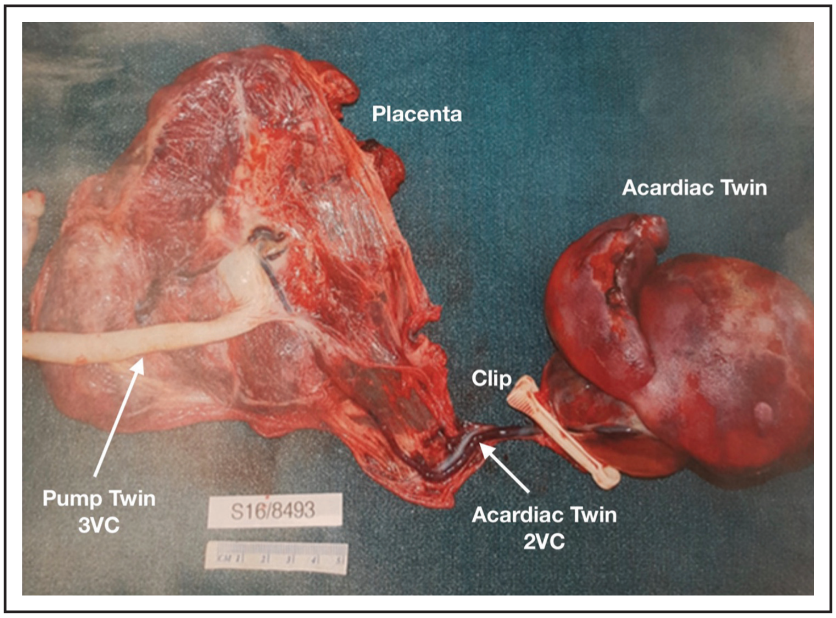


Figure 6. Perinatal Autopsy. Photograph of the placenta and attached acardiac twin with converging umbilical cords. Arrows point to the normal 3VC of the pump twin, and the small 2VC feeding the acardiac twin.

Table 1. Acardiac Twin Morphology Classification

Number	Subtype	Features	Prevalence
1	Acardius acephalus	Absent head, thorax, and upper extremities; Abdomen, pelvis and lower extremities are developed	Most common
2	Acardius anceps	Partial head, thorax, abdominal organs, and extremities; Lacks even a rudimentary heart	Highly developed
3	Acardius acormus	Rudimentary head only, no thorax or lower extremities; Umbilical cord inserts into the head	Rare
4	Acardius amorphous	Amorphous mass, least differentiated form	Poorly developed

was placed on continuous positive airway pressure for one day and normalized. Echocardiograms were normal, there were no other features of distress or dysmorphia, and the infant was discharged on day 26 of life, corrected at 36 weeks. No additional hospital visits have been documented.

Discussion

The fundamental requirement for TRAP sequence is the development of arterial-to-arterial vascular anastomoses between the umbilical arteries of MC twins.[1–6] Arteries normally carry blood away from the fetus and toward the placenta to receive oxygen from the maternal circulation. The acardiac twin blood supply is reversed, entering the umbilical artery and exiting the umbilical vein.[1–6] Lack of oxygen, nutrients and circulatory failure result in fatal anomalies. Maldevelopment of the upper body and an absent, rudimentary, or non-functioning heart is a primary feature.[1–6]

The pump twin is likely to experience systemic stress to meet blood supply demands. High-risk associations include hydrops fetalis, polyhydramnios, congestive heart failure, and preterm birth.[1–6] Poor prognosis has also been associated with twin weight ratios.[1–5] The greater the size of the acardiac fetus, the greater adverse risk for the pump twin, presumably from the increased workload and cardiac failure.[1–5] Mortality rate has been reported at > 50%.[1–5]

Management can include serial ultrasound assessments for fetal growth and biophysical scores including a fetal stress test to ensure the well being for the "pump" twin. Fetal echocardiograms can evaluate heart function and if strain is present.

Treatment options during the pregnancy are controversial and can be conservative or interventional. Ultrasound-guided invasive methods aim to terminate the vascular connection of the umbilical vessels supplying blood to the acardiac mass. Radiofrequency ablation has a higher success rate over cord occlusion techniques.[9] Intervention reduces stress on the pump twin and increases its chance of survival.

Differential diagnosis may include teratoma, cystic hygroma, intra-amniotic tumours, and fetal demise.[1–5] Colour and pulsed Doppler with the reversed flow in the umbilical artery of the acardiac twin confirms TRAP Sequence.[1–6] In this case study, TRAP sequence was less likely suspected given the cardiac activity in the "acardiac" twin, normal pump twin, and inability to detect vascular connection due to ruptured membranes.

The etiology for TRAP sequence is extrinsic and is not based on genetic or chromosomal errors.[6] Recurrence is unknown, however probability of repeated MC twin pregnancy is approximately 1%, and the incidence of TRAP sequence is rare.[1–6] The majority of reported TRAP sequence cases are monochorionic diamniotic female twin pregnancies, again making this case unusual.[1,4,6]

Conclusion

TRAP sequence is a rare complication in MC twin pregnancies with vascular anastomoses, anomalies, and poor prognosis. Early and accurate ultrasound imaging is essential for detection, management, and improved outcome. It should be considered in cases with one structurally normal fetus with or without complications, and the presence of a mass-like structure. TRAP sequence was a differential diagnosis, but not highly suspected given the unusual sonographic findings. This is a unique case report of an acardiac twin with a functional rudimentary heart and partial upper body development, which is not an expected finding with this disorder. Cardiac activity in an "acardiac" twin does not exclude TRAP sequence, evident in this case and contrary to literature. Prenatal diagnosis can be made using Doppler to show reversed flow in the acardiac twin UA. This was not identified due to ruptured membranes, a potential pitfall to recognize. A perinatal autopsy confirmed this case, highlighting the importance of diagnosis, counselling for future pregnancies, research, and teaching. The ultrasound and pathology findings, in this case, were uncharacteristic, emphasizing the variability and complexity of TRAP sequence.

Acknowledgments

Thank you to the Brant Community Healthcare team involved in the care and diagnosis.

A special thank you to the following Sonographers and Radiologist for their contribution and insight towards this case study: Kristen Lalande, Ray Lappalainen, and Dr. Angela Fleming.

Images by permission of Brant Community Healthcare System, Brantford, ON.

Informed consent was obtained from the parents before taking photographs.

References

1. Barth RA, Crow HC. Ultrasound evaluation of multifetal gestations. In: Callen PW. Ultrasonography in Obstetrics and Gynecology, 4th edition. Philadelphia: Saunders; 2000.
2. Levi CS, Lyons EA, Martel MJ. Sonography of multifetal pregnancy. In: Rumack CM, Wilson SR, Charboneau JW. Diagnostic Ultrasound, 3rd edition. Philadelphia: Mosby; 2005.
3. Stephenson SR. Diagnostic Medical Sonography: Obstetrics and Gynecology, 3rd edition. Philadelphia: Wolters Kluwer; 2012.
4. Saritha S, Anjankar SS. Twin Reversed Arterial Perfusion Sequence (TRAP Sequence). The Acardiac / Acephalic Twin. Int J Ant Res 2013;03:140–4.
5. Moore TR, Gale S, Benirschke K. Perinatal outcome of forty-nine pregnancies complicated by acardiac twinning. Am J Obstet Gynecol 1990;163:907–12.

6. Chen H. Atlas of Genetic Diagnosis and Counseling, 2nd edition. New York: Springer-Verlag; 2012.
7. Hornberger LK, Jaeggi ET, Trines J. The fetal heart. In: Rumack CM, Wilson SR, Charboneau JW. Diagnostic Ultrasound, 3rd edition. Philadelphia: Mosby; 2005.
8. Showkathali I, Mini K, Ambooken RP. Twin reversed arterial perfusion sequence: acardiac-acephalic twin - a case report. Eur J Anat 2014;18:345–52.
9. Lee H, Wagner AJ, Sy E, et al. Efficacy of radiofrequency ablation for twin-reversed arterial perfusion sequence. Am J Obstet Gynecol 2007;196(5):459.e1–4.
10. Acharya G, Wilsgaard T, Berntsen GK, et al. Reference ranges for serial measurements of umbilical artery Doppler indices in the second half of pregnancy. Am J Obstet Gynecol 2005;192(3):937–44.

CJMS Article: Sonography Canada CPD Credit

Sonography Canada members can earn 1 Free CPD credit by reading this article and successfully completing the online quiz. Visit Sonography Canada member's site at https://sonographycanada.ca/members/canadian-journal-medical-sonography

Article Name: Twin Reversed Arterial Perfusion (TRAP) Sequence: A Rare Case Report of an "Acardiac" Twin

Authors Name: Amanda Cook, MRSc, DMS, CRGS, RDMS, RMSKS

1. TRAP Sequence is unique to monochorionic twin pregnancy

a) True
b) False

2. Differential diagnosis for TRAP Sequence may include

a) Teratoma
b) Cystic hygroma
c) Fetal demise
d) Intra-amniotic tumours
e) All of the above

3. Features of an "acardiac twin" can include

a) Absent heart
b) Rudimentary heart
c) Non-functioning heart
d) Functional rudimentary heart
e) All of the above

4. Prenatal diagnosis of TRAP sequence is confirmed by demonstrating

1. A single placenta
2. Reversed flow in the umbilical artery of the pump twin
3. Reversed flow in the umbilical artery of the acardiac twin
4. A structurally normal fetus along with an abnormal fetus

a) 1,2,3
b) 1,3,4
c) 1,2,4
d) 2,3,4

5. Doppler may fail to demonstrate TRAP Sequence in the presence of

a) PROM
b) Hydrops fetalis
c) Polyhydramnios
d) High twin weight ratio

Pictorial Essay

Babitha Thampinathan, HBSc, RDCS, CRCS (AE),
Marcello Seung Ju Na, H.BSc, RDCS (AE), MHI (Candidate)
Jennifer Lam, BSc, RDCS, CRCS (AE)

Strain Imaging in Echocardiography Part 1 of 3: An Overview for Sonographers

About the Authors

Babitha Thampinathan, HBSc, RDCS, CRCS (AE), is affiliated with Toronto General Hospital, Ted Rogers Center for Heart Research and Mohawk-McMaster University Institute for Applied Health Sciences.

SeungJu Marcello Na, H.BSc, RDCS (AE), MHI (Candidate), is affiliated with Women's College Hospital, St. Michael's Hospital and Mohawk-McMaster University Institute for Applied Health Sciences.

Jennifer Lam, BSc, RDCS, CRCS (AE), is affiliated with Women's College Hospital and Toronto General Hospital.

ABSTRACT

Echocardiography is considered an important cardiovascular diagnostic test. Its development over recent years has made it an important clinical tool when obtaining information about cardiac structure and function non-invasively.

With the advancements in technology, the evaluation of myocardial function has also evolved. By introducing new imaging techniques such as strain echocardiography, cardiac sonographers with detailed acquisition and analysis can provide highly comprehensive information on left ventricular systolic and diastolic function. As global longitudinal strain (GLS) is already a routine clinical application, our goal is to provide imaging techniques and post-processing tools over a 3-part series for cardiac sonographers using this relatively novel assessment in echocardiography.

Keywords: speckle tracking echocardiography, strain imaging, left ventricular deformation, global longitudinal strain, myocardial deformation

Fundamental Concepts in Strain Imaging

Understanding the fundamental concepts of strain imaging can assist sonographers during image acquisition and optimization. The first part of this series will provide a brief overview of key terms and fundamental concepts that is used in strain imaging (Table 1).

Strain is also known as the deformation resulting from applied force. Strain imaging measures change in regional or global myocardial length throughout the cardiac cycle (Figure 3). More specifically, the strain formula represents the fractional (%) relationship of systolic deformation of myocardial length from end-diastole (Lo) to end-systole (L)[1]. Therefore, it is important to note that the lengthening of the myocardium is represented by a positive value; whereas, the shortening of the myocardium is represented by a negative value[2].

It is important to remember that the heart is three-dimensional, hence, during systolic deformation, there are several different ways strain imaging can be used (Figure 2). Unlike tissue Doppler imaging (TDI), where

Table 1. Fundamental Concepts in Strain Imaging

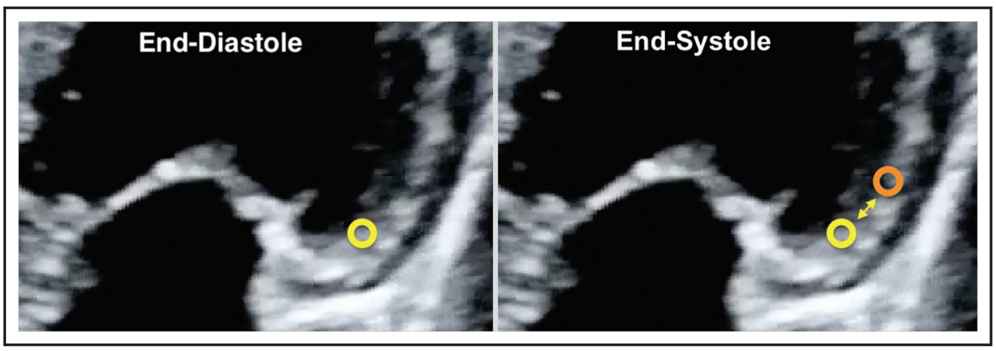
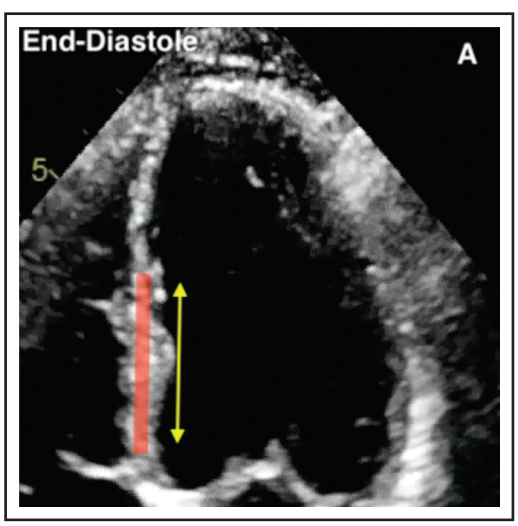
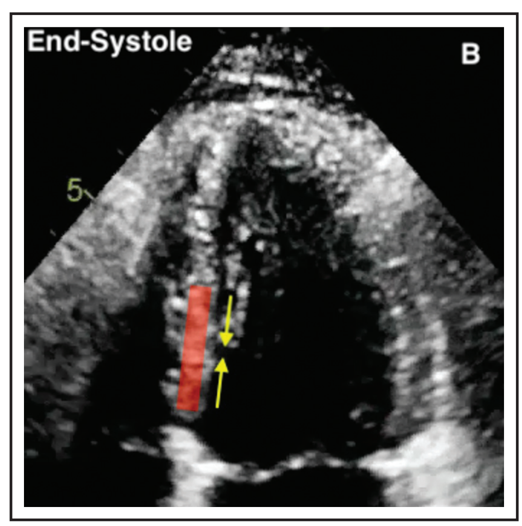
Key Terms	• Displacement: Overall change in shortening and lengthening of myocardial fibres. • Velocity: Time interval represented as distance over time acquired from Tissue Doppler Imaging. • Strain Rate: The change in strain (deformation) with respect to time.[4]
Speckle Tracking vs. Tissue Doppler	• Strain Analysis: Expressed in Percentage (%) ○ Measures change of myocardial fiber length over the cardiac cycles and can track the myocardium throughout the entire cardiac cycle.[5] ○ Angle Independent (Figure 1)  Figure 1. The advantage of strain imaging is angle independence. • Tissue Doppler: Expressed in Velocity (cm/s) ○ Measures instantaneous local myocardial velocities at a specific site (e.g., medial or lateral E'); however, may not follow the myocardium throughout the entire cardiac cycle.[6,7] ○ Angle Dependent
Directions of Strain	 Figure 2A. Longitudinal end-diastole.  Figure 2B. Longitudinal end-systole.

Table 1. Fundamental Concepts in Strain Imaging (*continued*)

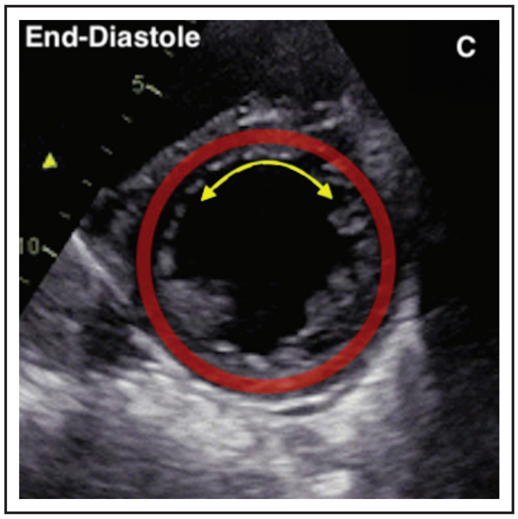
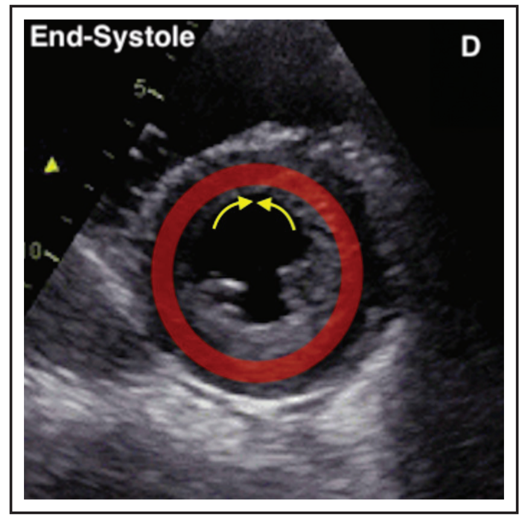
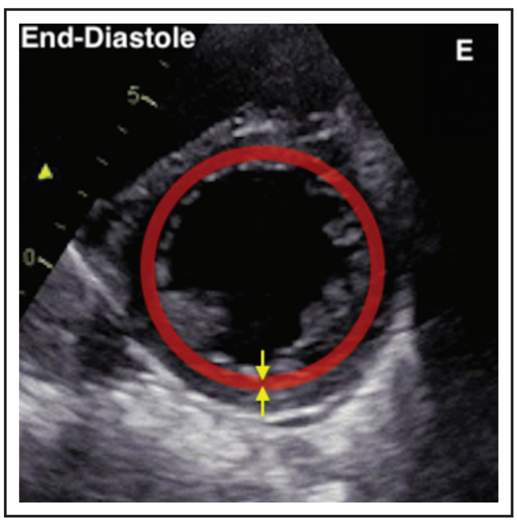
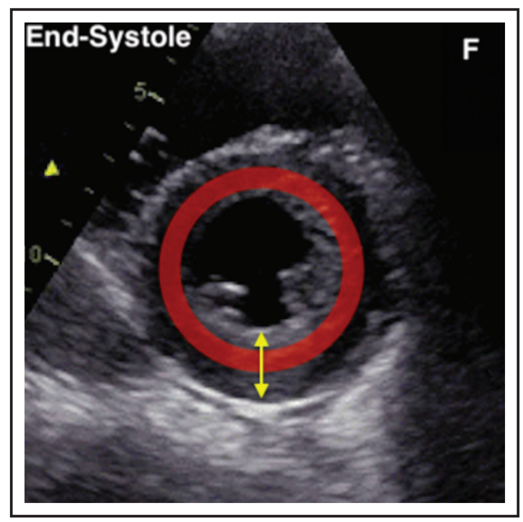
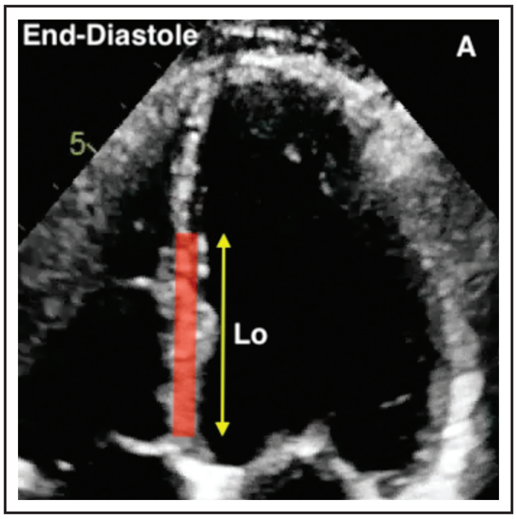
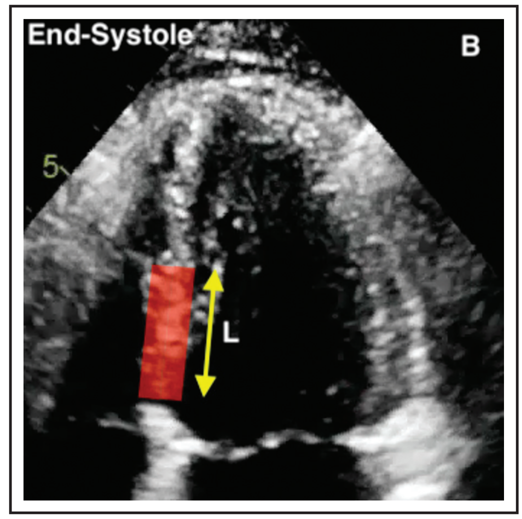
Directions of Strain (*continued*)	 Figure 2C. Circumferential end-diastole.  Figure 2D. Circumferential end-systole.  Figure 2E. Radial end-diastole.  Figure 2F. Radial end-systole.

Table 1. Fundamental Concepts in Strain Imaging (*continued*)

Fundamental Physics Concept	 Figure 3A. End-diastole.  Figure 3B. End-systole. $E = \frac{L - Lo}{L} = \frac{\Delta L}{Lo}$ E = myocardial deformation; L = myofiber length in end-systole; Lo = myofiber length in end-diastole. • Deformation: The change in shape that occurs to an object during its movement. • Speckle Tracking: A software that recognizes and follows a collection of individual speckles that are a reflection of the myocardial tissue throughout a cardiac cycle. • Strain imaging uses speckle tracking to measure myocardial fiber shortening and lengthening, ultimately providing information about myocardial deformation.

the imaging limitations include angle dependence and local myocardial analysis, strain imaging is angle independent and can analyze global and regional myocardium with better reproducibility.[3]

Strain imaging technique is a valuable tool to analyze left ventricular deformation and motion. Although strain can be measured using spectral Doppler methods, Two-Dimensional Speckle Tracking Echocardiography (2D STE) based strain measurements have become the clinical standard. 2D STE involves the tracking of ultrasound speckles, independent of the angle of insonation, following their motion within the myocardium frame-by-frame to calculate myocardial velocity, displacements, strain and strain rate in any direction. However, 2D STE is highly operator-dependent and discrepancies in image quality, acquisition and post-processing can lead to significant inter- and intra-observer variability.

Understanding the concepts of longitudinal strain imaging as provided in part 1 of this 3-part series is important when exploring techniques for image acquisition, optimization, analysis and post-processing of data. Our goal for this 3-part series is to provide a primer for new sonographers who wish to start performing longitudinal strain imaging during routine echocardiography. This includes focusing on clinical applications and technical limitations for cardiac sonographers using this relatively novel echocardiographic imaging technique in upcoming publications. We have focused on longitudinal strain measurements as this is the only measure that is ready for routine clinical application.

References

1. Hernandez-Suarez DF, López-Candales A. Strain imaging echocardiography: What imaging cardiologists should know. Curr Cardiol Rev 2017;13(2):118–29. doi:10.2174/1573403X12666161028122649.
2. Leung YD and Ng ACT. Emerging clinical role of strain imaging. Echocardiograph Heart Lung Circ 2010;19(3):161–74. https://doi.org/10.1016/j.hlc.2009.11.006.
3. Argyle RA and Ray SG. Stress and strain: double trouble or useful tool? Eur J Echocardiograph 2009;10:716–22. 10.1093/ejechocard/jep066.
4. Fleming AD, Xia X, McDicken WN, Sutherland GR, Fenn L. Myocardial velocity gradients detected by Doppler imaging. In: Br J Radiol 1994;67:679–88.
5. Otto MC. Cardiomyopathies, hypertensive and pulmonary heart disease. In: Textbook of Clinical Echocardiography, 3rd ed. Elsevier Saunders; 2004.
6. Phelan D, Collier P, Thavendiranathan P, et al. Relative apical sparing of longitudinal strain using two-dimensional speckle-tracking echocardiography is both sensitive and specific for the diagnosis of cardiac amyloidosis. Heart 2012;98:1442–48.
7. Serri K, Reant P, Lafitte M, et al. Global and regional myocardial function quantification by two-dimensional strain: Application in hypertrophic cardiomyopathy. J Am Coll Cardiol 2006;47:1175–81.

CJMS Article: Sonography Canada CPD Credit

Sonography Canada members can earn 1 Free CPD credit by reading this article and successfully completing the online quiz. Visit Sonography Canada member's site at https://sonographycanada.ca/members/canadian-journal-medical-sonography

Article Name: Strain Imaging in Echocardiography: Part 1: An Overview for Sonographers

Author's Names: Babitha Thampinathan, Marcello Seung Ju Na, Jennifer Lam

1. It is important to note that the lengthening of the myocardium is represented by a __________ value; whereas, the shortening of the myocardium is represented by a __________ value.

a) zero, positive
b) zero, negative
c) positive, negative
d) negative, positive

2. Strain rate is defined as:

a) The tension in the myocardial fibers.
b) The change in strain (deformation) with respect to time
c) Overall change in shortening and lengthening of myocardial fibers.
d) Time interval represented as distance over time acquired from Tissue Doppler Imaging.

3. Local myocardial analysis, strain imaging is angle dependent.

a) True
b) False

4. Speckle Tracking is defined as:

a) A vendor specific software used for strain
b) A software which is used on the echo machine to image Doppler patterns
c) A software which is used to distinguish speckle patterns from red blood cells
d) A software that recognizes and follows a collection of individual speckles that are a reflection of the myocardial tissue throughout a cardiac cycle.

5. In the equation $E = \frac{L - Lo}{L} = \frac{\Delta L}{Lo}$ the L refers to which of the following:

a) Speckle length
b) myocardial deformation
a) myofiber length in end-systole
b) myofiber length in end-diastole

Literature Review

Mengling Chen

A Review of the Triangular Fibrocartilage Complex Tear and its Sonographic Features

About the Author

Mengling Chen is a Student at McMaster University/Mohawk College in Hamilton, Ontario.

ABSTRACT

The triangular fibrocartilage complex (TFCC) serves as a major stabilizer of the ulna-carpal space, however, there is no official guideline on how to investigate a TFCC tear on ultrasound and there is little to no protocol on how to scan this structure. Although small, the complexity of the relational anatomy should not be underestimated. Hence there are several difficulties in recognizing anatomy and distinguishing the tears on Ultrasound. The use of 10-15 MHz high-frequency linear transducer is allowing sonographers to include TFCC examination as part of the wrist ultrasound. Two classification systems of TFCC tears and different treatment options will be discussed, comparing the existing treatment method and new emerging techniques.

The triangular fibrocartilage complex (TFCC) plays three important roles: it stabilizes the ulno-carpal and distal radio-ulnar joint, distributes 20% of the wrist load to the forearm, and allows the complexity in the movement of the wrist.[1] An injury to the TFCC commonly results in ulnar sided pain and joint instability.[2] Typically, the peripheral tears are caused by traction and twisting of the forearm and wrist and a fall on the outstretched hand (FOOSH).[3] The assessment of the wrist ligaments and TFCC is relatively new in Ultrasound. The evaluation of TFCC on ultrasound is still evolving and the results are very promising.[4] Studies have reported that there is a 71% correlation between ultrasound and MR arthrography for TFCC tears,[5] and an accuracy of 64% to 85% for detecting TFCC tears on ultrasound.[6] Therefore, more musculoskeletal sonographers should have an awareness of this structure and a basic understanding of the scanning techniques.

Literature Review

Anatomy

TFCC is found in the ulnar aspect of the wrist located between the ulnar, the lunate and the triquetrum.[7] In 1981, Palmer and Werner defined a group of soft tissue structures that stabilize the distal radioulnar joint (DRUJ) as the triangular fibrocartilage complex.[8] The primary stabilizers of this complex are the radioulnar ligament and the triangular fibrocartilage disc (TFC). On top of these two structures, they also included the ulnar collateral ligament, the extensor carpi ulnaris tendon sheath, and the meniscus homologue to the complex (Figure 1 and 2).[8]

Palmer and Warner defined the fibrous thickening originating from the extensor carpi ulnaris tendon sheath and the ulnar collateral ligament as 'meniscus homologue.' This term is confusing because the TFC itself is similar to a meniscus. Since the meniscus homologue serves no specific function, Teunis and Ring believe that "it seems preferable to simply describe it rather than naming it."[8] However, this term has been commonly used in most of the recent literature and textbooks. The TFC has a very thin center and a thickened periphery.[9] It attaches to the cartilage of the radial sigmoid notch at one end, and has a double insertion on the tip and the base of the ulnar styloid, thus creating a triangular shape. The volar and the dorsal radioulnar ligaments run from the radial notch to the base of the ulnar styloid fixating the anterior and the posterior portion of the complex.[9] It was found that ligaments do not provide a great role in stabilizing the DRUJ, but they are grouped with the fibrocartilage disc because they cannot be separately dissected.[8] In summary, the complex is composed of the TFC with the supporting structures surrounding it.

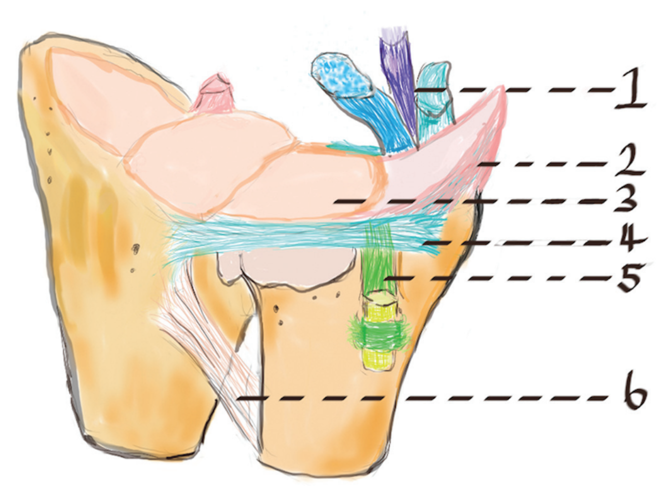


Figure 1. (1) Volar ulnocarpal ligament; (2) Meniscus homologue; (3) Fibrocartilage disc; (4) Dorsal distal radioulnar ligament; (5) Extensor carpi ulnaris sheath; (6) Distal oblique band of the interosseous ligament. [a]

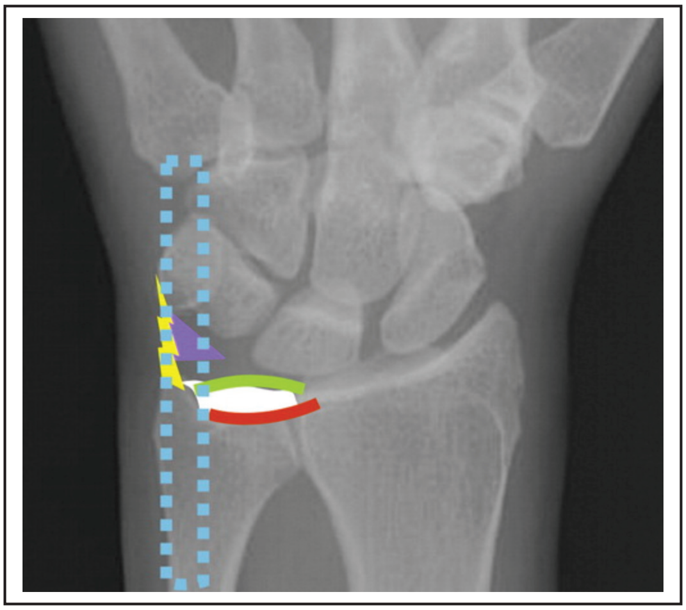


Figure 2. Radiograph of the Intrinsic and Extrinsic Wrist Ligaments and Triangular Fibrocartilage Complex. Red = dorsal radioulnar ligament; green = palmer radioulnar ligament; purple = meniscus homologue; blue = extensor carpi. [b]

Ultrasound Scanning Techniques and Sonographic Finding

Ultrasound provides valuable information in real-time and detects associated pathology. Nevertheless, Tricompartmental Arthrography and MRI are still the gold standard for diagnosing TFCC tears.[6] For an ultrasound examination of the TFCC, a layer of thick transmission gel or a stand-off pad can be used to achieve the correct visualization of the superficial ligaments.[10] It is preferable to scan with the 9–12 MHz linear "hockey stick" transducer because the small footprint helps maintain contact with the soft tissue.[11] Alternatively, a larger 14 MHz linear transducer can be used to allow tissue harmonic imaging and an extended field of view.

A useful initial examination of TFCC is by scanning through a coronal plane along the ulnar side of the wrist using the extensor carpi ulnaris as a window.[6] At this plane, one can visualize the TFC, the meniscus homologue, the triquetrum, the ECU, and the ulna. Sonographically, TFC is homogenous and echogenic; it is seen as an inverted triangular structure between the ulnar styloid and triquetrium. The normal measurement for the wide base of the TFC is about 4.5 mm, and the apex of the TFC attaching to the radius is normally measured as 2 mm.[6] The meniscus homologue may also appear as a hyperechoic triangular structure on ultrasound, however, the TFC is thinner and more proximal.[11] The sonographer should be cautious when differentiating between the TFC and the meniscus. After the initial evaluation, the TFC can be scanned dorsally with slight radial deviation (Figure 3), and with the wrist in supination (Figure 4). It is important to note that TFC demonstrates a hypoechoic appearance on the volar aspect, and it should not be mistaken as a tear. Some sonographers believe that scanning in supination shows a greater length of the disc because the styloid process is rotated dorsally.[10] The same patient position and transducer location used to scan the dorsal aspect of the TFC can be applied to scan the ulnar joint capsule (Figure 5), and it can be seen beneath the extensor carpi ulnaris.[10]

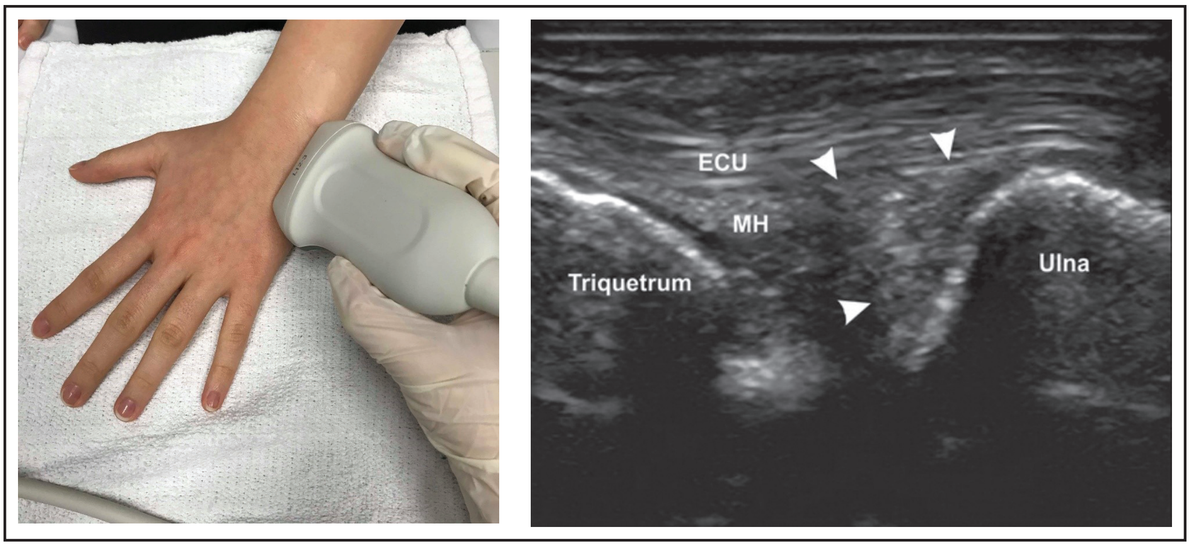


Figure 3. (Left) the transducer position for the scanning of TFC in the dorsal aspect. (Right) TFC (arrowheads), MH = meniscus homologue, ECU = extensor carpi ulnaris.

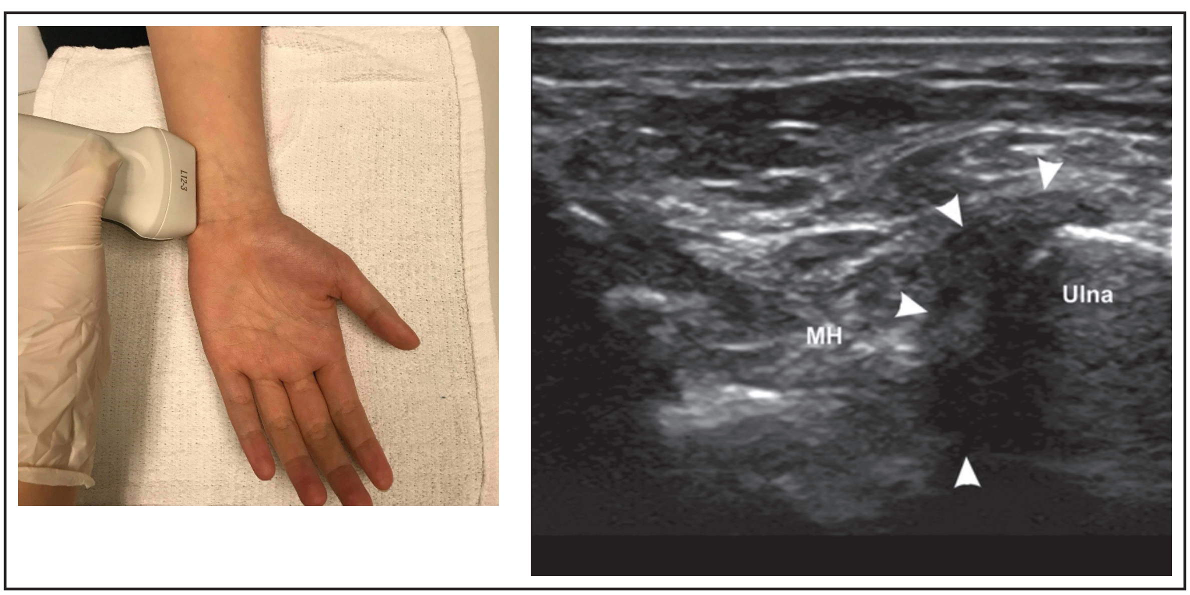


Figure 4. (Left) the transducer position for the scanning of TFC in the volar aspect. (Right) TFC (arrowheads), MH = meniscus homologue. [c]

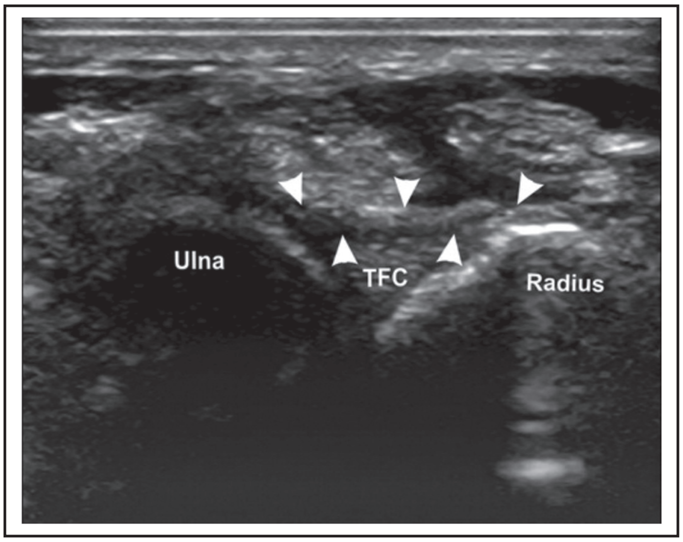


Figure 5. ulnar joint capsule (arrowheads).

Next, the evaluation can be performed by scanning the dorsal and the volar aspects of the radioulnar ligament in the transverse plane, moving the transducer a little closer to the radius from the scanning position for the TFC (Figure 6 and Figure 7). Normal radioulnar ligament appears as an echogenic band connecting the distal radius and ulna, and the two images can be taken in pronation and supination respectively.[10] TFCC injuries may be seen on ultrasound as an intra-substance defect and focal thinning (<2.5mm) of the TFC.[6] This is demonstrated in Figure 8 as a hypoechoic linear cleft. Other associated pathologies of TFCC such as a ganglion can also be detected on ultrasound (Figure 9). Table 1 indicates a protocol for scanning the TFCC and a checklist of anatomy demonstrated.

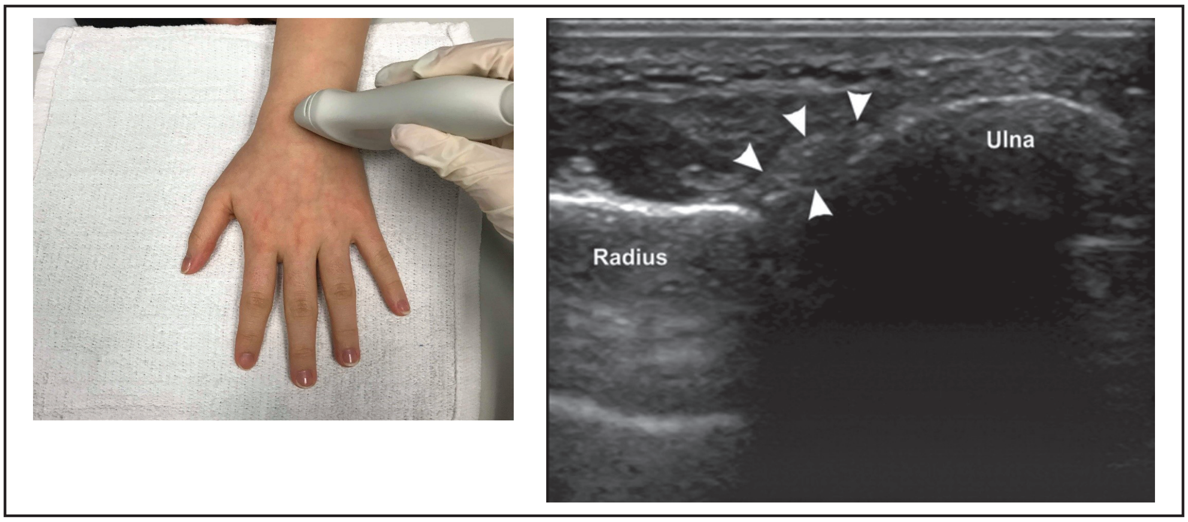


Figure 6. (Left) Position of transducer to scan the dorsal radioulnar ligament. (Right) Dorsal radioulnar ligament (arrowhead). [c]

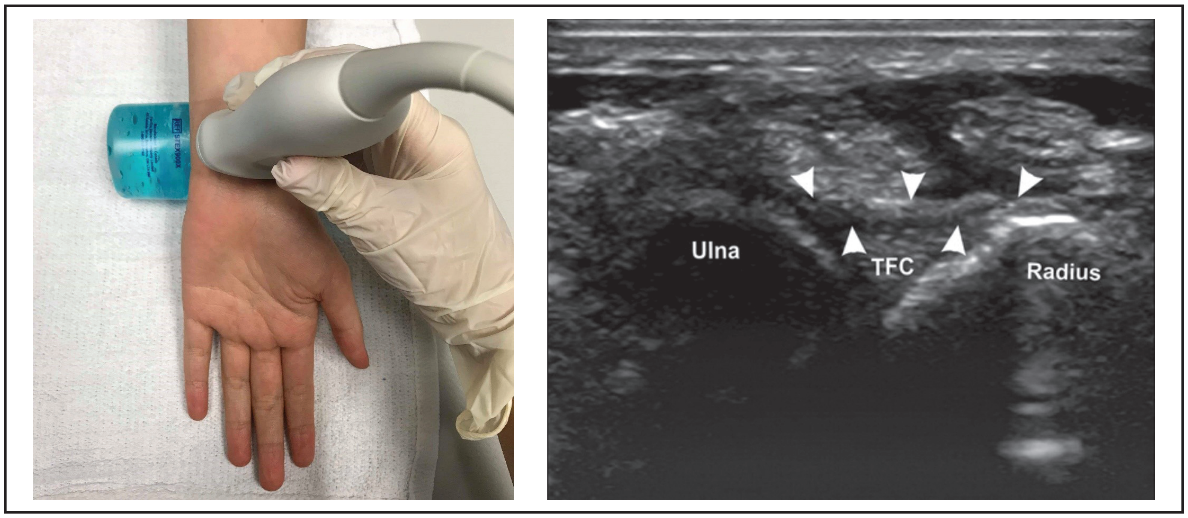


Figure 7. (Left) Position of transducer to scan the volar radioulnar ligament. (Right) Volar radioulnar ligament (arrowhead). [d]

Figure 8. Intra-substance tear of TFCC (yellow arrow).[e]

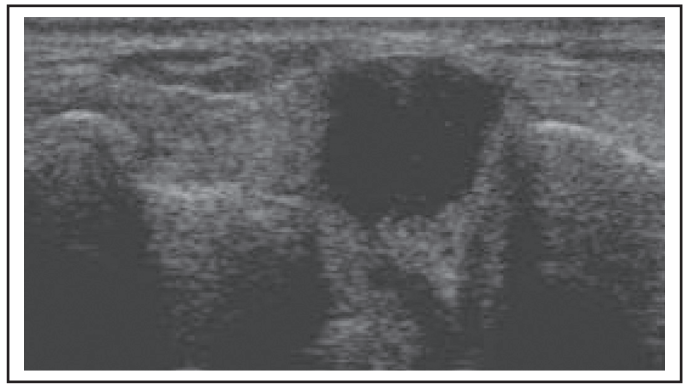


Figure 9. Ganglion within the TFCC. [e]

Table 1. TFCC Examination Checklist

Hand Position	Location & Scanning Plane	Structure of Interest
Pronation	Medial Coronal Plane	Triangular Fibrocartilage Disc, Meniscus Homologue, Ulna, Triquetrium, Lunate Extensor Carpi Ulnaris
Supination	Anterior Longitudinal Plane	Ulna Triangular Fibrocartilage Disc
Supination	Anterior Transverse Plane	Radius Ulna Dorsal Radioulnar Ligament
Pronation with slight radial elevation	Posterior Longitudinal Plane	Triangular Fibrocartilage Disc Ulna Meniscus Homologue
Pronation	Posterior Transverse Plane	Radius Ulna, Volar Radioulnar ligament Triangular Fibrocartilage Disc

Classifications and Treatment Algorithm

The early classification of the TFCC tears was introduced by Palmer and Werner in 1981. The accuracy of this system has not been tested.[8] However, it is widely accepted and used as a reference in many pieces of literature on TFCC.[3] This classification system divides different types of tears into two major categories: Type 1 traumatic lesions and Type 2 degenerative lesions. Each of the major categories is divided into 4 subcategories, A, B, C, and D (Figure 10). Table 2 explains the differences between each subcategory. In 2017, Atzei et al. developed a new classification system focusing on Type 1B tear because it is one of the most common cause of ulnar-sided pain (Figure 11).[3] This system includes clinically relevant information, and it provides a guideline for the treatment options. The clinical and arthroscopic assessments of Type 1B tear were conducted, and the results of the assessment were correlated to establish a treatment-oriented system with 5 different classes (Table 3).

The new classification system by Atzei and many other studies suggest that a major indicator for the course of treatment is if a patient has DRUJ instability. Arthroscopic suture repair is a very common treatment for TFCC injury with DRUJ instability, and it is known to be the gold standard treatment for any wrist pain, especially for TFCC lesions.[13] A

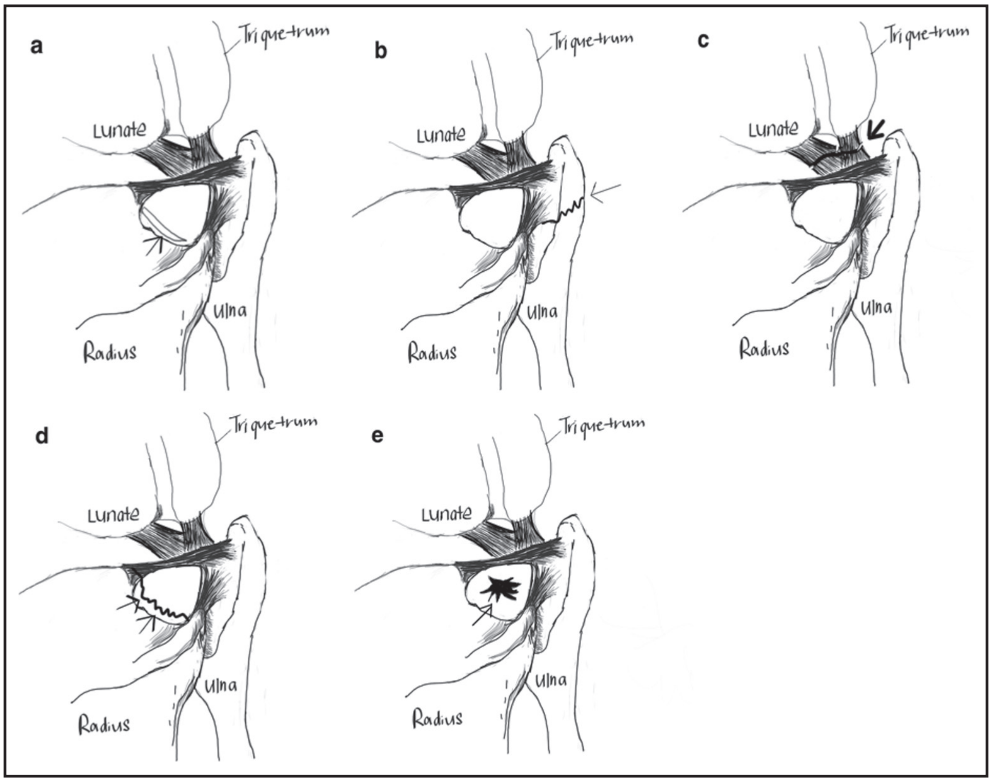


Figure 10. Triangular fibrocartilage complex (TFCC) tears - Palmer and Werner's classification system. (a) Type IA tear. (b) Type IB tear. (c) Type IC tear. (d) Type ID tear. (e) Type II tears. [f]

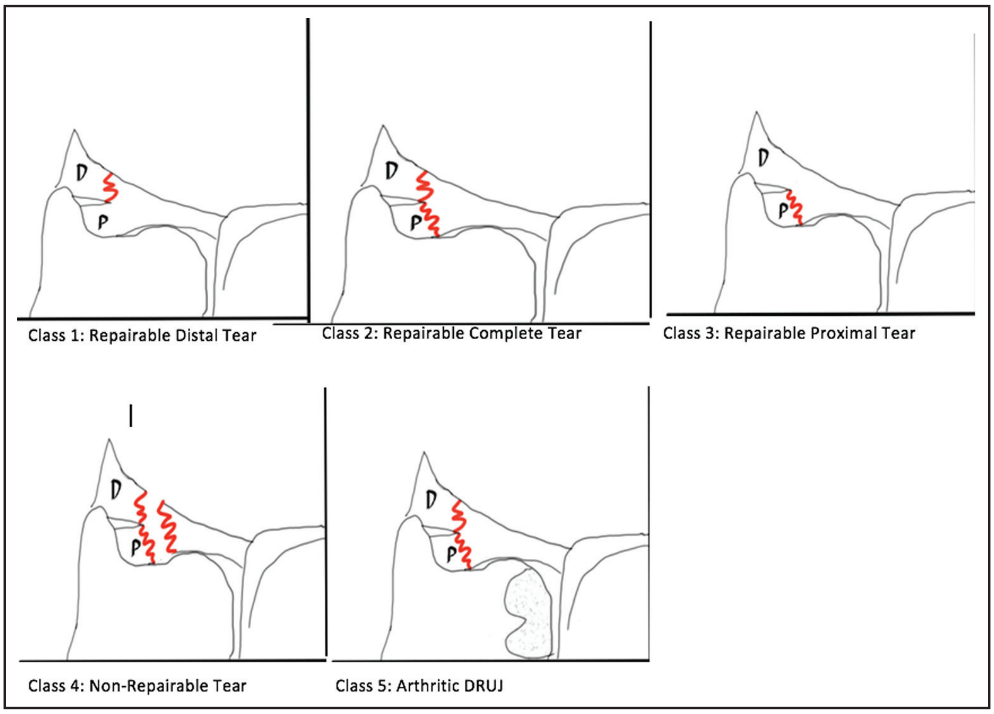


Figure 11. TFCC Type IB tears classification system by Atzei et al comparing five Classes of lesions.

Table 2. Classification of TFCC by Palmer and Werner[8]

Type 1 Traumatic	Type 2 Degenerative
A: Pathology involving the fibrocartilage disc and not involving the DRUJ ligaments	A: Wear to the complex without involving the articular disc
B: Injury of radioulnar ligament due to detachment from the distal ulna or due to a fracture located at the ulna styloid	B: Wear to the cartilage of the lunate or ulnar head without perforation
C: Lesions involving ulnocarpal ligament attachment associated with potential carpal instability	C: Perforation of the cartilage of the lunate or ulnar head
D: Complete avulsion of TFCC from the distal radius	D: The same condition as Type 2C plus the damage to the lunotriquetral ligament

Table 3. Modified Classification of TFCC & Treatment Options[3]

	TFCC Tears	Treatment
Class 1	Isolated tears of the complex No distal ulnar joint disability	Arthroscopy repair: Ligament to capsule rupture
Class 2	Rupture of TFCC and the proximal attachment of TFCC to the fovea Associated with distal radio-ulnar instability Most common symptomatic peripheral TFCC tear	Arthroscopy/ Surgical repair: Reattach the proximal insertion of the radioulnar ligament
Class 3	Rupture of the proximal attachment of TFCC to the fovea Associated with distal radio-ulnar instability Greater expertise in DRUJ required	
Class 4	Irreversible tears Severe and non-replaceable	Ligament reconstruction
Class 5	Chronic TFCC tear due to severe joint degeneration Association with joint arthritis	Can only be treated with salvage procedures

study was conducted to compare the effectiveness of an All-Inside Arthroscopic Suture Repair versus an Extensor Retinaculum Capsulorrhaphy with Herbert Sling in the restoration of joint stability. In comparison to open surgery, arthroscopic guidance decreases soft tissue trauma and increases final wrist motions. Though it may not fully address the anatomy of the TFCC.[13] Herbert Sling, on the other hand, uses an ulnar based flap of extensor retinaculum to stabilize both the radioulnar and the ulnocarpal articulation. The results of the study indicated that the recovery outcome is the best when both procedures are implemented, compared to performing each procedure alone.[13]

Another study was done on patients with TFCC tears who did not have DRUJ instability and the patients were followed for an average of 16 months. The result shows that 30% of the participants achieved complete recovery in 6 months, while 50% reached a full recovery in a year without surgical interventions.[14] It was found that non-surgical treatment can be successful in treating patients with TFCC tears, with a recommendation of a 6-month non-surgical treatment as the first option.[14] An alternative method opposing to non-surgical treatment for TFCC tears without DRUJ instability is the use of thermal energy combining with arthroscopic treatment. Some proposed that laser-assisted arthroscopy is an effective way to treat TFCC tears because it serves a location denervation effect and contributes to pain relief.[15] A study was conducted and 154 out of 162 patients had some degree of pain relieve and restore in the range of motion. It demonstrated that the use of thermal energy can assist in the management of ligaments and TFCC lesions.[15]

Discussion

The advancement in musculoskeletal ultrasound such as high-frequency probes and smaller probe face makes it possible to acquire high resolution images and detect tears in TFCC.[16] These tears are commonly caused by FOOSH and they are common at the periphery of the TFCC.[16] Sometimes it is possible to find a fracture or other injuries related to the upper extremity when a TFCC tear is found.[3] Treatment options are dependent on the stability of DRUJ, with the Arthroscopic suture being the gold standard. Although Tricompartmental Arthrography and MRI are the primary imaging tools for TFCC tears, ultrasound can assist with screening the patients and providing an adequate amount of diagnostic information about tears and other pathologies related to TFCC.

Conclusion

Triangular fibrocartlage complex is a relatively small structure in the musculoskeletal system and it plays an important role in the mobility of the wrist joints. Diagnostic Medical Ultrasound is a good test to diagnose TFCC, it is widely available, extremely safe, noninvasive, and provides real-time imaging; Including TFCC should be part of the scanning protocol for the wrist ultrasound.

Reference

1. Snell C. Triangular fibrocartilage complex tears: evidence based assessment and management [Internet]. [Publisher unknown]: The Sports Physiotherapist; 2012 [cited 2018 Oct 20]. Available from http://www.thesportsphysiotherapist.com/triangular-fibrocartilage-complex-tears-evidence-based-assessment-and-management/.
2. Lee J, Hwang J, Lee S, et al. What is the natural history of the triangular fibrocartilage complex distal radioulnar joint instability. Clin Orthop Relat Res 2018.
3. Atzei A, Luchetti R, Garagnaini L. Classification of ulnar triangular fibrocartilage complex tears. A treatment algorithm for Palmer type IB tears. J Hand Surg Am 2017;42(4);405–14.
4. Vassalo P. Ultrasound of the wrist ligament. The Synapse. 2011;(4);26–27.
5. McCarthy C, Calleja M. Radiology Society of North American 2010 Science Assembly and Annual Meeting [Internet]. [Publisher Unknown]; 2010 [cited 2018 Nov 23]. Available from https://www.ncbi.nlm.nih.gov/pubmed/23409566.
6. McNally GE. Practical Musculoskeletal Ultrasound. 2nd Edition. Philadelphia: Elsevier Limited; 2014.
7. Goel A, Knipe H. Radiopaedia [Internet]. [Publisher Unknown]: Radipaedia; [date unknown] [cited 2018 Nov 20]. Available from https://radiopaedia.org/articles/triangular-fibrocartilage-complex.
8. Teunis T, Ring D. Review of Palmer and Werner (1981) on the triangular fibrocartilage complex of the wrist anatomy and function. J ISAKOS. 2017; 2(6); 350–54.
9. Mespreuve M, Vanhoenacker F, Verstraete F. Imagining Findings of the Distal Radio-Ulnar Joint in Trauma. J Belg Soc Radiol 2015;99(1);1–20.
10. Taljanovic S, Goldberg R, Sheppard E, et al. US of the Intrinsic and Extrinsic Wrist Ligaments and Triangular Fibrocartilage Complex – Normal Anatomy and Imagining Technique [Internet]. [Publisher unknown]: Radio Graphics; 2011 [cited 2018 Nov 15]. Available from https://pubs.rsna.org/doi/10.1148/rg.e44.
11. Jacobson J. Fundamental of Musculoskeletal Ultrasound. 3rd Edition. Philadelphia: Elsevier Limited; 2017.
12. Nakamura T, Matsumura N, Iwamoto T, et al. Arthroscopy of the distal radioulnar joint. Handchir Mikrochir Plast Chir 2014;46(05);295–99.
13. Patel A, Alhandi A, Milne E, et al. Biochemical analysis of al-inside, arthroscopic suture repair

versus extensor retinaculum capsulorrhaphy for triangular fibrocartilage complex tears with instability. J Hand Surg Am 2016;41(3);387–93.

14. Lee J, Hwang J, Lee S, et al. What is the natural history of the triangular fibrocartilage complex distal radioulnar joint instability. Clin Orthop Relat Res 2018.
15. Lopez G I, Delgado J P, Abad M J, et al. Thermal energy for the arthroscopic treatment of tears of the triangular fibrocartilage of the wrist. Acta Orthop Belg 2012;78(6);719–23.
16. Watanabe A, Souza F, Vezeridis S P, et al. Ulnar-sided wrist pain. II. Clinical imaging and treatment. Skeletal Radiol 2010;39(9);837–57.

Images retrieved from:

Figure 1. Distal radioulnar joint. Journal of ISAKOS. Review of Palmer and Werner (1981) on the triangular fibrocartilage complex of the wrist anatomy and function. 2017; https://www.researchgate.net/publication/319401076_The_Classic_Review_of_Palmer_andWerner_1981_on_the_triangular_fibrocartilage_complex_of_the_wrist_anatomy_and_function. Accessed November 10, 2018

Figure 2. 2011: https://pubs.rsna.org/doi/10.1148/rg.e44. Accessed November 20, 2018.

Figures 3,4,5,6. Radio Graphic. US of the Intrinsic and Extrinsic Wrist Ligaments and Triangular Fibrocartilage Complex—Normal Anatomy and Imaging Technique. 2011; https://pubs.rsna.org/doi/10.1148/rg.e44. Accessed November 20, 2018

Figure 7. Radio Graphic. US of the Intrinsic and Extrinsic Wrist Ligaments and Triangular Fibrocartilage Complex—Normal Anatomy and Imaging Technique. 2011; https://pubs.rsna.org/doi/10.1148/rg.e44. Accessed November 20, 2018.

Figure 8 and Figure 9. Pathology of TFCC. The Synapse. Ultrasound of the wrist ligament. 2011; https://www.um.edu.mt/library/oar/handle/123456789/12794. Accessed November 15, 2018,

TFCC Lesions. Skeletal Radiol. Ulnar-sided wrist pain. II. Clinical imaging and treatment. 2010; 10.1007/s00256009-0842-3. Accessed January 15th, 2019

TFCC Lesions. J Hand Surg Am. Classification of ulnar triangular fibrocartilage complex tears. A treatment algorithm for Palmer type IB tears. 2017; https://www.ncbi.nlm.nih.gov/pubmed/28132592. Accessed November 10th, 2018.

CJMS Article: Sonography Canada CPD Credit

Sonography Canada members can earn 1 Free CPD credit by reading this article and successfully completing the online quiz. Visit Sonography Canada member's site at https://sonographycanada.ca/members/canadian-journal-medical-sonography

Article Name: A Review of the Triangular Fibrocartilage Complex Tear and its Sonographic Features

Author Name: Mengling Chen

1. The Triangular fibrocartilage complex is located

a. Ulna, capitate
b. Radial head, capitate
c. Ulna, lunate and the triquetrum
d. Ulna, ulna styloid process & lunate

2. The 3 roles of triangular fibrocartilage complex tear are:

1. Stabilizes proximal radio-ulnar joint
2. Stabilizes the carpal bones
3. Allows complex movement of the wrist
4. Distributes 20% of the wrist load to the forearm
5. Stabilizes the ulno-carpal & distal radio-ulnar joint

a. 1,2,3
b. 2,3,4
c. 3,4,5
d. 1,3,4

3. Injury to the TFCC commonly results in ________________ and wrist joint instability

a. Palmar pain
b. Fingertip pain
c. Ulnar sided pain
d. Radial sided pain

4. Triangular fibrocartilage complex tears are commonly caused by caused by

a. FISH
b. TORCH
c. FOOSH
d. Fractures

5. Best Diagnostic imaging for triangular fibrocartilage complex tears are

a. CT & MRI
b. CT & X-Ray
c. MRI & Ultrasound
d. X-Ray & Ultrasound

Sonography Canada Échographie® Canada

Plan on joining us for #SonoCon2020 in Calgary, Alberta, May 8 – 10, 2020. This is the only national educational conference on sonography in Canada.

SONOCON2020

For 2020, **we have re-branded our conference to SonoCon**, to reflect the modern sonographer. Our 2020 National Conference is where sonographers, managers, educators, allied health professionals, employers and decision makers will congregate to update their skills and knowledge, achieve their professional goals and to learn about new trends and developments that supports a high standard of patient care.

Sonography Canada Échographie® Canada

FOCUS ON YOUR WILD SIDE

Conference & AGM | May 8-10, 2020
Hyatt Regency Hotel Calgary

The theme for the conference this year is "Focus on Your Wild Side", and we have some exciting NEW additions to our program this year:

- Lightning Round Sessions
- New Education Track
- Exciting Keynote Speakers
- Enhanced Hands-On Workshops
- Our Saturday Social Event: Get Your Wild Side On at the Calgary Zoo

Overview of the program:

We are thrilled to announce that we will be welcoming Dr. Doug Hamilton, who will kick off the conference on the first morning with his Space talk.

Other keynotes include Dr. Doug Whiteside who will present Wild Imaging – Use of Ultrasound in Zoo Species; and Teri Price will close out the conference on Sunday with the Greg's Wings Video & Panel Presentation

Plenary sessions will feature:

- Professional Practice Guidelines & Q&A (presented by Tara Chegwin, CRGS)
- Sonography Canada Update (presented by the Sonography Canada team)
- Sonography Canada Awards Presentation, Annual General Meeting & Halifax Presentation

Our tracks represent a variety of interests, with fantastic education planned! Here is a sampling of what you can expect:

<u>Breast Stream:</u>

- Breast Cancer Patient Experience (Ms. Katherine Jensen, BA MRT(T))
- Axillary Sonography in Breast Imaging (Dr. Mollie Ferris)

<u>Cardiac Stream:</u>

- Pediatric Cardiac Tumors (Dr. David Patton, MD, FRCPC)
- Heart Transplant Assessment (Dr. Debra Isaac, BN, MD, FRCPC, FACC, FCCS)
- Hypertrophic Cardiomyopathy (Dr. Andrew Grant, MD)
- Fetal Echo (Dr. Deborah Fruitman)

<u>Education Stream:</u>

- Presentation Skills (Mr. Doug Downs)
- Journal Writing (Ms. Sheena Bhimji-Hewitt, CRGS, CRVS, DMS)
- Student Transitions (Tara Chegwin, CRGS & Tim Proveda, CRGS, CRVS)
- Shift Change. A Patient Perspective Learning Tool (Ms. Sandra Dobson, MEd; CRGS)

<u>Generalist Stream:</u>

- Neck Pathology Cases (Ms. Jill Woodwark, CRGS, CRCS, CRVS)
- Perianal Fistulas (Ms. Andie Kidd (CRGS, CRCS, CRVS)
- Mullerian Duct Anomalies (Ms. Amber Javaid, CRGS, RDMS,RV,RMSKS)

<u>MSK Stream:</u>

- Giant Cell Tumor (Ms. June Cotton, CRGS, CRCS, CRVS, RMSKS)
- Hamstrings (Mr. Luke McLeod, CRGS, RMSKS)
- Peripheral Nerves (Dr. Sarah Koles, FRCPC)

Pediatric Stream:

- NICU Neurosonography (Dr. David Lautner)
- Sonographic and Doppler Evaluation of Soft Tissue Vascular Lesions (Dr. Zarina Assis, MD)
- Interesting Cases (Lucy Creamer, CRGS, CRVS)

Vascular Stream:

- Gated Aorta (Dr. Randy Moore)
- Temporal Arteries (Mr. Simon Greenwood, Accredited Vascular Scientist (SVT GB&I) Clinical Scientist (Health and Care Professions Council, UK) CRVS
- Thoracic Outlet Syndrome (Dr. Chris Ford, MD, FRCPC)

And SO much more over the three days of the conference!

What else is happening?

MORE time for Hands-On Workshops:

Our Program Committee has worked really hard to put together a phenomenal program, including extended hours for MORE opportunities for Hands-On Workshops. We did this because year over year, this is a very popular part of the program, and we want to make sure as many participants have the opportunity to experience this as possible!

Social Night at the Calgary Zoo:

Get ready to bring out your inner party animal!! Join us at the African Pavilion at the Calgary Zoo for a great night of fun and networking from 6PM till Midnight. We will enjoy a sit-down dinner with incredible Duelling Pianos entertainment, and your zoo admission is included if you choose to take in some of the exhibits before dinner. *Additional Fee Applies*

Ready to learn more & register? Visit our website for ALL the details:

- Booking your hotel room
- NEW: Our toolkit (to help you make the case for participating in the conference with your team/superiors)
- Program-at-a-Glance
- Sponsor/Exhibitor Information
- Registration!

Questions about the conference this year? Do not hesitate to reach out to conferenceinfo@sonographycanada.ca