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CJMS

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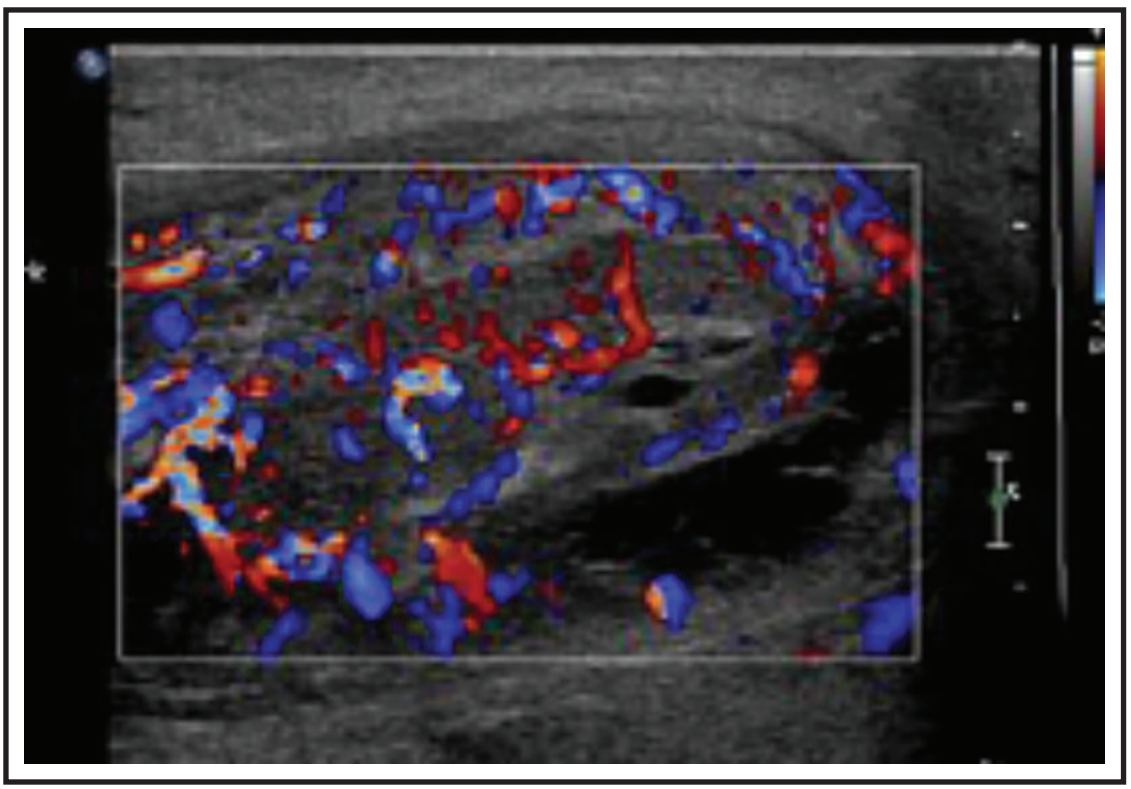

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About the Cover

This image is from Manon Pilotte, & Megan White's article on Acute Epididymo-Orchitis-Related Infarction of the Testicle: How Did Spectral Doppler Predict the Outcome? Case Figure 2. Left testicle. D. Sagittal image demonstrating enlarged hyperemic epididymal tail.

Message from the Editor-in-Chief

Preparing issue two for publication was a challenge since all our lives have been turned around by the rapid onset of COVID-19. Sonographers are on the front lines, working in hospitals that have COVID-19 patients while conducting examinations on patients that need routine and follow up ultrasounds required in obstetrics.

Most clinical sites have cancelled elective ultrasound appointments resulting in the temporary layoff of sonographers or their deployment to other areas due to the reduction in ultrasound procedures. All health care workers including sonographers are stressed by the implications of this disease, its transmission, and the lack of available personal protective equipment (PPE) at some sites.

The condition of COVID-19 patients and physical distancing measures are a challenge for sonographers as the very nature of ultrasound scanning puts sonographers in close contact with patients. Working with PPE for contact and droplet isolation and doing an ultrasound that may take 40 minutes or longer puts a sonographer at a greater risk of contracting COVID-19 themselves. Healthcare workers also fear that they may take this infection home with them.

Sonography educators across Canada are transitioning to an online format for the academic components of their courses and utilizing more simulations as clinical practicums are put on hold. Students who started their clinical practicums are at home awaiting openings for them to complete their clinical competencies for graduation and credentialing. Examination centres have closed and will not re-open until restrictions are lifted.

Sonography Canada has adjusted exam eligibility criteria to make allowances for this situation and stated schools and the regulator in Ontario. Also, students will be able to challenge their examinations in a secure online format. Visit the Sonography Canada website for more information. The National Education Academic Council (NEAC) is actively facilitating collaborations between the accredited ultrasound programs making it possible for students and faculty in Canada to share knowledge and resources.

Never in our lifetimes have we been touched by such a contagious virus; its impact is changing our normal lives and stressing family, colleagues, friends and all those that are on the front lines; our health care workers, first responders, grocery store workers, delivery personnel, garbage collectors and more, but Canadians have come together at this time to support and share their resources.

Research on this infection is coming out at a rate that I have never seen before. Lung ultrasound at the patient's bedside has gained a place in diagnostic imaging and I have compiled some literature and resources in a special report for this issue.

Also, this issue has an interesting case report on acute epididymo-orchitis infarction of the testicle and the importance of utilizing Doppler Ultrasound, authored by Manon Pilotte and Megan White, two generalist sonographers from the Ottawa area.

Babitha Thampinathan and her team from the University Health Network in Toronto have submitted part 2 of a 3-part series on Strain imaging in Echocardiography. This installment deals with sonographer initiatives and an imaging protocol. This is presented as a pictorial essay and has some excellent images.

Sonography Canada is sharing the survey results from the membership survey conducted in 2018; reported in 2019 and is also publishing the "Sonography Canada Statement: Sonographers and COVID-19." The Statement has been supported by the Canadian Association of Radiologists and may be found on their website at or the Sonography Canada website at https://car.ca/covid-19/.

CJMS editors, reviewers, and I encourage you, your families, and all those around you to be safe and healthy during this challenging time.

Pushing the boundaries

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

Editor-in-Chief

*This 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

La préparation du deuxième numéro pour la publication a été un défi puisque toutes nos vies ont été bouleversées par l'apparition rapide de COVID-19. Les échographistes sont en première ligne, travaillant dans les hôpitaux qui ont des patients COVID-19 tout en effectuant des examens sur les patients qui ont besoin d'échographies de routine et de suivi en obstétrique.

La plupart des sites cliniques ont annulé des rendez-vous d'échographie électifs, ce qui a entraîné le licenciement temporaire des échographistes ou leur déploiement dans d'autres secteurs en raison de la réduction des procédures d'échographie. Tous les travailleurs de la santé, y compris les échographistes, sont stressés par les implications de cette maladie, sa transmission et le manque d'équipement de protection individuelle (EPI) disponible dans certains sites.

L'état des patients COVID-19 et les mesures d'éloignement physique constituent un défi pour les échographistes, car la nature même de l'échographie met les échographistes en contact étroit avec les patients. Le fait de travailler avec un EPI pour l'isolation des contacts et des gouttelettes et de faire une échographie qui peut prendre 40 minutes ou plus augmente le risque pour les échographistes de contracter eux-mêmes COVID-19. Les travailleurs de la santé craignent également d'emporter cette infection chez eux.

Les éducateurs en échographie du Canada sont en train de passer à un format en ligne pour les composantes académiques de leurs cours et utilisent davantage de simulations au fur et à mesure que les stages cliniques sont mis en attente. Les étudiants qui ont commencé leurs stages cliniques sont chez eux à attendre des ouvertures pour qu'ils puissent compléter leurs compétences cliniques en vue de l'obtention de leur diplôme et de leur accréditation. Les centres d'examen ont fermé et ne rouvriront pas tant que les restrictions ne seront pas levées.

Sonography Canada a modifié les critères d'admissibilité aux examens pour tenir compte de cette situation et a indiqué les écoles et l'organisme de réglementation en Ontario. De plus, les étudiants pourront contester leurs examens dans un format en ligne sécurisé. Visitez le site web de Sonography Canada pour plus d'informations. Le National Education Academic Council (NEAC) facilite activement la collaboration entre les programmes d'échographie accrédités, ce qui permet aux étudiants et aux professeurs du Canada de partager leurs connaissances et leurs ressources.

Jamais de notre vie nous n'avons été touchés par un virus aussi contagieux; son impact change notre vie normale et stresse la famille, les collègues, les amis et tous ceux qui sont en première ligne ; nos travailleurs de la santé, les premiers intervenants, les employés des épiceries, les livreurs, les éboueurs et bien d'autres encore, mais les Canadiens se sont réunis en ce moment pour soutenir et partager leurs ressources.

La recherche sur cette infection progresse à un rythme que je n'avais jamais vu auparavant. L'échographie pulmonaire au chevet du patient a gagné une place dans l'imagerie diagnostique et j'ai rassemblé quelques documents et ressources dans un rapport spécial pour ce numéro.

Ce numéro présente également un cas intéressant d'infarctus aigu du testicule dû à une épididymo-orchite et l'importance de l'utilisation de l'échographie Doppler, rédigé par Manon Pilotte et Megan White, deux échographistes généralistes de la région d'Ottawa.

Babitha Thampinathan et son équipe du University Health Network de Toronto ont soumis la deuxième partie d'une série de trois articles sur l'imagerie des contraintes en échocardiographie. Ce volet traite des initiatives des échographistes et d'un protocole d'imagerie. Il se présente sous la forme d'un essai en images et comporte d'excellentes images.

Sonography Canada partage les résultats de l'enquête menée en 2018 auprès de ses membres et partagée en 2019 et publie également la "Déclaration de Sonography Canada" : Les échographistes et COVID-19". La déclaration a été soutenue par l'Association canadienne des radiologistes et peut être consultée sur son site web à l'adresse suivante ou sur le site web de Sonography Canada à l'adresse suivante : https://car.ca/covid-19/.

Traduit avec www.DeepL.com/Translator (version gratuite)

Les rédacteurs et les réviseurs de la CJMS et moi-même vous encourageons, ainsi que vos familles et tous ceux qui vous entourent, à être en sécurité et en bonne santé pendant cette période difficile.

Repousser les limites

Sheena Bhimji Hewitt

Rédactrice en chef

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

Special Report

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

COVID-19: The Use of Lung Ultrasound

March 11, 2020 was the date that the World Health Organization (WHO) declared Coronavirus 2019 (COVID-19) a pandemic.[1] This declaration and the virus has impacted the world; as of April 18, 2020; 185 out of 195 countries have been impacted, there are 2,265,727 confirmed cases, 156,064 global deaths. Canada has 32,857 people infected and 1,356 deaths.[2]

COVID-19 is predominantly a respiratory disease and the severity of symptoms ranges from mild to fatal.[3] Transmission between humans is thought to be brought about by close physical contact whereby respiratory droplets or airborne pathways are created during procedures that generate aerosols. COVID findings are consistent with viral pneumonia caused by viral infections such as Severe Acute Respiratory Syndrome (SARS) or Middle East Respiratory Syndrome (MERS).[4,5]

Computerized tomography (CT) of the chest is the best diagnostic imaging test for lung consolidation and is used for the management and evaluation of urgent findings.[6,7] To utilize CT, the patient has to be transported to the room, increasing points of contact for other healthcare workers such as porters, CT staff, and, in critical cases, exposure to the respiratory therapist (RT) or accompanying nurse.[8] CT also exposes the patient to radiation and is contraindicated for a pregnant patient. There is a limited number of CT scanners at hospital sites and disinfecting the CT diagnostic suite and equipment is extensive which limits access to conduct cases.

As Canadian sonographers we are not directly involved in the imaging of this disease presently; but reports out of China and Italy, two of the first and hardest-hit countries in the world, are reporting positive results for the use of bedside lung ultrasound (LUS) to confirm lung consolidation.[3,7–9] To date LUS has been utilized to diagnose respiratory conditions such as pneumonia, pleural effusions, and pneumothorax; mostly by POCUS users.[5]

Looking from a generalist or cardiac sonographer's perspective, portable LUS at the patient's bedside may reduce exposure for HCWs since there is no transport involved. LUS may also provide better care for the patient in respiratory distress, pregnant patients, young children, and patients of reproductive age where a dose of CT radiation is contraindicated. Disinfection of the portable or handheld ultrasound device is much simpler and more efficient than disinfecting an entire CT suite.[2] Testing done at the patient's bedside may make it easier for a patient who may be very scared and in distress.

There are many resources available on the Internet to learn the skill of conducting a lung ultrasound. The challenge is to train, apply, and gain expertise in this skill promptly to impact patient care now. Here are some good resources on conducting lung ultrasound that you may find helpful

https://litfl.com/lung-ultrasound-in-covid-19/

https://www.youtube.com/watch?v=zDNQnXETSBw&list=PLUkApVTR3S-6PEaS-By1kru1qqNqUEcRI&index=5

There is limited research in the reliability of lung ultrasound in COVID and no robust correlational studies with CT. I hope that you can take this opportunity in your clinical practice to learn and apply this new

examination, to research the correlation between CT and lung ultrasound findings and create a hub to train the trainer to spread this knowledge and skill.

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Article Name: Special Report: COVID-19-The Use of Lung Ultrasound

Authors Name: Sheena Bhimji-Hewitt, MAppSc, DMS, CRGS, CRVS, RDMS, RVT

1. COVID-19 is predominately transmitted by all of the following except

a) Close contact
b) Any body fluid
c) Respiratory Droplets
d) Airborne during procedures that generate aerosols

2. Best diagnostic imaging test for lung consolidation is

a) Chest X Ray
b) Lung ultrasound
c) Respiratory Therapy
d) Computed Tomography

3. In China and Italy the following bedside medical diagnostic imaging proved to be useful and allowed for less contact with other health care workers

a) Chest XRay
b) Lung ultrasound
c) Respiratory Therapy
d) Computed Tomography

4. Computed Tomography may be contraindicated for some specific populations

1. Young children
2. Pregnant patients
3. Critical patients in severe respiratory distress
4. Patients of reproductive age

a) 1
b) 2
c) 1,2
d) 1,2,3
e) All of the above

5. COVID-19 was declared a pandemic by the

a) ACR
b) CAR
c) WHO
d) MERS

Sonography Canada: Recommended Resources for COVID-19

The following resources are also posted on the Sonography Canada Website at https://sonographycanada.ca/covid

Department Guidelines/Recommendations	
RSNA	Radiology Department Preparedness for COVID-19: Radiology Scientific Expert Panel https://pubs.rsna.org/doi/10.1148/radiol.2020200988
ISUOG	How to prepare your unit for Corona virus- lessons learned https://www.isuog.org/clinical-resources/coronavirus-covid-19-resources/webinar-series-on-covid-19/first-webinar-prepare-your-unit-for-coronavirus.html
ASE	Webinar: COVID-19 Preparedness for Echo Labs: Insights from the front lines https://www.asecho.org/covid-19-resources/
AIUM	Quick Guide on COVID-19 Protections- Patient and Ultrasound Provider Protection https://aium.s3.amazonaws.com/covid19/Covid19_Quick_Guide_PUPP.pdf
Hand Hygiene	
IPAC	https://ipac-canada.org/hand-hygiene.php
Personal Protection Equipment (PPE)	
WHO	Put on: https://www.who.int/csr/disease/ebola/put_on_ppequipment.pdf Take off: https://www.who.int/csr/disease/ebola/remove_ppequipment.pdf
CDC	https://www.cdc.gov/hai/prevent/ppe.html
PSHA	PSHSA Resources https://www.pshsa.ca/covid-19
PHO	https://www.publichealthontario.ca/-/media/documents/ncov/updated-ipac-measures-covid-19.pdf?la=en
ASE	Webinar Specific Considerations for The Protection Of Patients And Echo Service Providers When Performing Perioperative Or Periprocedural TEE During The 2019 Novel Coronavirus Outbreak https://www.asecho.org/covid-19-resources/

Preparation and Cleaning of Ultrasound Room, Equipment, and Transducers	
AIUM	Guidelines for Cleaning and Preparing External- and Internal-Use Ultrasound Transducers and Equipment Between Patients as well as Safe Handling and Use of Ultrasound Coupling Gel https://www.aium.org/officialStatements/57
ASUM	Guidelines for Reprocessing Ultrasound Transducers https://onlinelibrary.wiley.com/doi/pdf/10.1002/ajum.12042
AIUM	Quick Guide on COVID-19 Protections — Ultrasound Transducers, Equipment, and Gel https://aium.s3.amazonaws.com/covid19/Covid19_Quick_Guide_UTEG.pdf
SoR	Effective and safe decontamination of ultrasound machines and transducers https://www.sor.org/news/effective-and-safe-decontamination-ultrasound-machines-and-transducers
ISUOG	ISUOG Safety Committee Position Statement: safe performance of obstetric and gynecological scans and equipment cleaning in the context of COVID-19
FUSIC	Ultrasound Transducer and Equipment Cleaning and Disinfection https://www.acutemedicine.org.uk/wp-content/uploads/2020/03/FUSIC_FAMUS-Decontamination-guidelines.pdf

Abbreviation List

AIUM: American Institute of Ultrasound in Medicine

ASE: American Society of Echocardiography

ASUM: *Australasian Society for Ultrasound in Medicine*

CDC: Centers for Disease Control & Prevention

FUSIC: Focused Ultrasound for Intensive Care

IPAC: Infection Prevention & Control

ISUOG: International society of professionals in ultrasound for obstetrics and gynecology

PHO: Public Health Ontario

PSHA: Public Services Health & Safety Association

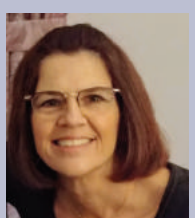
SoR: The Society of Radiographers

WHO: World Health Organization

Case Report

Manon Pilotte, RDMS, CRGS, DMS and Megan White, BMRSc, RDMS, RVT, CRGS, CRVT, DMS

Acute Epididymo-Orchitis-Related Infarction of the Testicle: How Did Spectral Doppler Predict the Outcome?



About the Authors

Manon Pilotte has recently retired as a general and musculoskeletal sonographer at the Ottawa Hospital after 36 years in the wonderful world of sonography.

She now has more time to enjoy the great outdoors and her precious family. Correspondence can be directed to: manonpilotte3@gmail.com.

ABSTRACT

Epididymo-orchitis (EO) can be easily managed but can be challenging and have dramatic effects in patients with a spinal cord injury (SCI). A 55-year-old man with a spinal cord injury (SCI) presented to the emergency department (ED) with a swollen and hardened left testicle. Ultrasound demonstrated a progression from retrograde diastolic flow to an avascular testicle suggesting infarction. Depending on the degree of infection the vascularity of the epididymis and testicle alters. A better understanding of the spectral Doppler beyond the classic differentiation between torsion and inflammation will increase the sensitivity of the sonogram. Calculating resistive indices when performing scrotal ultrasounds can only add to the accuracy of the diagnosis and predicted outcome. Colour and spectral Doppler should be obtained in all clinical circumstances.

It is common practice to request a scrotal ultrasound in the setting of acute scrotal pain as high-resolution ultrasound is the modality of choice when imaging the testicles.[1,2] Acute epididymitis is the most common cause of acute scrotal pain.[1,3] Testicular involvement (orchitis) can occur in about half the cases and is referred to as epididymal-orchitis (EO).[2,4]

Epididymitis most commonly presents between 18 and 35 years of age.[1–3] It is an infectious inflammatory process bacterial in origin, its true incidence is unknown.[1,5] Patients present with unilateral scrotal pain, swelling and inflammation of relatively acute onset but may present bilaterally in 5–10% of patients.[3] There may be a history of symptoms suggesting a urinary tract infection or bacteriuria.[1,6] Typically the severity of the infection is well documented with ultrasound. It can range from epididymitis, EO, funiculitis, abscess formation and might be accompanied by hydrocele or pyocele.[1–5] Severe testicular edema can compromise the venous drainage from the testis and potentially lead to ischemia and infarction.[1,2,5,7] EO-related testicular

infarction is rare and there is minimal literature on the subject.[1,5,7] The key to predicting the outcome was in the analysis of the spectral Doppler.

CASE DESCRIPTION

A 55-year-old male with a past medical history of incomplete quadriplegia secondary to a C8-T1 spinal cord injury (SCI) presented to the ED with two separate concerns. Firstly, he had a prolapsed stoma (colostomy) which General Surgery reduced without issue. Secondly, while bathing he noted that there was significant swelling and hardness of the left testicle. He has no sensation at this level. He experienced a prior episode of left EO, 5 years ago, which was treated and resolved without complication.

Systemically he was well, with no fever, chills or vomiting. He appeared alert and oriented. His vital signs were within normal limits. He has a neurogenic bladder managed with an indwelling urethral catheter, which was ordered to be changed every 4 weeks; however, the current one was changed 7-weeks prior.

Examination of his scrotum revealed an enlarged, firm left hemiscrotum. The scrotal skin was not erythematous. No evidence of skin breakdown along with the scrotum or perineum, no crepitus or fluctuance. The clinical diagnosis was a possible EO. A scrotal ultrasound was requested for confirmation.

Empiric therapy of intravenous (IV) antibiotics was implemented. The Foley catheter was exchanged without issue and the scrotal ultrasound was performed. The sonogram was performed with a Philips IU22, using a high-resolution linear probe, 12-5 MHz.

The sonogram revealed on the right side a focal area of enlargement of the epididymal tail with associated hyperemia. As well as an unremarkable right testicle with normal colour flow and spectral analysis (Figure 1).

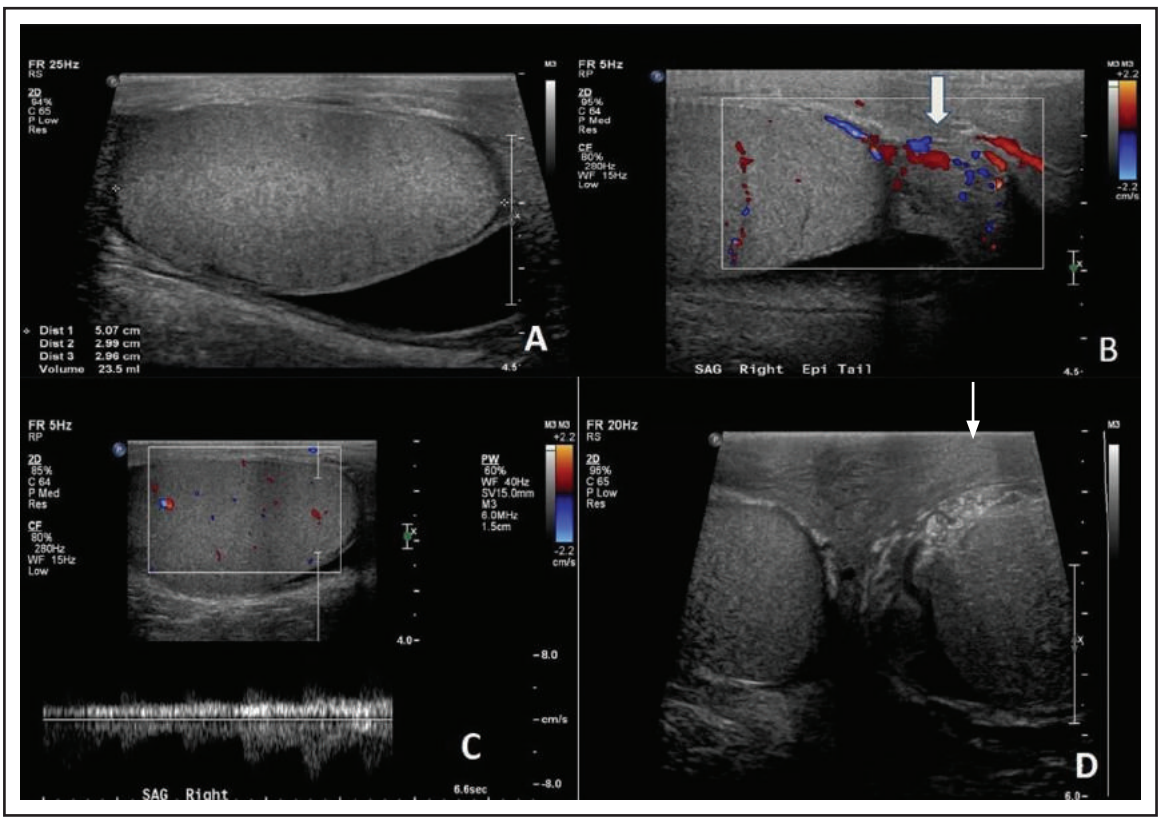


Figure 1: Right testicle. A. Sagittal image demonstrating normal testicular parenchyma and size. B. Sagittal epididymal tail showing mild focal hyperemia (thick arrow). C. Normal arterial and venous spectral waveforms of the intra-testicular artery. D. Transverse image comparing the right and left testicle, demonstrating thickened scrotal skin (thin arrow).

Sonographic evaluation of the left side (Figure 2) revealed an epididymis that was diffusely enlarged with marked hyperemia. The testicle was heterogeneous with hyperechoic foci, no hyperemia was noted. There was a septate collection with debris surrounding the testicle. The scrotal wall was thickened with hyperemia, as well as the spermatic cord was enlarged, hyperechoic and hyperemic. Spectral analysis of an intra-testicular artery demonstrated reversed end diastolic flow.

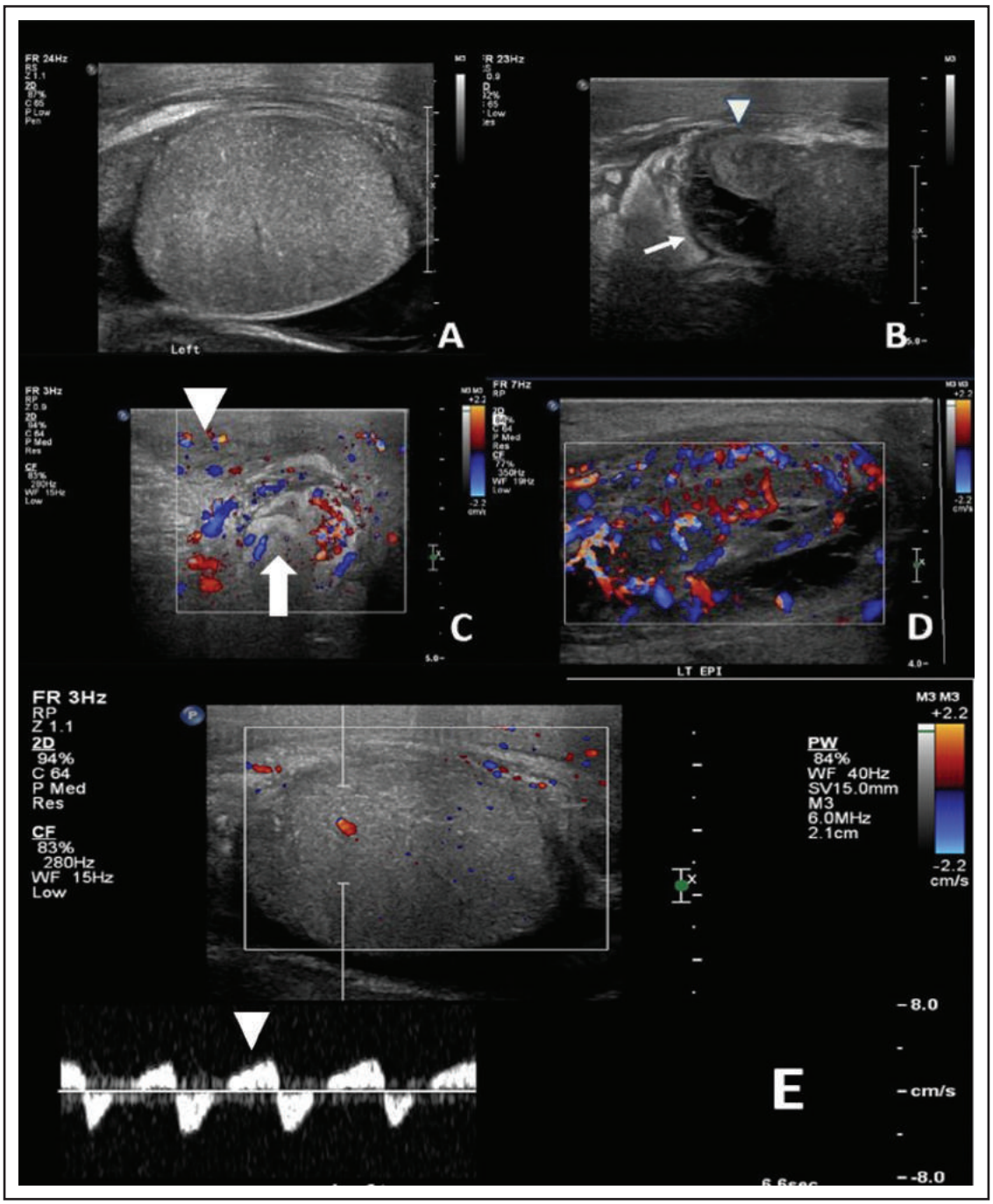


Figure 2. Left testicle. A. Sagittal image showing a heterogeneous echotexture with echogenic foci scattered throughout. B. Sagittal view of the enlarged, heterogeneous epididymal head (arrowhead) and pyocele (arrow). C. Transverse spermatic cord demonstrating funiculitis (thick arrow) and hyperemic scrotal skin (arrowhead). D. Sagittal image demonstrating enlarged hyperemic epididymal tail. E. True reversal of diastolic flow (arrowhead), a high-resistance flow pattern.

The collaboration of Radiology and Urology recognized the reversal of diastolic flow as a sign of impending testicular infarction secondary to testicular congestion and high testicular pressure. For treatment and potentially prevent testicular infarction the patient was admitted for IV antibiotics and close monitoring. Given the patient experiences no sensation at this level, progressive deterioration or red flag signs (crepitus, spreading erythema, progressive swelling) may not be recognized. Due to the severity of the infection, IV ceftriaxone was administered and scrotal support provided. Repeat ultrasound in 24 hours was requested to assess for clinical response and improvement in Doppler flow.

The follow-up ultrasound was performed using a Philips HDI 5000, high-resolution 12-5 MHz linear probe. It demonstrated an avascular left testicle (Figure 3 top). There was no twisting of the spermatic cord to suggest acute arterial torsion as the cause of the loss of vascularity (Figure 3 bottom). There was a complex collection suspicious for a pyocele. The sonographic findings were concerning for testicular infarction secondary to the underlying EO.

The patient developed autonomic dysreflexia (AD) shortly after the ultrasound which was presumed to be secondary to a blocked Foley catheter. The catheter was changed. AD is a reaction of the autonomic nervous system to overstimulation in patients with SCI, characterized by sudden onset of severe high blood pressure, throbbing headaches, profuse sweating, slow heart rate, anxiety, and cognitive impairment[8].

That evening the patient showed signs of sepsis and associated delirium. It was concluded that source control of the infection was required. Surgery was performed the next day. The surgical report described diffuse edema. Pus was expressed and sent for culture. There was no viable testicular tissue. With the patient systemically unwell and a non-viable testicle, the urologist performed a left orchiectomy. The postoperative diagnosis: left infarcted testicle with pyocele. No complications during surgery, the patient was stable and transferred to the recovery unit for monitoring to ensure his cognitive function improved. Pathology confirmed the diagnosis of infarction with *pseudomonas aeruginosa* as the bacterial agent.

The patient experienced multiple life-threatening complications. He was intubated and admitted to the ICU with recurrent desaturations, bradycardia, low level of consciousness and multifactorial delirium. He sustained a cardiac arrest and required a tracheostomy. More than 1 month after admission the patient was clinically stable, tracheostomy was removed and he was discharged home with the following instructions:

1. Follow up appointment with urology in 4-6 weeks.
2. Catheter change required every 4 weeks.
3. To return to the ED if febrile, blocked catheter or any other symptoms arise.

DISCUSSION

Complications from epididymitis can have a serious impact on the quality of life.[4,8] Patients with SCI-related neurogenic bladder dysfunction who are using an indwelling catheter are at higher risk of developing UTI and complications from other inflammatory processes. Complications such as epididymitis, pyelonephritis, orchitis, prostatitis and urosepsis.[8]In this patient population, nociceptive visceral pain below the level of the SCI caused by epididymitis is vague or even absent.[8] This leads to more serious consequences as a severe infection might be overlooked.[8]

Pathophysiology

Frequently, epididymitis is caused by a retrograde ascent of pathogens from the lower urinary tract, such as the bladder or prostate via the lymphatics of the spermatic cord to the epididymis[2]. Risk factors include high-risk sexual behaviours, strenuous physical activities, prolonged sitting periods, recent urethral instrumentation or catheterization, prostatitis, UTIs and prostate hypertrophy.[2,6,8]

In adolescents and men under 35, it is typically caused by sexually transmitted pathogens.[2–6] In men over 35 years old, common pathogens such as *Escherichia coli, Enterococci* and *Pseudomonas aeruginosa* are seen.[2–6]

The inflammation and swelling begin in the head or the tail of the epididymis, then through contiguous

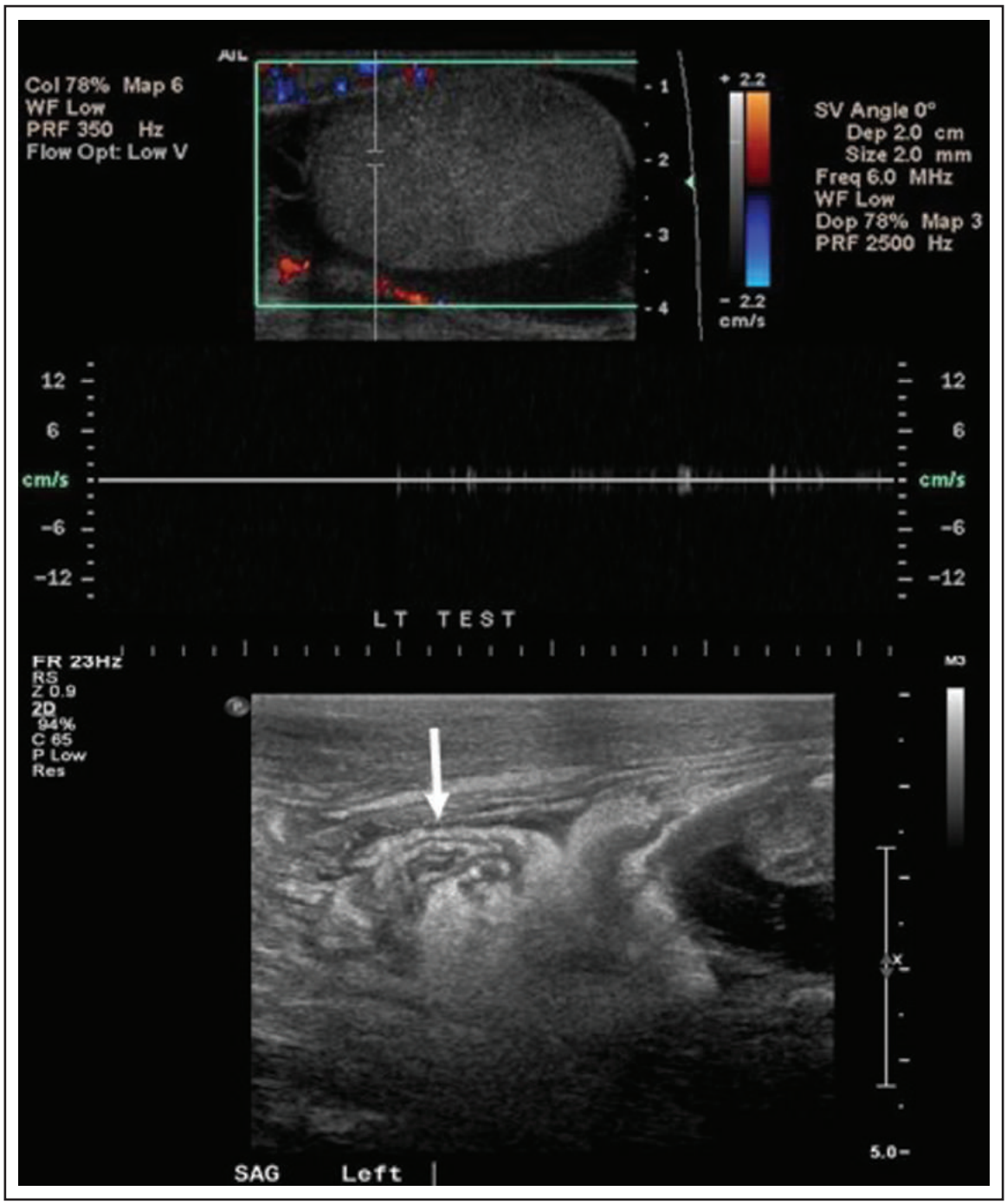


Figure 3. (Top) Left testicle 1 day later. A. Sagittal image showing an avascular testicle. (Bottom) Left spermatic cord, sagittal image demonstrated funiculitis, a thickened and hyperechoic spermatic cord (arrow), with no evidence of twisting.

spread involves the entire epididymis and testicle.[2,3,6] The spermatic cord is usually tender and swollen and the scrotal skin thickened.[1–3] The inflammation and edema of the epididymis, testicle or spermatic cord can lead to the compression of the testicular vein, testicular artery and/or the lymphatic drainage leading to ischemia that can progress to infarction.[2,5] Compression can also be caused by a large simple/complex hydrocele or pyocele.[5] A scrotal pyocele, a purulent collection surrounding the testicle, is a rarely described urologic emergency that must be recognized and treated quickly to prevent testicular damage.[5,9]

Table 1. Grey-Scale Imaging of Epididymo-Orchitis

Organ	Sonographic Appearance
Epididymis	Enlarged, hypoechoic, and heterogeneous[2,4,5]
Testes	Focal: Patchy, hypoechoic lesions within the testicle[2,4,5] Can be well or ill-defined
	Diffuse: Enlarged Varies with the progression of infection: normal, homogeneous, hypoechoic or heterogeneous echotexture Infarction: heterogeneous with hyperechoic foci [2,4,5]
Cord	Normal or thickened and hyperechoic [2,4,5]
Fluid	Hydrocele: simple anechoic fluid collection, +/- low-level echoes or thin septations[9]
	Pyocele: Complex fluid collection, internal echoes, loculations, septae, fluid/fluid or air/fluid levels[9]
Skin	Thickened (>8mm)[11]

Sonographic Appearance

The varying grey-scale appearances of EO are summarized in Table 1.

A diagnosis of EO should not be made without the evaluation of the testicle and epididymis with colour and/or power Doppler.[2,5,10] The sensitivity of colour Doppler for epididymitis is 92–100%.[1]

Colour Doppler appearance[1,2,10,11]: A normal epididymis when assessed with colour Doppler demonstrates little to no vascularity. Although the presence of colour flow does not strictly mean inflammation. The epididymis should not be hyperemic compared to the colour flow in the normal testicular parenchyma.

Isolated epididymitis can be a focal area of hyperemia (head or tail) of diffuse hyperemia of the entire epididymis. The key feature is recognizing the asymmetrical increase of blood flow in the affected epididymis (Figure 4).

EO can be identified with colour Doppler as hyperemia of the testicle and epididymis, also known as a testicular inferno (Figure 5). Decreased colour flow is a sign of impending infarct.

Although colour Doppler adds value, spectral analysis of the intra-testicular artery and vein provides a better characterization of the vascularity. The information that can be obtained from the spectral analysis is Peak systolic velocity (PSV), end-diastolic velocity (EDV) and Resistive Index ([RI] = [PSV-EDV]/[PSV]). RI is an angle-independent ratio, making it a reliable indicator[13] that represents the resistance to blood flow.[2,5]

Normal spectral analysis of the intra-testicular artery in an adult[5,10] is depicted in Figure 6. Features include a low resistance flow pattern, a broad systolic component and antegrade diastolic flow. The RI range should be between 0.5–0.7 and the PSV <15 cm/s. It is important to note that there may be an asymmetry between the two testes.

Early-stage of EO[1,10] is depicted in Figure 7. Spectral Doppler features can include a PSV >15 cm/s, increased EDV and RI <0.5 as well as readily detectable intra-testicular venous flow.

The progression of EO[2,5,10] (Figure 8) is demonstrated by high-resistance flow patterns, RI value of > 0.7. The diastolic flow could be reversed indicating the loss of tissue perfusion.

Increased values of RI in acute EO indicate ischemia which can rapidly progress to a more serious consequence – infarction.[2,5,10] With infarction, greatly diminished and/or lack of blood flow is diagnostic.[2,10]

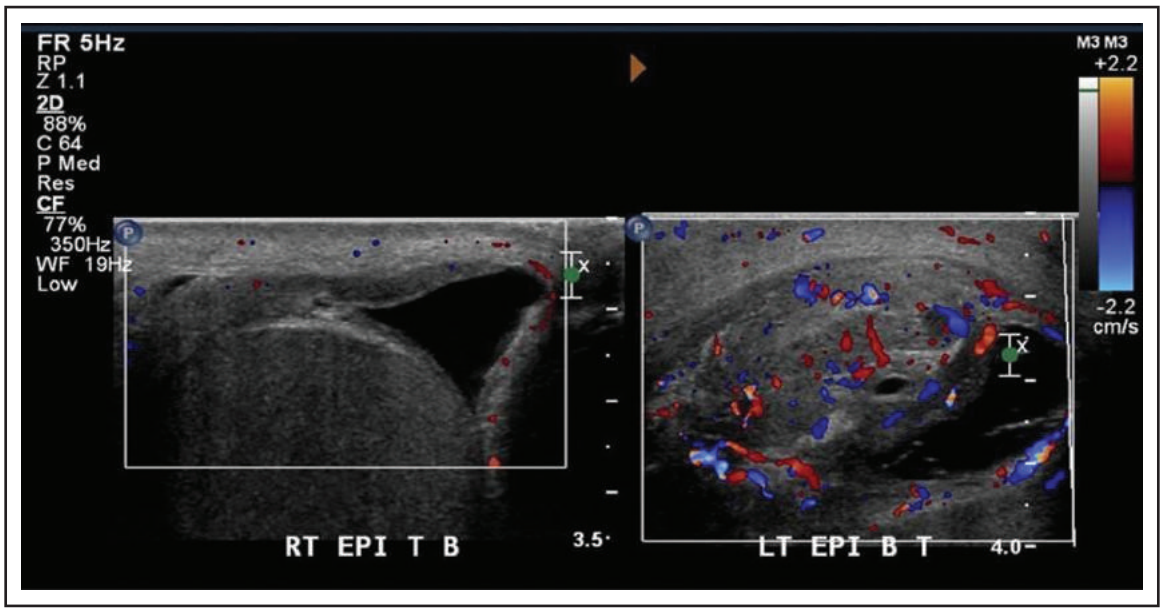


Figure 4. Comparison view of a normal and abnormal epididymis. Sagittal image demonstrating asymmetry in both size and vascularity with colour imaging.

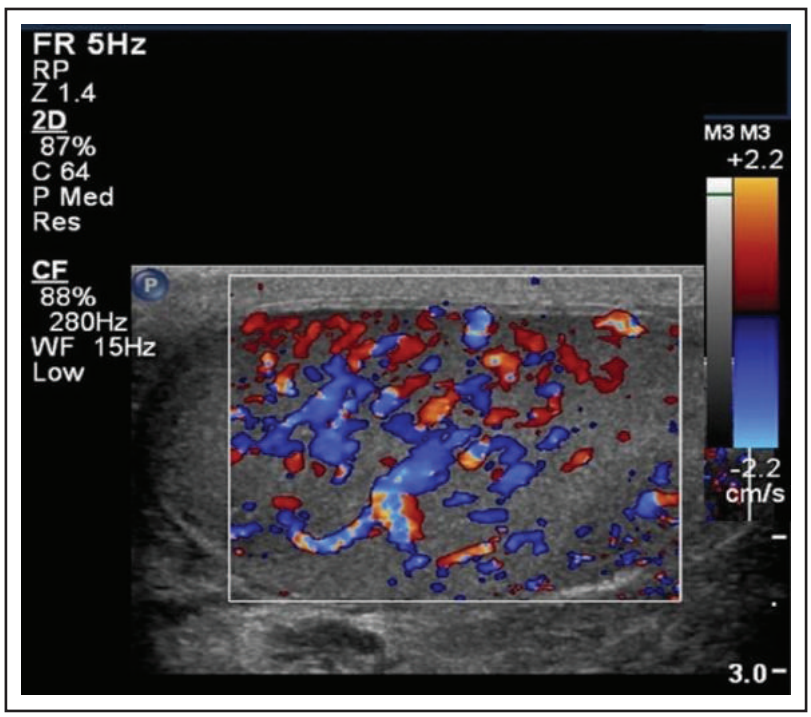


Figure 5. Colour Doppler. Sagittal colour Doppler image demonstrating testicular inferno.

Differential Diagnoses

Evaluation of the clinical presentation and sonographic findings should consider the differential to include: torsion, tumour, abscess or infarction,[1,2,5] Testicular torsion, a surgical emergency, should be considered in all cases[1,2,5] (Table 2).

Increased RIs are not only seen cases of advanced EO. Hydroceles can cause high RI spectral flow patterns from compression which can lead to the development of testicular infarction without evidence of infection[5,10] (Figure 9). Increased RIs have also been shown in atrophic testicles.

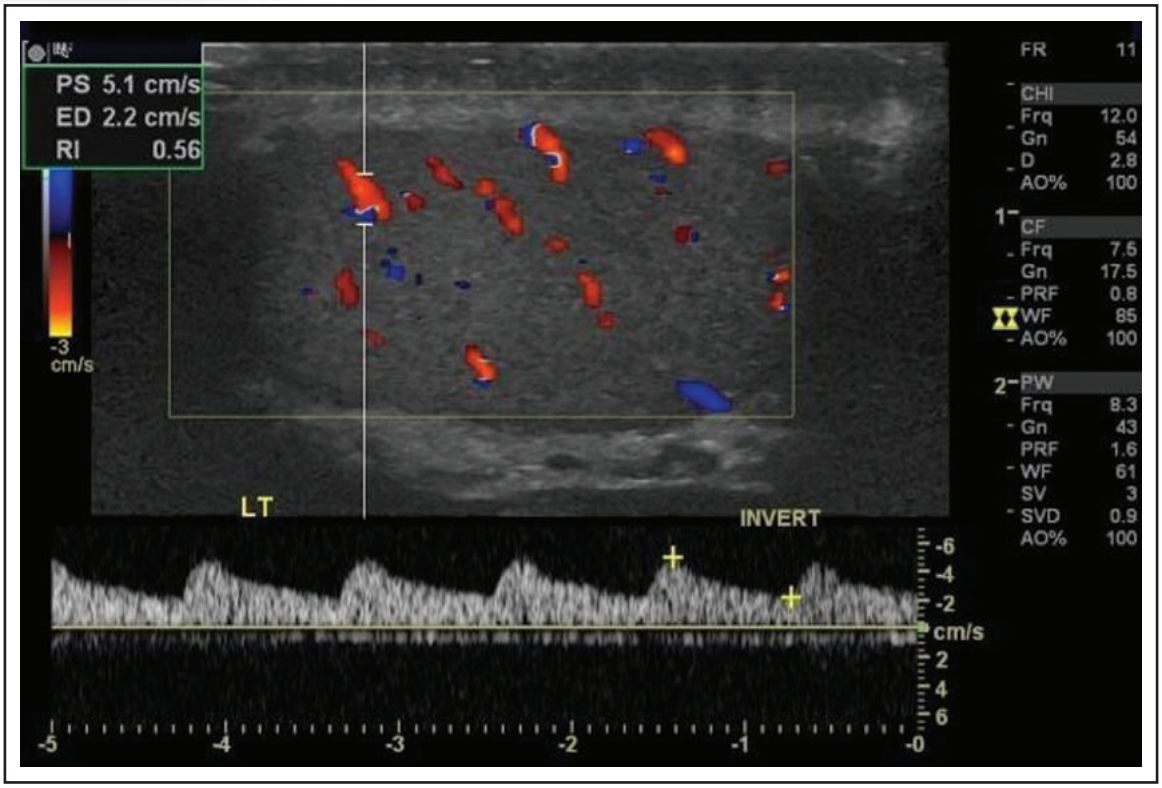


Figure 6. Normal spectral Doppler waveforms. Normal perfusion, low resistance waveforms with an RI of 0.56.

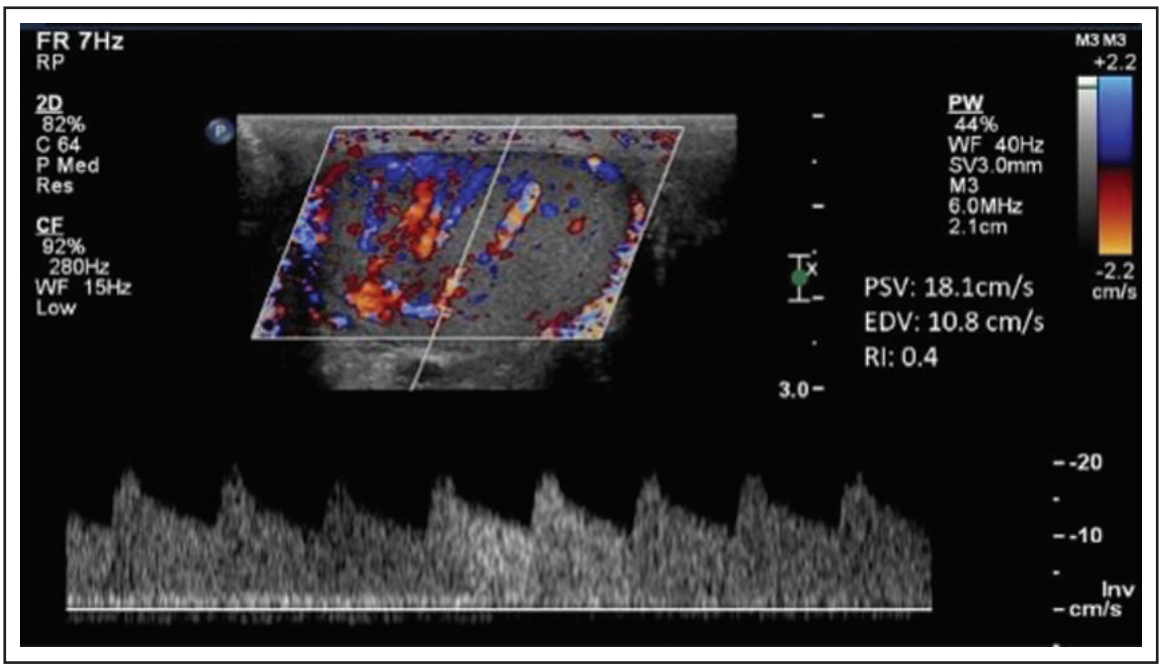


Figure 7. Abnormal spectral doppler waveform in early EO. Spectral waveform demonstrating an increased PS and EDV with a decreased RI: 0.4.

Treatment

Patients with scrotal pain usually consult a physician within a few days of symptom onset. In mild cases, appropriate antibiotic therapy will resolve the infection.[3] If symptoms persist or sudden severe pain suggests a more sinister pathology (i.e., torsion) the patient should be referred to ED. A sonogram may be necessary to confirm a diagnosis, evaluate the effectiveness

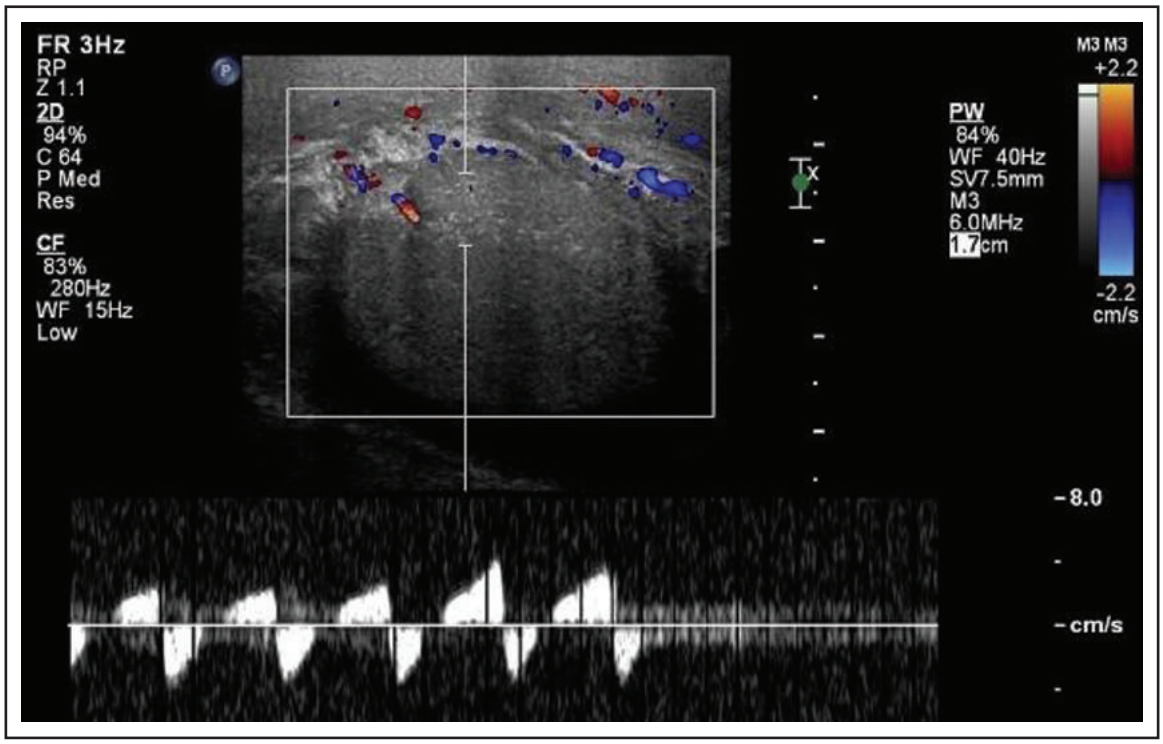


Figure 8. Spectral Doppler. Sagittal image colour flow showing decreased perfusion and spectral analysis demonstrating high resistive-flow patterns with the reversed end-diastolic flow.

Table 2. Differential Diagnoses Considered with Acute Scrotal Pain and Swelling

Differential Diagnosis	Clinical Presentation	Sonographic Appearance
Torsion	Sudden onset of pain/swelling No evidence of inflammation Nausea, vomiting	Varies with duration[9] Early: May be normal Progression of: Absent venous flow High-resistance arterial flow Absent flow Asymmetry between testicles Twisted spermatic cord
Tumour	Unilateral, palpable lump/mass, +/- pain, enlarged testicle	Focal mass or global infiltration Variable appearance and vascularity[9]
Abscess	Fever Focal acute pain - pinpoint pain,	Perineum, scrotal skin, epididymis or testicle: a complex collection with intense peripheral hyperemia[12]
Infarct	Acute onset of pain that mimics torsion	Segmental: avascular wedge-shaped hypoechoic lesion, well defined border[9] Global: Heterogeneous echotexture, avascular[9]

of antibiotic therapy and exclude any underlying pathologies.[7] IV broad-spectrum therapy may be required with severe cases of EO.[3,6] Hospitalization is considered when patients are unable or unlikely to comply with the treatment plan.[2,3,7] As an adjunct to antibiotic therapy, bed rest, scrotal elevation and analgesics are recommended until fever and local inflammation have subsided.[2,3]

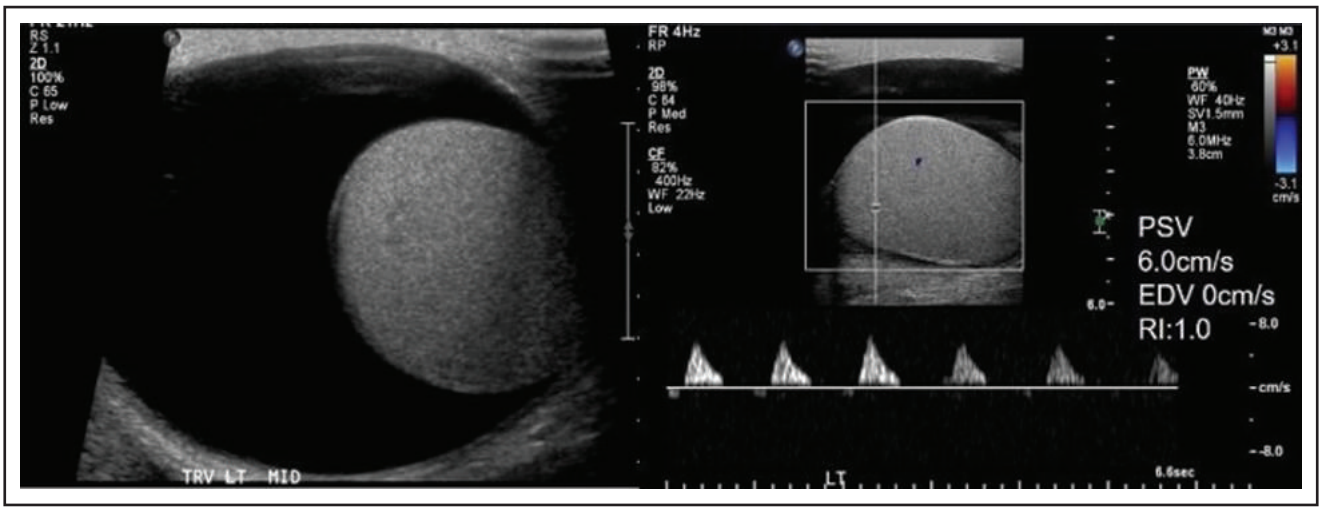


Figure 9. Increased intra-testicular RI. A. Simple hydrocele (left) causing increased RI as demonstrated by spectral analysis (right).

In patients with SCI where the antibiotic treatment is unsuccessful and infarction of the testicle ensues, the clinical presentation will decide if surgical intervention is necessary or if conservative management is sufficient.[8] If the systemic infection is well controlled, the orchiectomy might induce further morbidities or delay wound healing.[8] If source control of the infection is required to ameliorate symptoms surgical intervention is warranted.[8]

Impact on Scan Protocol

It is standard practice and imperative to document arterial and venous flow within the testicle while performing a scrotal ultrasound. With proper Doppler parameter settings, the presence or absence of flow is easily recognizable.[2,10] Performing an analysis of the spectral waveform is not routinely common. Spectral Doppler has typically been used to document the presence or absence of flow or distinguish between the arterial and venous flow.

However, the spectral waveform can provide more in-depth information to the clinical scenerio[2,5,10]. By understanding the mechanisms of infection and the impact on the vascularity, the abnormal spectral waveform becomes more recognizable to the sonographer.

Calculating the RI's reinforces the diagnosis of EO and is a predictor of the impending outcome.[2,5,10] It is highly suggested to perform these measurements routinely as the diagnostic information can contribute significantly to patient management. Implementing RI calculations allows for familiarization with the normal values and its correlation with colour and grey-scale imaging.

CONCLUSION

Reversal of diastolic flow of the intra-testicular artery is a strong predictor of impending testicular infarction.[5] Clinical evaluation of patients with an SCI is more difficult because of the patient's lack of sensation.[8] The ultrasound, specifically the spectral waveform, was key to the diagnosis. In all aspects of sonography correlation of patient's condition with the grayscale, colour and spectral analysis will optimize patient care and outcome.

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Article Name: Acute Epididymo-Orchitis-Related Infarction of the Testicle: How Did Spectral Doppler Predict the Outcome?

Authors Name: Manon Pilotte, RDMS, CRGS, DMS and Megan White, BMRSc, RDMS, RVT, CRGS, CRVT, DMS

1. What is true with regard to epididymal orchitis?

1. Bacterial in origin
2. Typically bilaterally
3. Can lead to infarction
4. Has no effect on venous drainage
5. Range from epididymitis to abscess or pyocele
   a) 2,5
   b) 2,3,5
   c) 1,3,4
   d) 1,3,5

2. Risk factors for epididymal orchitis are

1. Benign Prostatic hypertrophy
2. Urinary Tract Infections and BPH
3. Strenuous physical activity
4. Recent urethral instrumentation
5. High-risk sexual behaviour and prolonged sitting periods
   a) 1,2,3
   b) 1,2,4
   c) 1,2,5
   d) 2,3,4

3. The Spectral Doppler analysis in cases of epididymal orchitis shows

a) An RI >0.7 is normal
b) Early-stage has decreased end-diastolic flow
c) Venous flow is easily detected in advanced EO
d) Reversed ED flow is a prediction of ischemia leading infarction

4. Differential diagnosis of EO include

1. Torsion
2. Tumour
3. Abscess
4. Focal infarct
   a) 1,2
   b) 1,4
   c) 1,2,3
   d) 1,2,3,4

5. When performing a scrotal ultrasound it is important to

a) Obtain an accurate history
b) Analyze the spectral Doppler to indicate the severity of infection
c) Evaluate the testicle, epididymis and spermatic cord in both greyscale and colour
d) All of the above

Pictorial Essay

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

Strain Imaging in Echocardiography Part 2 of 3: Sonographer Initiatives and Imaging Protocol

About the Authors

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ABSTRACT

As the clinical utility of echocardiography grows, more emphasis has been placed on cardiac sonographer initiatives to implement and perform strain imaging as it can add diagnostic value and provide benefit when evaluating myocardial function. These include:

- Sensitivity and specificity to detect early myocardial changes
- Additive to LV function quantification
- Recognize distinct patterns displayed by Bull's-Eye plot correlating to a particular pathology

As strain echocardiography is a sensitive measure for left ventricular function, cardiac sonographers must spend time optimizing image acquisition and post-processing to ensure the reported global longitudinal strain values are accurate and reproducible. Before this stage, it is important to understand the fundamental concepts involved in strain imaging. This can be reviewed in part one of the strain imaging in echocardiography series. This second section of this 3-part series will review and provide guidelines for image acquisition, optimization, analysis and post-processing of data. This includes discussing clinical, technical and operator limitations that may provide challenges when performing strain imaging.

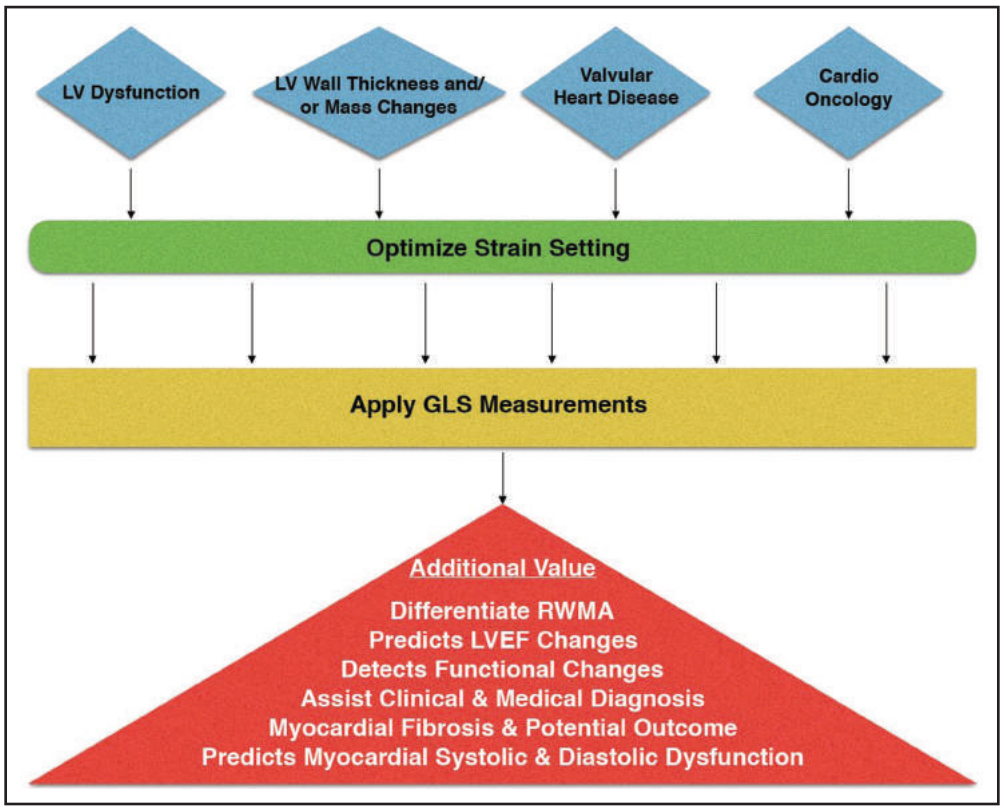


Figure 1. Clinical application flow chart for sonographers.

Optimization and Acquisition

Technical Optimization and Image Acquisition

Sonographers need to apply optimization strategies during the acquisition of apical three-chamber, four-chamber and two-chamber (AP3ch, AP4ch, AP2ch) views consecutively, to accurately measure global longitudinal strain (GLS). Sonographers should be mindful of including the mitral valve (MV), aortic valve (AoV), and the entire ventricle including throughout the cardiac cycle. Proper and clean ECG signal is necessary during acquisition to achieve optimal tracking of the myocardium.

Key technical optimization strategies during image acquisition are outlined in the bullet list below and Table 1.

- Patient-Focused Introduction: Briefly discuss with the patient the importance of image quality and patient participation in obtaining images.
- Electrocardiogram (ECG): Proper ECG signal gating and tracing can visually provide cardiac cycle timing to acquire three consecutive beats. Proper aortic valve closure (AVC) timing can be ensured by avoiding any ECG artifacts.
- Patient Positioning: Use of the apical-cutout window on the patient bed to reposition and optimize the scan window. This will help in avoiding foreshortening and drop-out of wall segments.
- Depth: Include part of the left atrium (LA) to prevent the LV (left ventricle) basal segments from swinging out of the imaging sector. This allows the software to properly track the LV myocardium.
- Sector Width: Ensure that the sector width is appropriate; the image should include entire LV myocardium in both systole and diastole especially closer to the apex, but the frame rate should not be compromised.
- Frame Rate: Maintain between 50 to 80 frames per second (FPS) as per ASE's guidelines for correct speckle tracking without compromising temporal resolution[1]. As previously mentioned, the frame rate can also be optimized by adjusting the size of sector width and depth.
- Gain and Focus: Appropriate levels of gain can enhance the visualization of the endocardium and

myocardium, potentially reducing any imaging artifacts to track speckles appropriately. The focus should be placed at the mid LV to improve the visualization of the endocardial borders.

- Avoid Foreshortening: Suboptimal tracking of all Region-of-Interest (ROI) LV wall segments can be avoided by ensuring the proper imaging window.
- Heart Rate: Acquisition of all three apical views sequentially together in time between 60 to 100 beats per minute (BPM) is required. Strain analysis can be challenging in patients with significant heart rate variations or arrhythmias.
- Respiration: Patient breath-holding techniques is key to prevent translational motion of the heart while reducing noise or reverberation caused by lung and rib artifacts.
- Multiple loops: Obtain 2–3 different apical images each for 3 beats if time permits so that several choices for analysis would be available.
- Post-processing: Analyze the acquired images before the patient leaves to ensure tracking is appropriate and data sets can be used.

Image Quality Assessment

The above points should be kept in mind and practiced during image acquisition. Following image quality improvement processes during acquisition will likely help reduce interobserver variability between sonographers during post-processing. Below are some examples of suboptimal acquisition and potential strain for global longitudinal strain analysis (Table 2).

Post-Processing and Analysis

Post-Processing

Once optimal images have been acquired, sonographers should be aware of the following during post-processing (Table 3) to generate accurate strain measurement results:

1. Image Quality Verification:
   - Sonographers should pay attention to frame rate and image quality before selecting the preferred loop. The entire LV myocardium and apex should be included in the imaging sector (see Table 2).
   - Clear visualization and delineation of LV myocardial borders will provide accurate tracking of the speckles.
2. Aortic Valve Closure (AVC) Timing:
   - Accurate ECG signal of the cardiac cycle (see Table 1) along with a visual assessment of AVC in the AP3ch view is important when selecting the correct end-systolic frame.
   - Some vendors allow analysis without an ECG signal. AVC can be automatically detected by the software or manually selected by the sonographer.
   - AVC can be determined using the PW Doppler of the LVOT.

Table 1. Checklist of Technical Optimization Strategies During Image Acquisition

Image Optimization During Acquisition
Gain and Focus Control: Reduce Imaging Artifacts
Depth Control: Partially Include Left Atrium
Sector Width: Not Too Narrow / Wide; Include All Myocardial Segments
Frame Rate: Range between 50 ~ 80 FPS
Heart Rate: Range between 60 ~ 100 BPM
Proper ECG Tracing: Normal Sinus Rhythm; Reduce Rhythm Artifacts
Avoid Foreshortening
Respiration: Reduce Noise or Reverberation caused by Lung and Rib Artifacts
Patient Positioning: Use Apical Cutout
Post-processing: Analyze Obtained Images to Ensure Data Sets Can Be Used

3. Three Reference Points:
   - Reference points should be placed (Figure 3):
     - in the LV side of the myocardium, past the mitral valve insertion point
     - the blood/tissue border at the level of the LVOT, just more apical to the location of the membranous septum (AP3ch view)
     - and at the apex
   - CAUTION: Do not place the reference points on the atrial side of the mitral annulus or into the LV outflow tract. This can cause inaccurate tracking and underestimate the strain value.

4. Define Region-of-Interest (ROI):
   - Tracking can be impaired if the ROI is too thick/wide or too thin/narrow (Table 2). It is important to include the entire compacted myocardium (Figure 4).
   - CAUTION: Do not include the pericardium. This can reduce the strain value (see Table 2).
   - CAUTION: Avoid structures that are not myocardium, such as papillary muscles or false chord[2] (see Table 2).

Table 2. Image Quality Implementation Examples

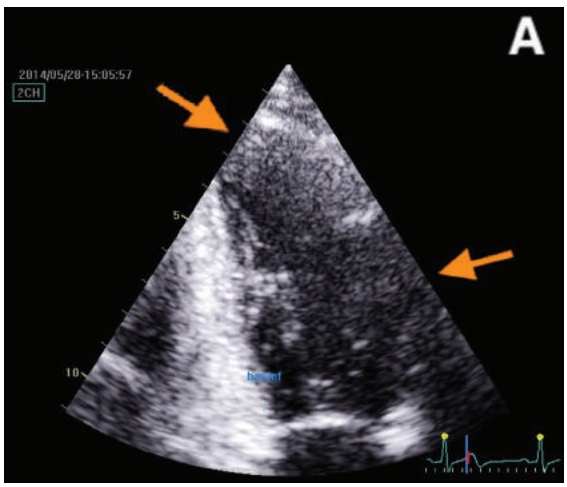
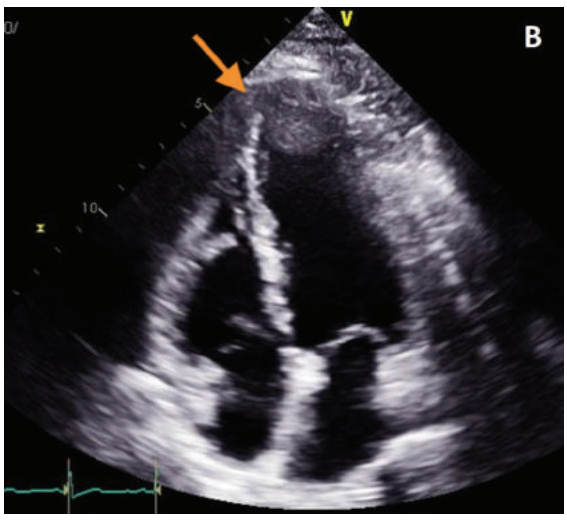
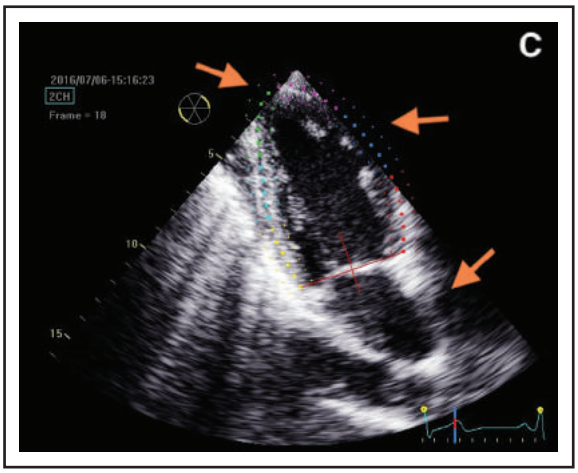
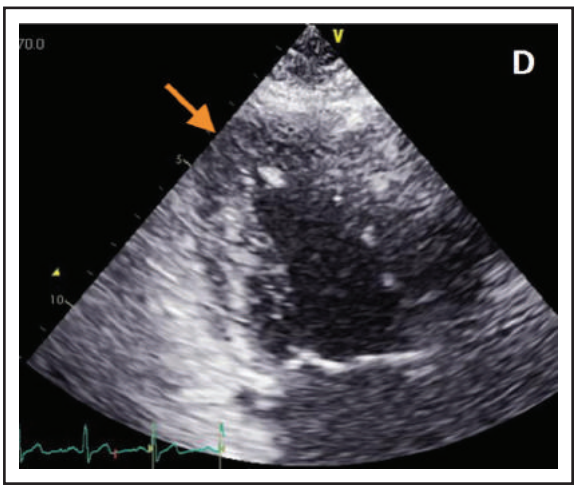
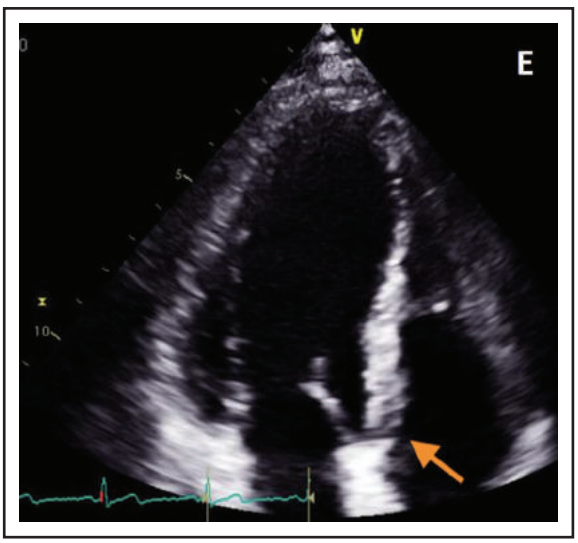
Image	Challenge	Solution
 Figure 2A. Narrow Sector Width	**Narrow Sector Width** • LV apex and anterior wall segments are missing from the acquired image. • Suboptimal border delineation of the anterior wall can result in poor tracking and generation of abnormal strain values.	• Adjust the sector width to include the missing wall segments and to avoid apical dropout. • Ensure the frame rate is not sacrificed during this process. • Try breath-holding to bring the anterior wall into the image.
 Figure 2B. Imaging Artifact at Apex	**Imaging Artifacts** • Recognition of imaging artifacts caused by ultrasound beam properties, equipment related artifacts, breathing/lung and rib interference as it can impair the myocardial border tracking.	• Understand the characteristics of different artifacts such as reverberation, mirror artifact, acoustic shadowing, side lobe artifact, beam width artifact and near field clutter. • Use gain, TGC (time gain compensation), compression, harmonic imaging, adjustment of the focal zone and alternate imaging windows/planes to reduce imaging artifacts and improve visualization of overall LV myocardial wall.

Table 2. Image Quality Implementation Examples (continued)

Image	Challenge	Solution
 Figure 2C. Inappropriate Depth	**Inappropriate Depth** • Depth affects spatial resolution, pulse repetition frequency, and frame rate. • Increasing the imaging depth reduces the spatial resolution and frame rates. This impacts image quality and can cause suboptimal myocardial speckle tracking.	• Decrease the imaging depth to focus on the entire LV cavity while ensuring all of the LV myocardial wall segments are within the imaging sector. • Partially including the left atrium will be helpful when placing the reference points during post-processingg.
 Figure 2D. Foreshortened	**Foreshortening** • When the imaging plane does not cut through the true apex, it causes a 'rounded' apical region. • Foreshortening or acquiring off-axis views of the LV can result in poor tracking of the myocardial borders and inaccurate strain values.	• Recognize true apex and on-axis image alignment of the LV cavity. • Use patient positioning, apical cut out on the echo bed, breathing techniques and alternate imaging windows to avoid oblique/ off-axis plane acquisition.
 Figure 2E. Suboptimal AP3C	**Suboptimal Apical 3 Chamber** • Inappropriate transducer rotation or rotation provides suboptimal visualization of the aortic valve.	• The transducer should be appropriately angled to show aortic valve to set AVC timing for accurate end-systolic timing.

5. Reject Segments with Suboptimal Tracking:
   - After setting the ROI, observe the tracking quality of each myocardial segment and re-adjust as needed. Tracking should follow the motion of the myocardial contraction and movement throughout the cardiac cycle.
   - If there is consistently suboptimal tracking of the myocardial segment, the sonographer should exclude the segment from the final strain calculation.

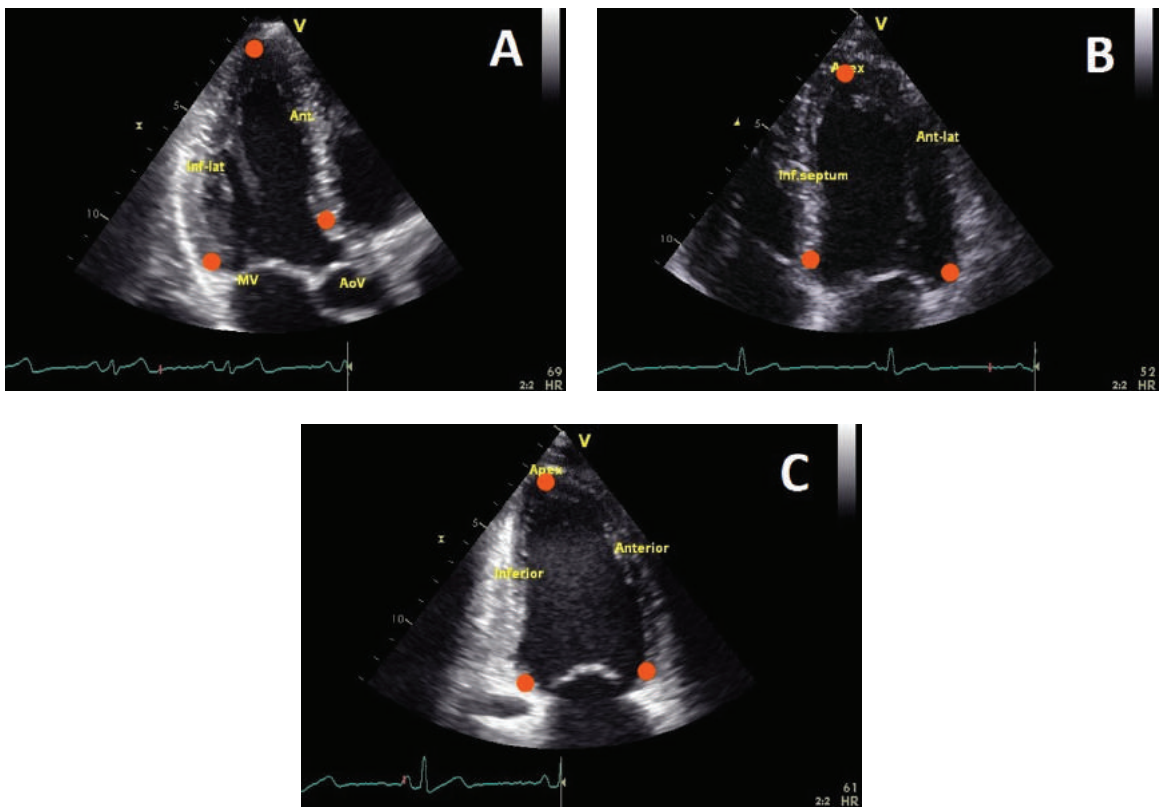


Figure 3. Three reference points in apical 3 (A), 4 (B) and 2 (C) chamber views.

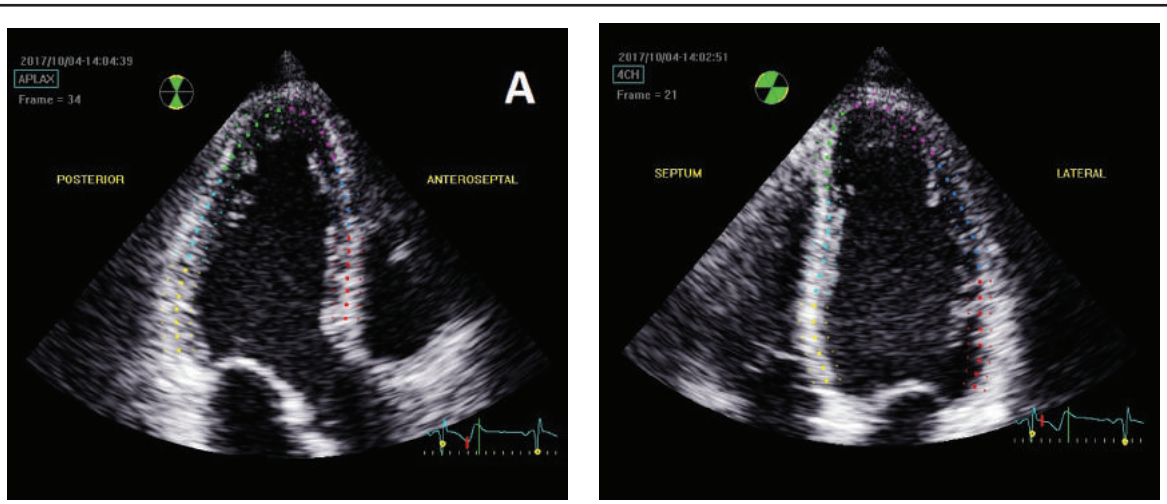


Figure 4. Defining ROI using different vendors. (Figure 4. A, B, C: GE strain software. Figure 4. D, E, F: Philips strain software)

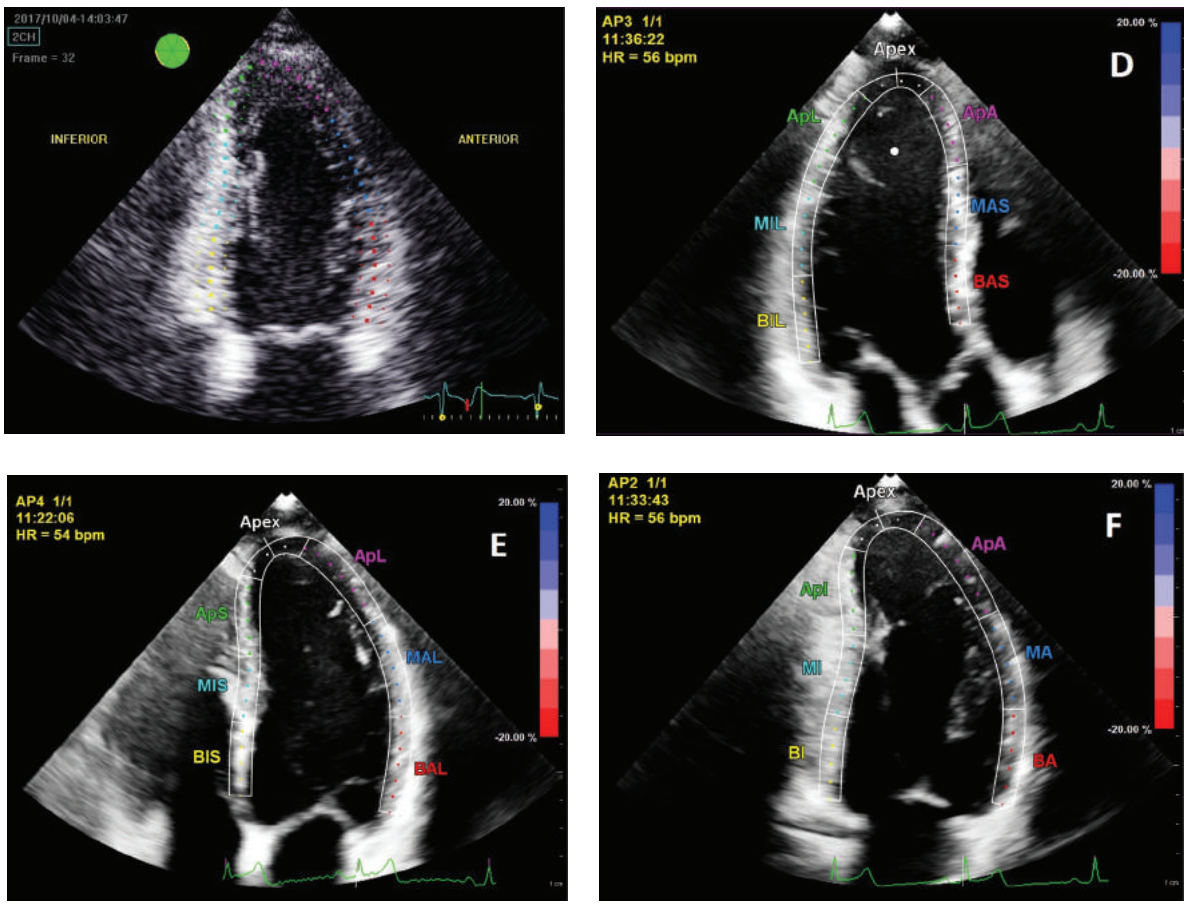


Figure 4. Defining ROI using different vendors. (Figure 4. A, B, C: GE strain software. Figure 4. D, E, F: Philips strain software) (continued)

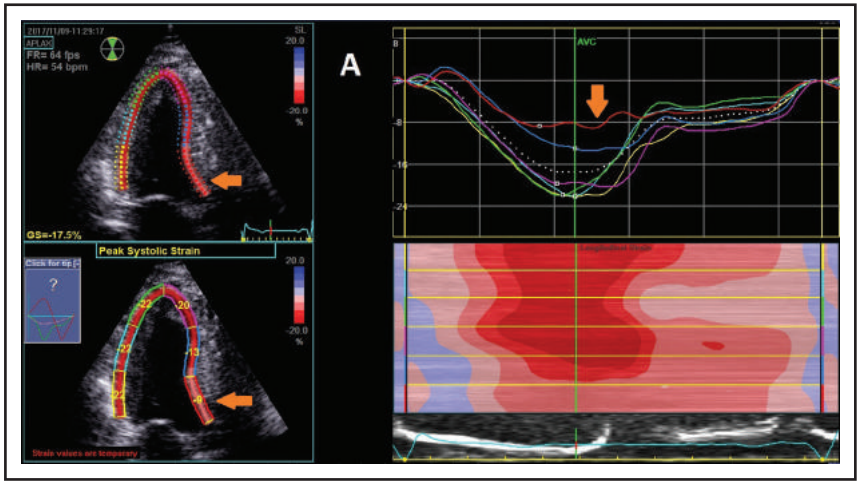
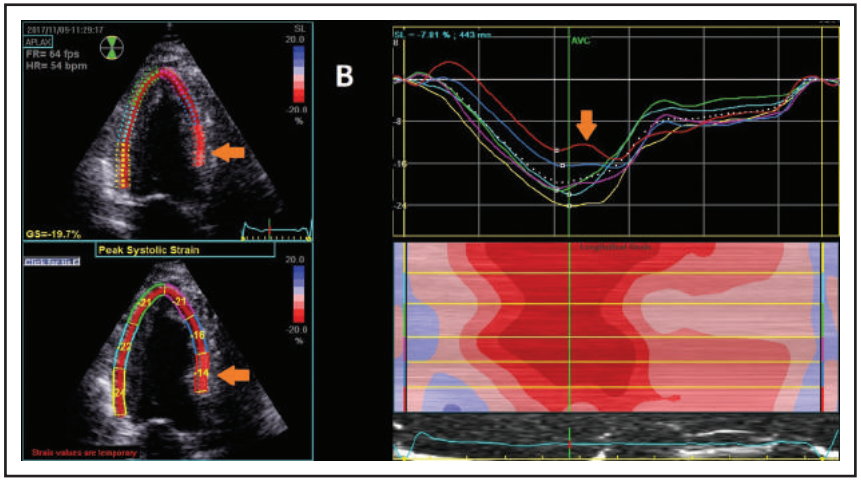
6. Strain Result:
   - Once the ROI is approved, the software generates a strain value and strain graph. Adjust the strain graph scale to include the entire curve of the graph (Figure 8B).
   - Sonographers should keep in mind that there will be technical differences with equipment and software amongst vendors, and to refer to ASE guidelines for GLS assessment based on different vendors. The normal GLS values differ based on the vendor and have been recently described in the ASE guidelines (Table 4).

Analysis

When the longitudinal 2-D strain acquisition and analysis is complete, the software generates an easy-to-understand "Bull's Eye Plot" which displays all the LV segments that were approved for tracking. The colour representation on the graphical diagram aids users to quickly visualize and understand myocardial contractility. The software also provides sonographers with quantitative data of Global Longitudinal Strain (GLS) values.

Most strain software provides a colour bar which correlates with the Bull's-eye plot, indicating wall segment function (Figure 10). Normal contractility of the myocardium (shortening of muscle fibers) is represented in a more negative value (darker red on the color bar), ranging between a GLS value of –18 to –20% depending on the software vendor.

Table 3. Post-Processing Quality Implementation Examples

Post-Processing Challenge	Post-Processing Solution
 Figure 5A	 Figure 5B
• The reference point placement is too far into the LVOT/on the aortic valve. • Poor tracking of the basal anteroseptal wall segment ('red' color segment on 2-D image). • Results in inaccurately generated strain values as seen on the graph ('red' color line on the strain curve graph as shown by arrows).	• The reference point placement is at the level of the LVOT. • Better tracking of the basal anteroseptal wall segment on the 2-D image. • Accurately generated strain values as seen on the strain curve graph (arrows).

(*continued*)

Table 3. Post-Processing Quality Implementation Examples (*continued*)

Post-Processing Challenge	Post-Processing Solution

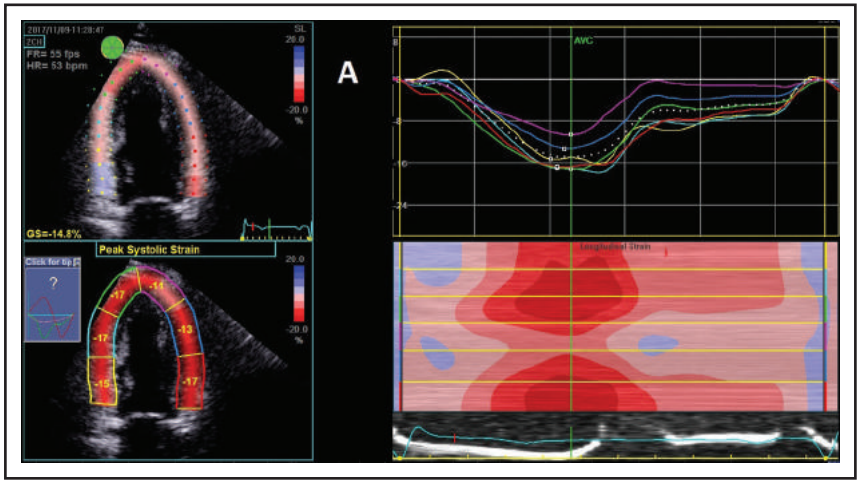
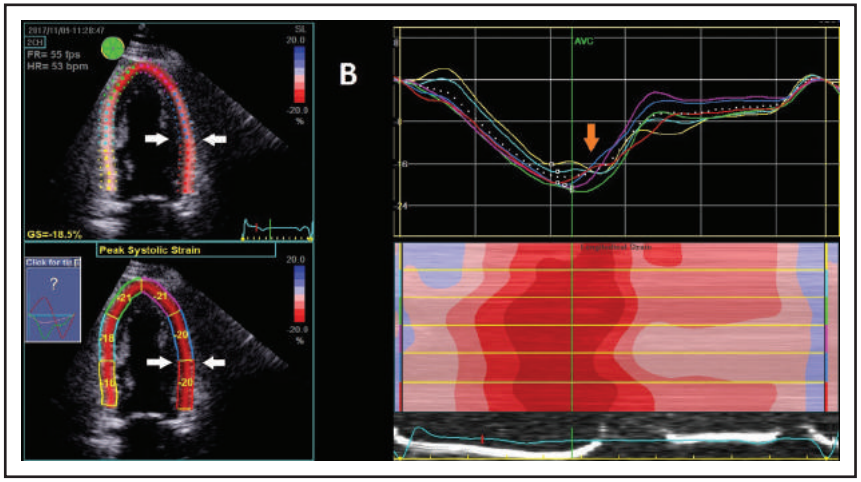
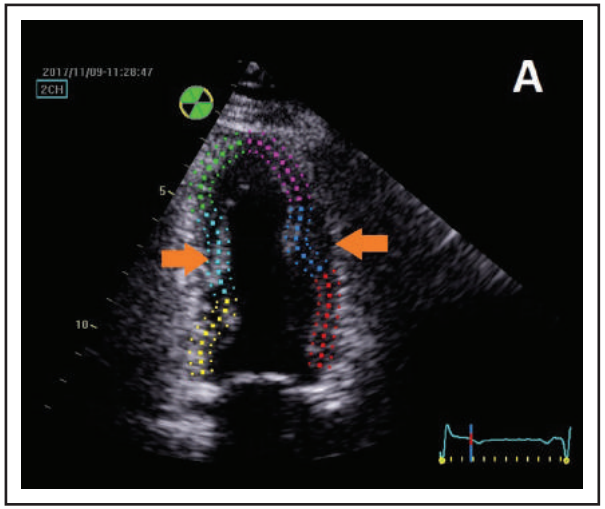
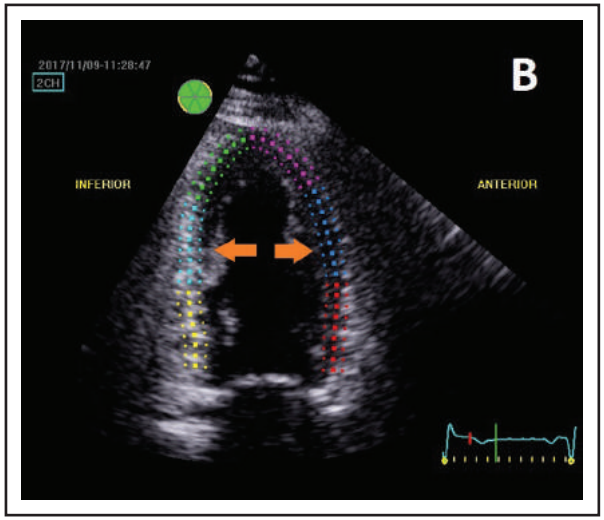
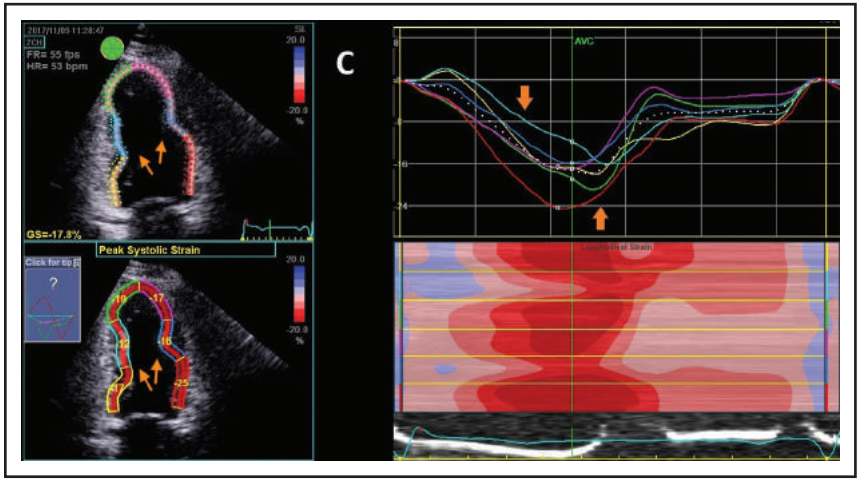
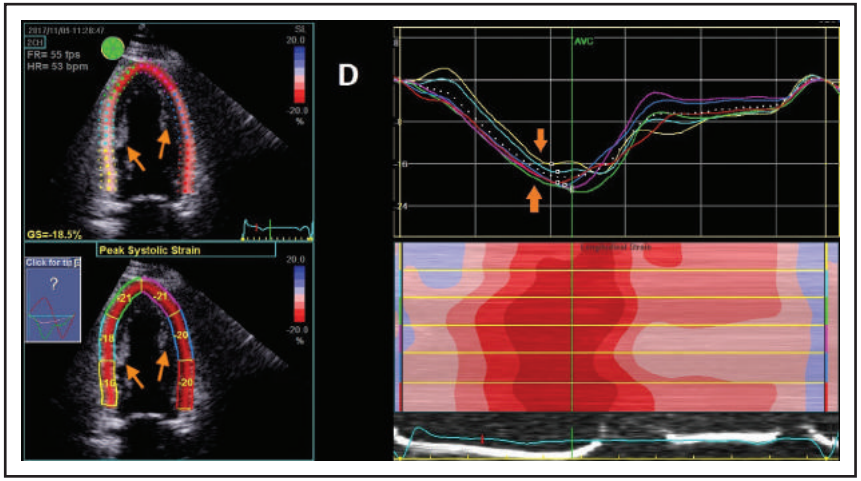

	

Figure 6A	Figure 6B
• Inappropriate ROI width/thickness on the 2-D image (white arrow). • It can cause tracking of the pericardium which artificially reduces strain values.	• Appropriate ROI width/thickness tracking the myocardial borders produces synchronized strain curves.

(*continued*)

Table 3. Post-Processing Quality Implementation Examples (*continued*)

Post-Processing Challenge	Post-Processing Solution
 Figure 7A	 Figure 7B
 Figure 7C	 Figure 7D
• Inclusion of structures within the LV cavity that are not myocardial segments. • False tracking of the papillary muscles (arrows) can result in inaccurate strain values.	• Review acquired cineloop to assess true myocardial motion. • Ensure ROI does not include papillary muscles or false tendons.

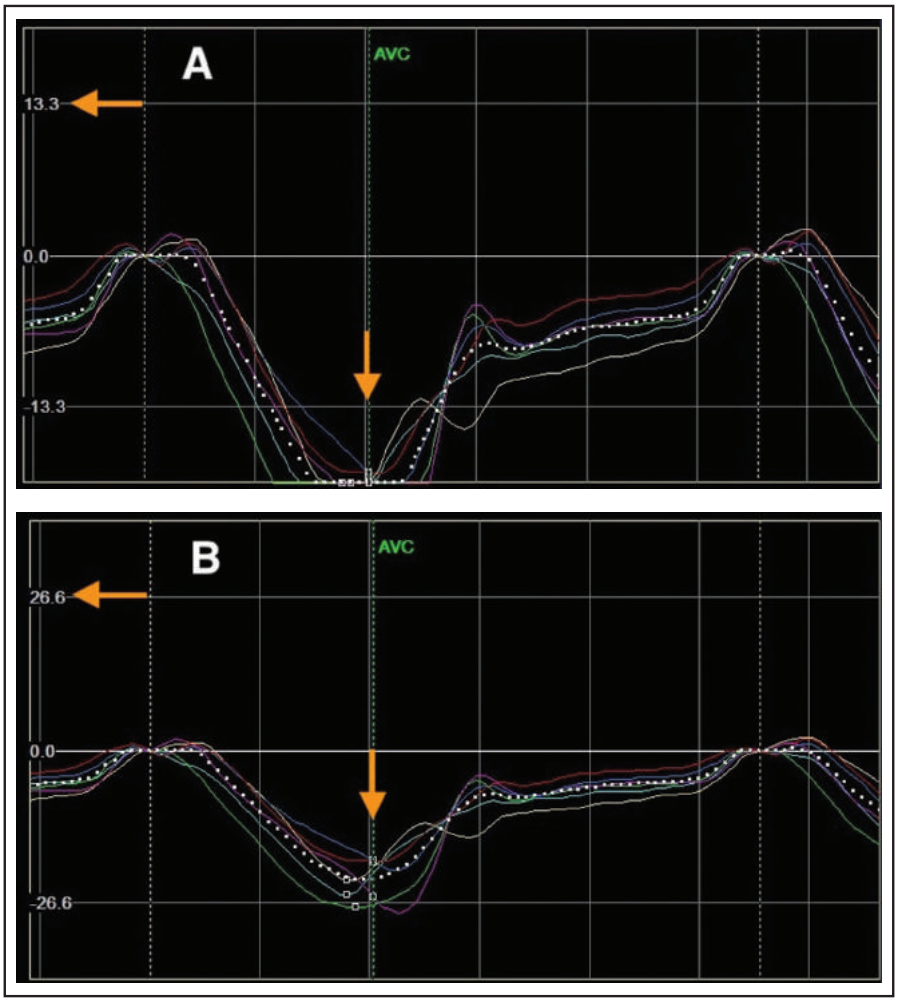


Figure 8. A shows a non-optimized strain graph scale. B shows an optimized strain graph scale. Lang et al 2015.[1]

Table 4. Recommendations for Cardiac Chamber Quantification by Echocardiography in Adults

Vendor	Software	Mean
Varying	Meta-Analysis	-19.7 %
GE	EchoPAC BT 12	-21.2 %
	EchoPAC 110.1.3	-21.3 %
Philips	QLAB 7.1	-18.9 %
Toshiba	Ultra Extend	-19.9 %
Siemens	WI	-19.8 %
Esaote	Mylab 50	-19.5 %

Differences in LV wall segmental strain values are represented by lighter shades of red, white and blue, respectively. Lighter shades of red indicate a varying degree of reduced longitudinal strain while the white represents severely reduced to incomplete speckle motion tracking during systole. The blue shade is indicative of the individual speckles moving away (opposite) from each other, representing lengthening of the muscle fibers, therefore the GLS value shows as more positive as seen in Figure 11.

Limitations

Although the clinical utility of strain imaging provides many benefits, sonographers should be aware of clinical, technical and operator limitations that may provide challenges when acquiring and post-processing strain images (Table 7).

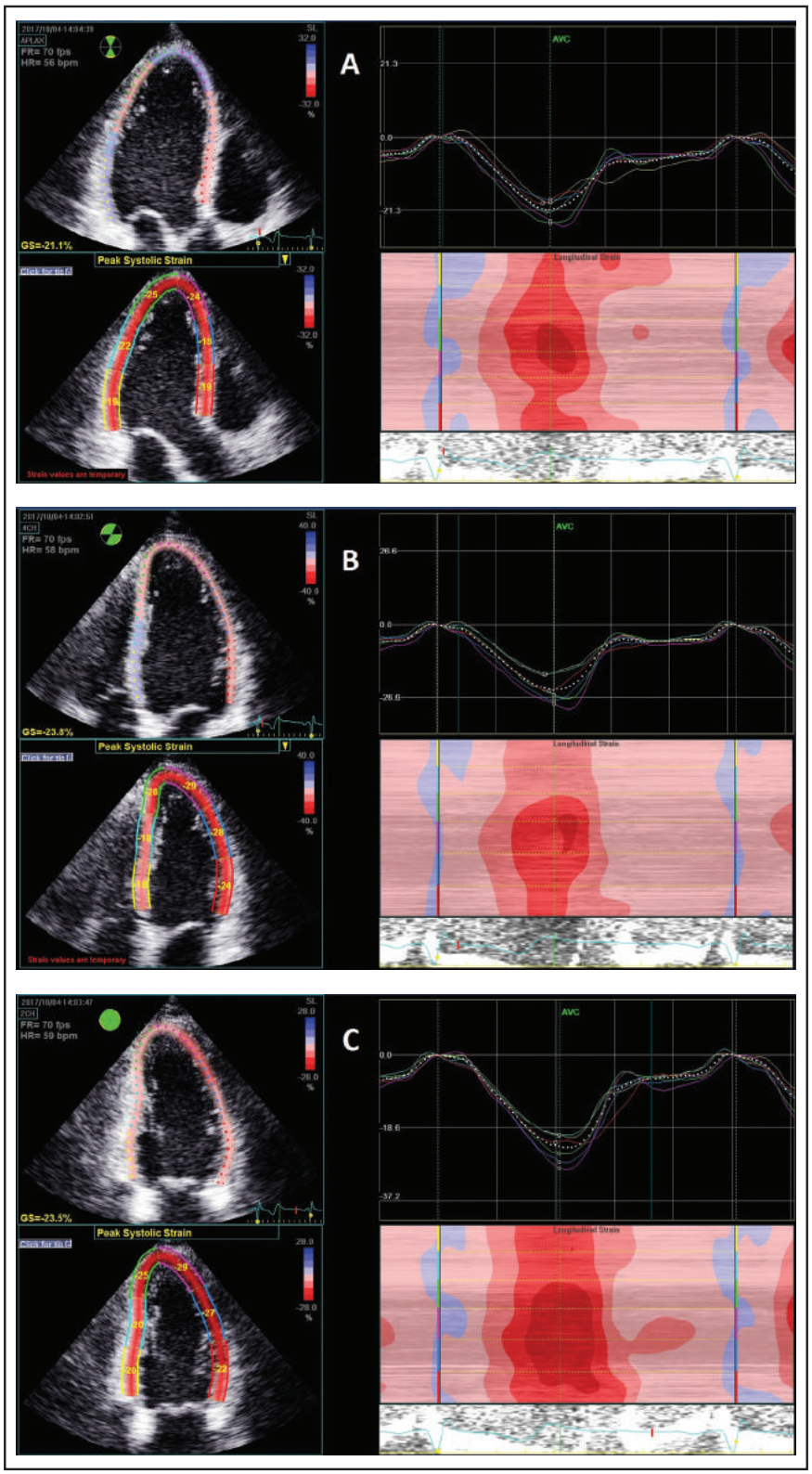


Figure 9. Strain curve results from different vendors' software (Figure 9. A, B, C, D: GE. Figure 9. E, F, G, H: Philips).

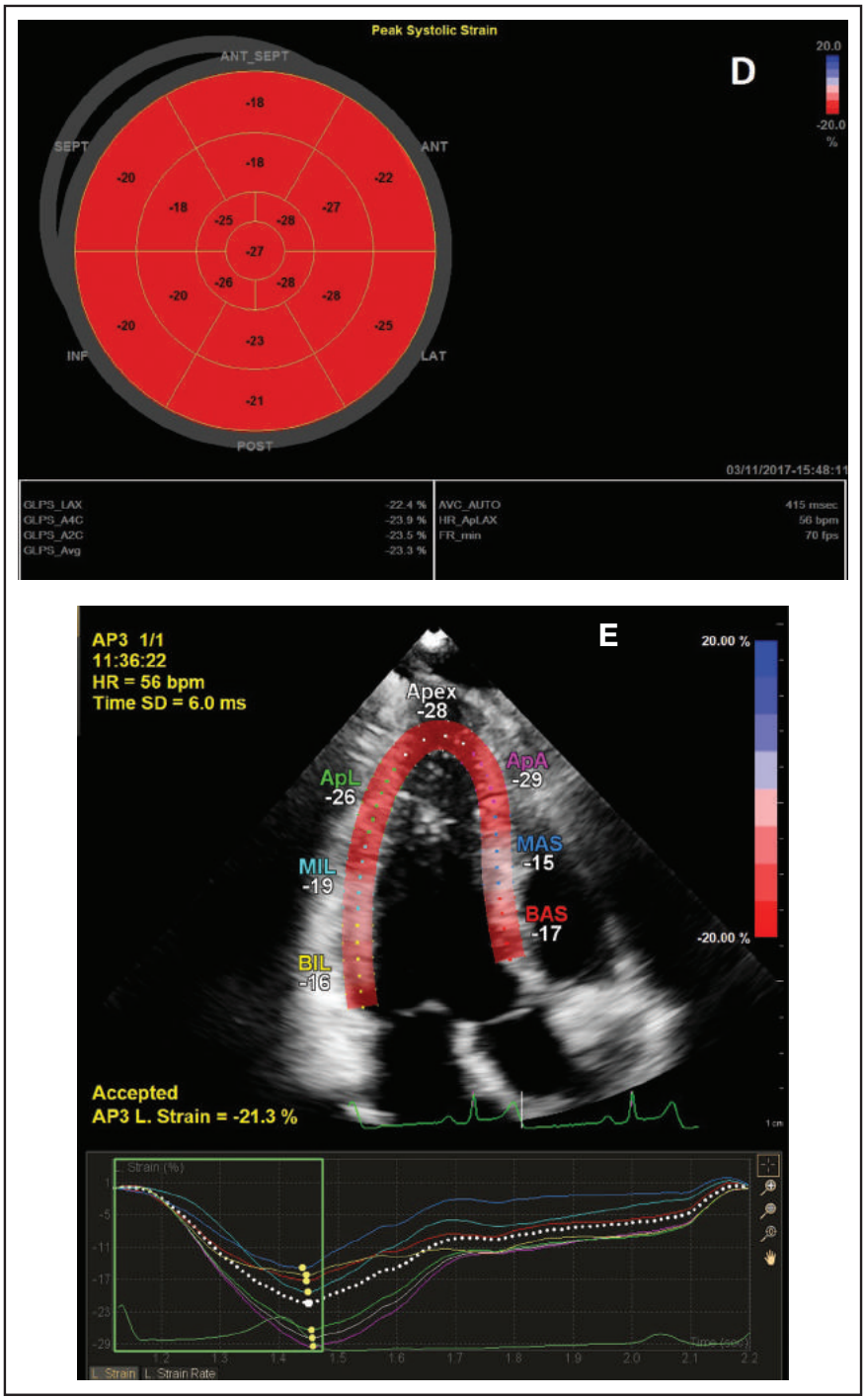


Figure 9. Strain curve results from different vendors' software (Figure 9. A, B, C, D: GE. Figure 9. E, F, G, H: Philips). (continued)

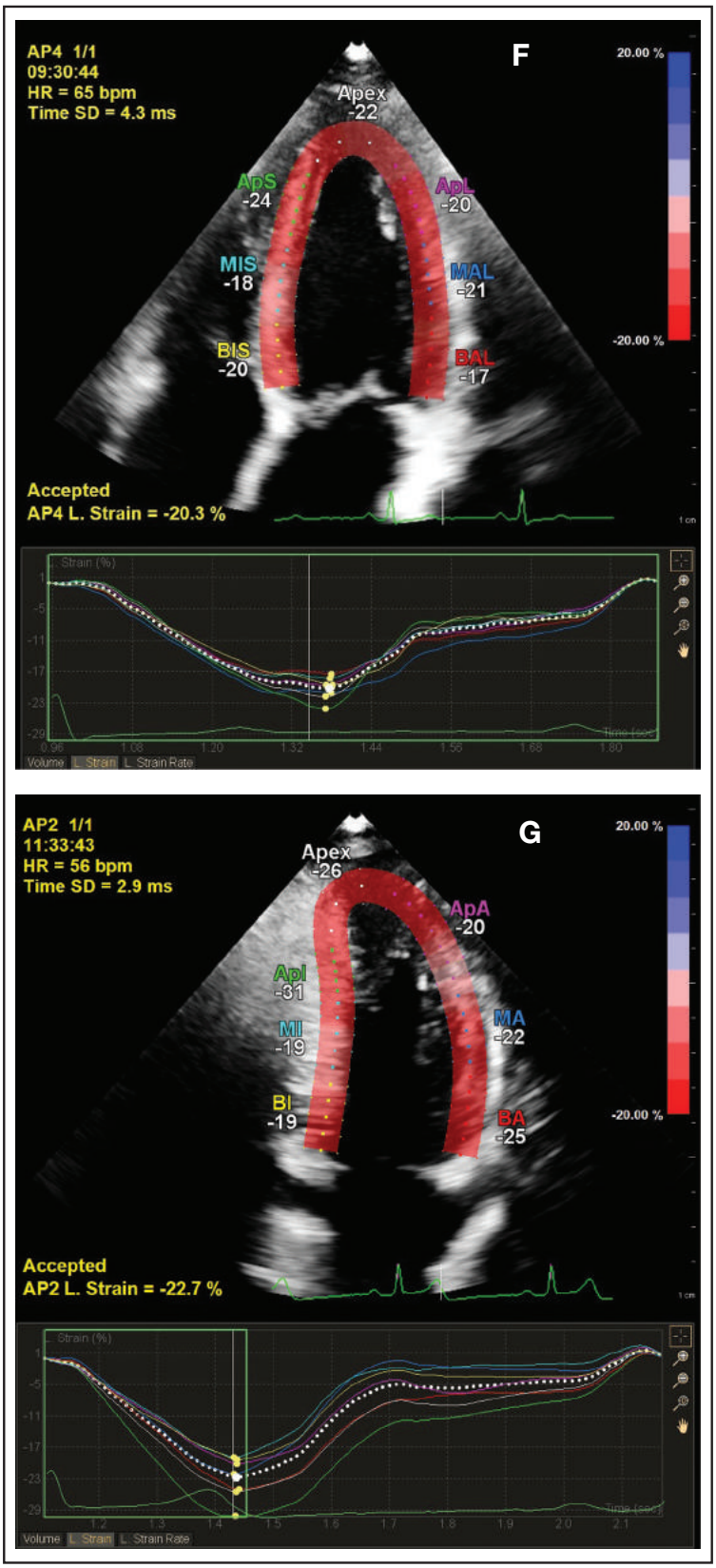


Figure 9. Strain curve results from different vendors' software (Figure 9. A, B, C, D: GE. Figure 9. E, F, G, H: Philips). (continued)

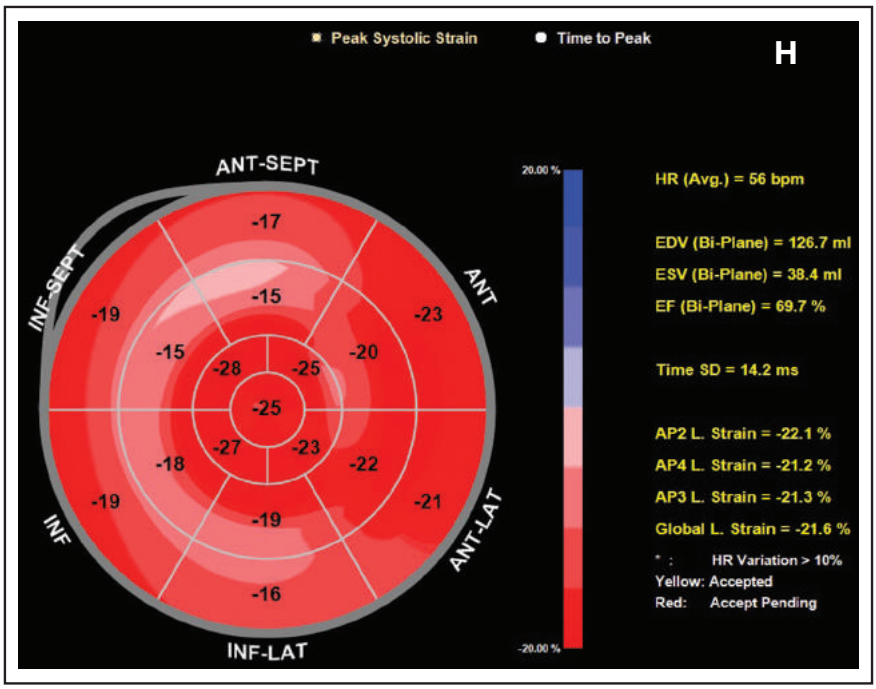


Figure 9. Strain curve results from different vendors' software (Figure 9. A, B, C, D: GE. Figure 9. E, F, G, H: Philips). (continued)

Table 5. Checklist for Post-Processing Steps

Checklist for Post-Processing
• Image Quality and Optimization
• Setting Aortic Valve Closure (AVC) Timing
• Placing Three Reference Points
• Defining Region-Of-Interest (ROI) and Assess Myocardial Tracking
• Reject Segments with Suboptimal Tracking
• Generate Strain Curves and Bull's Eye Plot

Integrating Strain Imaging Into Routine Practice: Where To Begin for Sonographers

The clinical utility of strain echocardiography for sonographers is a primary area of focus, however, recognizing the importance of quality improvement during integration is key when addressing learning curves and standardizing assessment.

Chan et al. reviewed the application of left ventricular global longitudinal strain analysis and determined that learning curves do exist to meet training requirements and achieving competency[3]. Identifying a single vendor that will be used in clinical practice would be the initial step in assuring consistency. Although the joint ASE/EACVI initiative with industry partners has improved standardization of inter-vendor strain measurements, the use of the same vendor during follow up will avoid variability.

Once a vendor has been selected, training sessions should be implemented for interested sonographers. Analysis by experienced readers should be used as the external reference standard. As the two major causes of variability are the placement of reference points

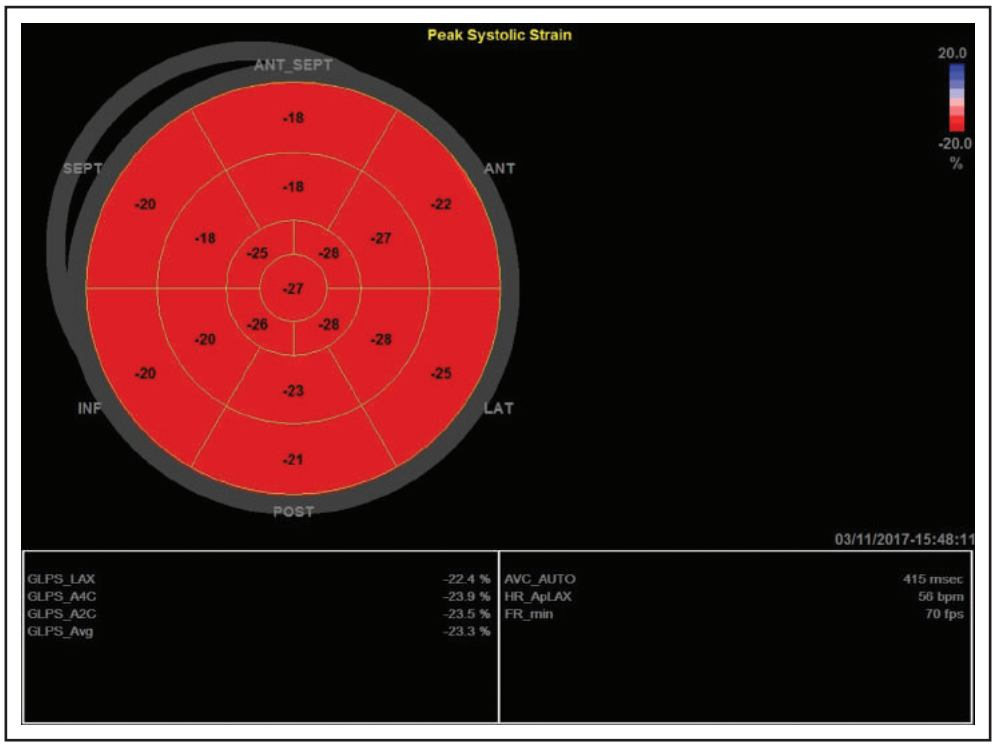


Figure 10. Colour bar and GLS value.

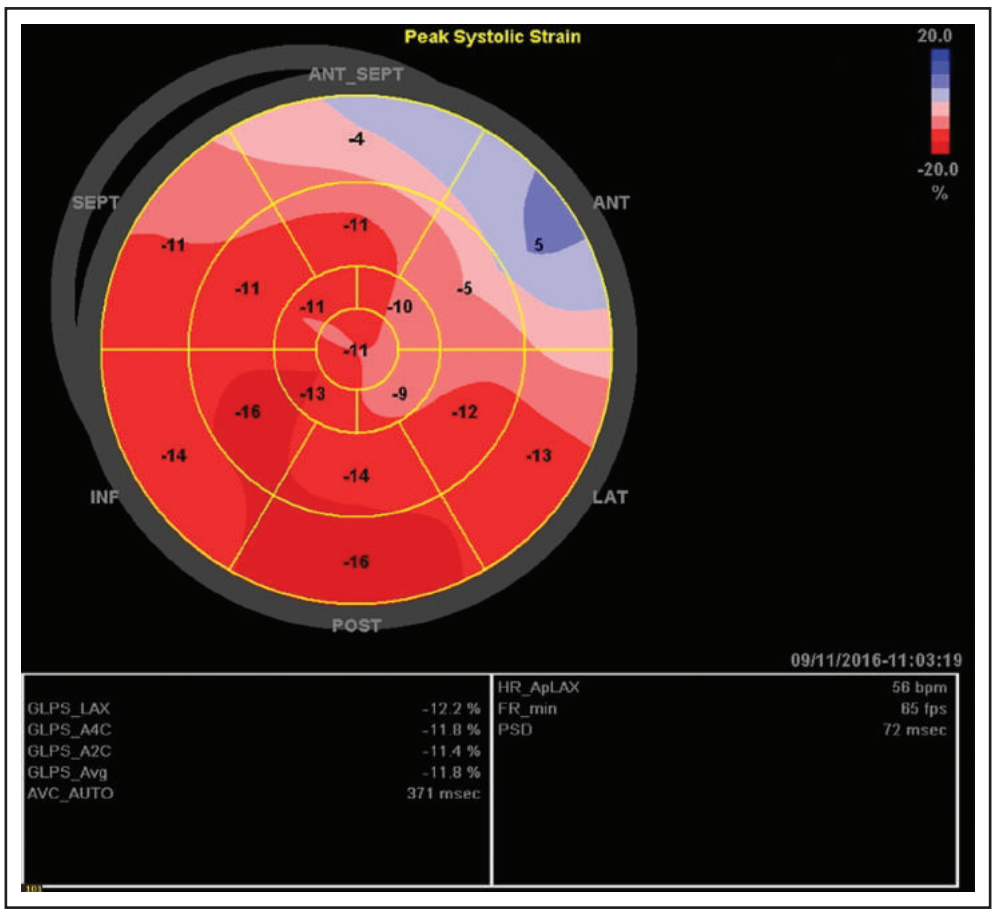


Figure 11. Bull's Eye colour segments.

Table 6. Colour Scheme and GLS Value.

Colour	Wall Motion	GLS Value
Red	**Normal**	-18 to -20%
Lighter Red	**Degree of Hypokinesis**	Less Negative
White	**Akinesis**	Zero
Blue	**Dyskinesis**	Positive

Table 7. Limitations in Strain Imaging.

Limitation	Factors

Patient / Clinical	• Dependent on Hemodynamics
	• Dependent on Demographics
	  ○ CAD, Hypertension, Diabetes, Medical record/comorbidities
	• Arrhythmia / Heart Rate
	  ○ GLS is variable depending on heart rate
	• Patient body habitus
	  ○ High BMI or surgical procedures may not allow for strain assessment

Technical	• Image Quality
	  ○ Obtaining high frame rates
	  ○ Foreshortening
	  ○ GLS cannot be performed if more than two myocardial segments have to be excluded due to suboptimal tracking
	• User Dependency
	  ○ Variability of strain between intervenor
	  ■ Post-processing techniques and algorithms vary between vendors. If a patient is having multiple follow-up echocardiograms, ASE guidelines recommend they be completed on the same vendor.
	  ■ Variation in the selected region of interest: Some software's allow for manual adjustment (thickness/thinness) of individual wall segments such as the apical regions
	  ○ Variability of strain between interobserver/intraobserver
	  ■ Correct placement of reference points: Placing points into the left ventricular outflow tract or on the atrial side of the mitral valve annulus will underestimate strain values
	  ■ Region of interest: Manually adjusting border contours2

Operator / Experience Dependence	• The learning curve can cause measurement variability • Recognition of suboptimal tracking and exclusion of segments that do not track well • Analysis time could cause slow the integration in a high volume lab

(MV annulus and apex) and inappropriate ROI width/thickness, feedback on strain tracing and tracking is a useful quality improvement tool after the initial analysis. Chan et al. recommend post-processing a minimum of 50 patients to achieve proficiency and reproducibility in GLS analysis.[3] They found that after 50 cases, the learning curve plateaued between the expert group and the study group. The process of validating sonographer strain measurements with external reference standards (e.g. expert readers) can facilitate the reduction of interobserver variability.

Once the variability has been assessed and a strain imaging protocol has been established, the next important step is understanding strain patterns and values amongst various cardiac pathologies. This will be covered in part three of the strain imaging in echocardiography series.

References

1. Lang RM, Badano LP, Mor-Avi V, Afilalo J, Armstrong A, Ernande L, et al. Recommendations for cardiac chamber quantification by echocardiography in adults: An update from the American society of echocardiography and the European association of cardiovascular imaging. Eur Heart J Cardiovasc Imaging 2015.
2. Negishi K, Negishi T, Kurosawa K, Hristova K, Popescu BA, Vinereanu D, et al. Practical guidance in echocardiographic assessment of global longitudinal strain. JACC Cardiovasc Imaging 2015;8:489–92.
3. Chan, J et al. Left Ventricular Global Strain Analysis by Two-Dimensional Speckle-Tracking Echocardiography: The Learning Curve. Journal of American Society of Echocardiography. 2017;30(11):1081–1090. DOI: https://doi.org/10.1016/j.echo.2017.06.010

CJMS Article: Sonography Canada CPD Credit

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Article Name: Strain Imaging in Echocardiography
Part 2: Sonographer Initiatives and Imaging Protocol

Authors Name: Babitha Thampinathan, Marcello Seung Ju Na, Jennifer Lam

1. Sonographers should be mindful of optimizing their strain imaging by including which of the following:

a) Mitral valve
b) Aortic Valve
c) All of the Left Ventricle
d) All of the Left Atrium
e) a, b & c above

2. To optimize your image, ensure you maintain a frame rate between _____ frames per second (FPS).

a) 20 to 50
b) 35 to 45
c) 50 to 80
d) 80 to 100

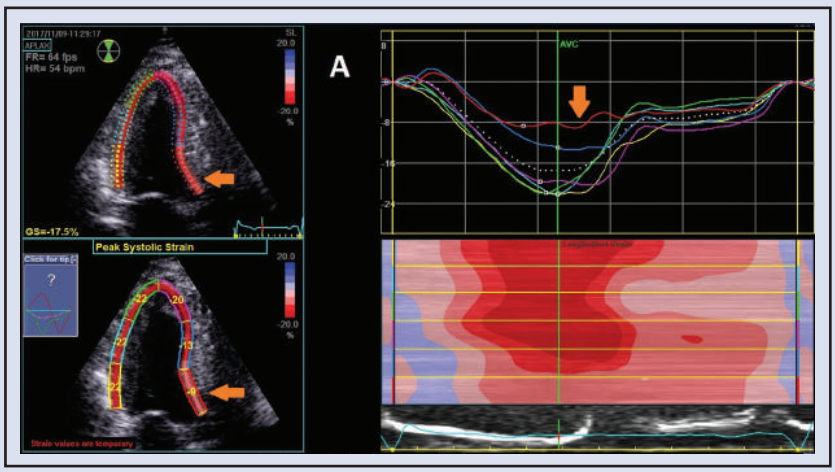
3. Foreshortening or acquiring off-axis views of the LV does not affect tracking of the myocardial borders or strain values.

a) True
b) False

4. Do not include the pericardium in your strain image as this can reduce the strain value.

c) True
d) False

5. In the image the red arrow is indicating which issue:



a) Inappropriate ROI width/thickness
b) Optimal tracking of the basal anteroseptal
c) Reference point is not far enough into the LVOT/ on the aortic valve
d) Reference point placement is too far into the LVOT/ on the aortic valve.

LISTENING TO THE VOICE OF SONOGRAPHY CANADA MEMBERS: Results of the 2018 Sonography Canada Membership Survey

By Tara Chegwin, Professional Services Coordinator, Sonography Canada

The profession of diagnostic medical sonography has started to become regulated by Canadian provinces and territories, thereby requiring Sonography Canada to focus on its role as a professional association. Leadership also changed significantly in 2018 with the arrival of Ms. Susan Clarke as the new Executive Director and the election of a Board of Directors with a new Chair and three new members. With this new leadership and significant changes to the health-care environment came the opportunity to revisit and set a new direction for the organization.

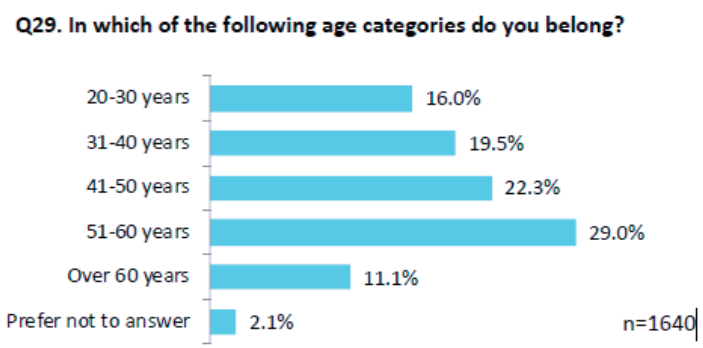
Before putting pen to paper (or more accurately fingers to a keyboard) to outline this new direction for the organization, Sonography Canada conducted an online membership survey from December 3rd to 31st, 2018, with the assistance of Meredith Low Consulting, to capture member input.

"*As a professional association, Sonography Canada is ultimately accountable to its members. Therefore, a new strategic plan could not be articulated without first consulting the membership to achieve a better understanding of their needs and expectations,*" stated Victor Lee, Chair of Sonography Canada.

Over 2,000 members (37% of Active members) completed the questionnaire which allowed the association to collect valuable data on member demographics and work-related conditions to help support strategic planning, human resource planning, and decision-making. Here are a few of the key things we've learned!

We need more sonographers!

Almost 50% of respondents plan to retire in the next 10 years.

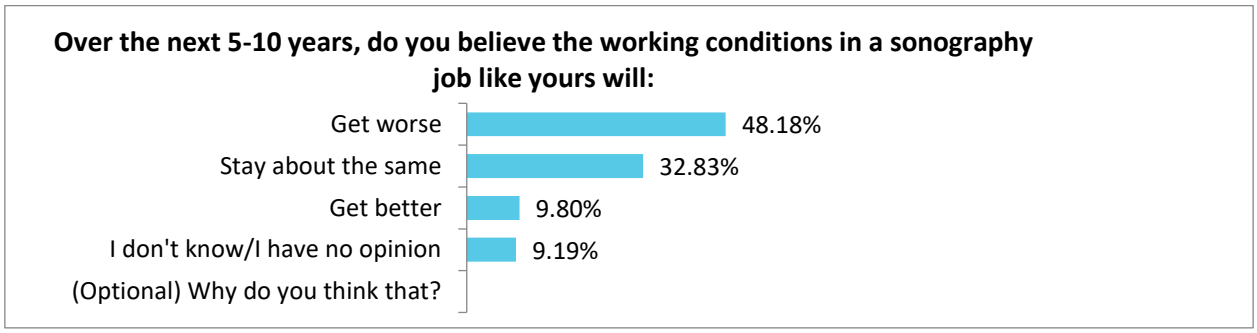


Sonography Canada must adapt to the aging demographic of its members. With over one third of respondents over 51 years of age (40%) and having been employed as a sonographer for more than 20 years (35%), it's safe to say that recruitment and succession planning will be essential for our profession in the years to come.

"*The demand for sonographers across Canada already exceeds the number of qualified professionals to fill these positions. As a result, increased efforts to attract and train students in our profession will be key to meeting current and future demands*," stated Ms. Gisèle Mayer-Burton, CRGS, CRVS, Chair of Sonography Canada's National Education Advisory Committee.

Members Hold a Somewhat Pessimistic Outlook on the Future of Sonography

Almost 50% of respondents believe the working conditions in sonography will get worse.



This survey explored a number of factors affecting the career of sonographers. Those who expect working conditions to decline primarily expressed concerns around what might be described as contradictory demands for increased productivity in the workplace and unrealistically high expectations from both employers and patients.

Survey participants indicated that, while employers call for reduced scan times, they have also increased their demand for more detailed scans. The perception is that the increase in demand is being made despite staff shortages, increasingly large and more complex patients, as well as budget cuts. Some also suggested that there are a number of "unnecessary" scans being requested, thereby adding to the burden of sonographers across the country. In general, there appears to be a sense that employers are making decisions in an attempt to reduce wait times and patient waitlists, without giving equal consideration to the impact these decisions might have on sonographers.

While some respondents expressed optimism because their health-care facility was hiring more staff, a larger number of sonographers expressed concern that, to meet increased demands, they may be called upon to do more shift work or extend their shifts. They are also worried that a decrease in scan time could mean an increased likelihood of missing pathology and, as radiologists face the same time constraint challenges, sonographers are assuming more of a direct role in reporting.

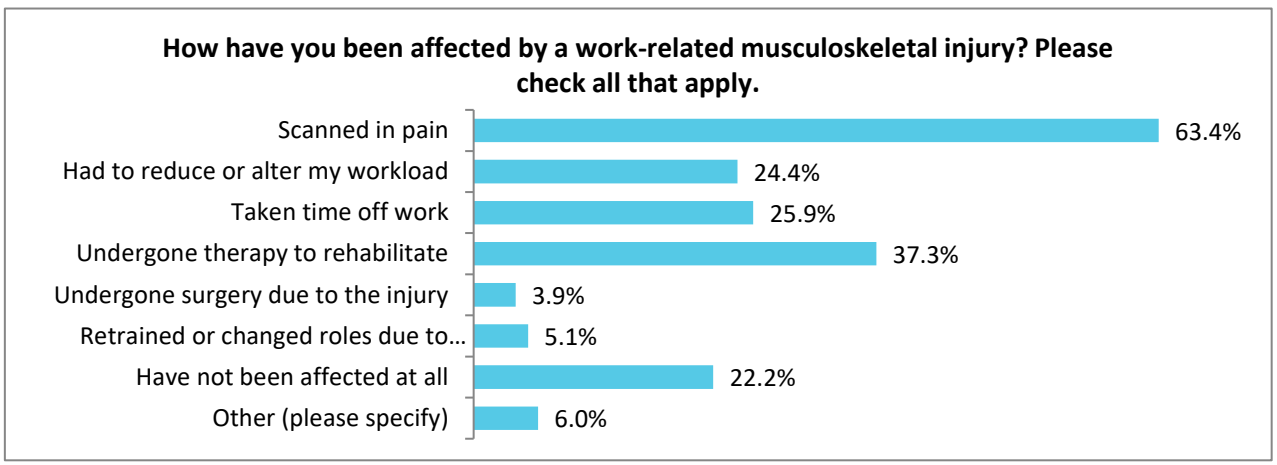
Though some sonographers welcomed technology as a potential source of improvement for the profession, others felt that they risked being replaced by these new tools.

Kim Boles, CRGS, CRVS, Chair of Sonography Canada's Professional Practice Committee indicated that: "*Sonography Canada has an important role to play in sharing best practices and educating sonographers as well as employers as we advocate for ongoing improvements to workplace standards and practices. To this end, we are proud to be developing* National Practice Protocols*, to accompany the updated Professional Practice Guidelines which were released in early 2019. These practice protocols along with the Canadian Institute for Health Information (CIHI) guidelines for ultrasound examination scheduling and time allotments should go a long way to addressing some of the workflow concerns expressed by our members.*"

Working as a sonographer can be a "painful" experience

Almost 80% of respondents have experienced some kind of work-related pain or injury during their career.

The results of the ever-growing demands on sonographers are increased stress and risk of burn-out throughout the profession as well as an ever-growing risk of musculoskeletal injury.



Sonography Canada shares the view that injuries can be expensive, and prevention is cheaper and ultimately more beneficial for our profession, our members and employers. The tools used, the way the room is set up, the organization of a daily schedule, and the posture assumed by our sonographers all contribute to the issue of work-related injuries.

Work-related injuries generally get progressively worse over time and can lead to time off work to obtain the treatment, therapy or surgery required to address the issue. But these injuries have an impact beyond those being addressed by the affected sonographer. Their absence from work can have important operational impacts on the remaining team members who will likely be called upon to manage the workload and the department.

Our association is committed to educating employers and managers about the risks and the costs associated with an injured sonographer. We strive to emphasize the importance of ergonomics and the practical application of best practices for everyday scanning to help reduce and, ideally eliminate, repetitive strain injuries and other work-related injuries in our profession.

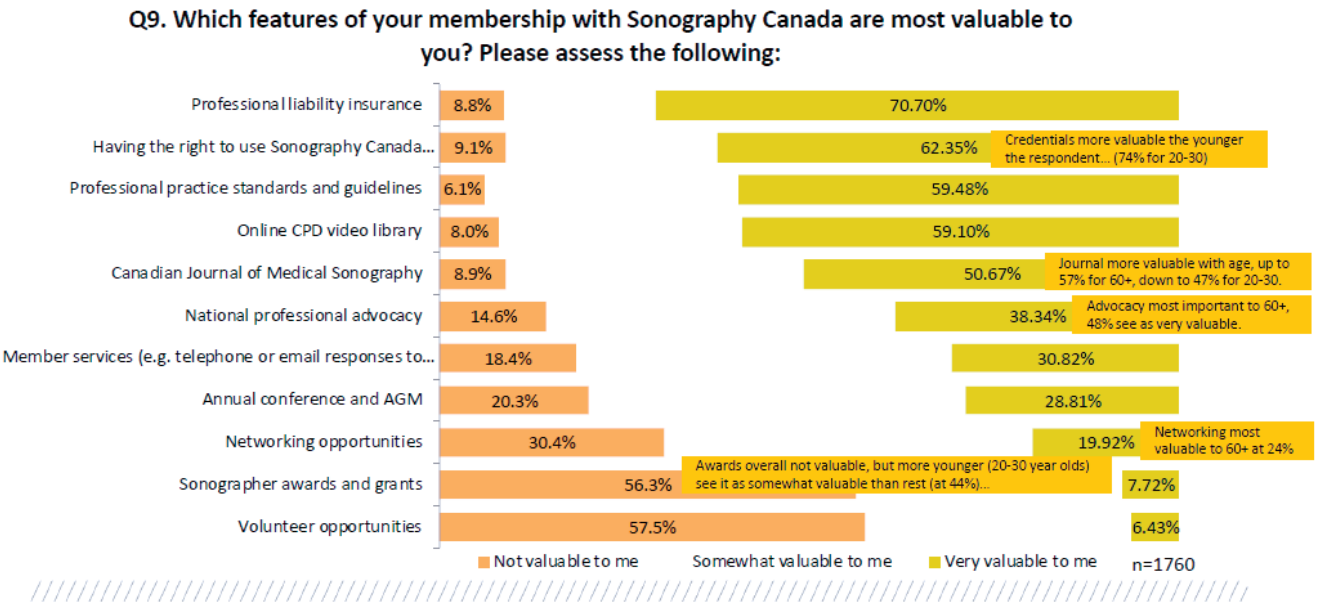
"While our members strive to provide patients with the best possible care they can, Sonography Canada is committed to providing them with the best possible value for their membership by supporting them throughout their career. From the time they are students to the day they choose to retire, our goal is to meet their needs and address their concerns through professional guidelines, standards, communications, and training," said Ms. Susan Clarke, Executive Director of Sonography Canada.

The Sonography Canada Value Proposition

A slight majority (55%) of members are satisfied or very satisfied with their Sonography Canada membership.

This statement indicates that almost an equal proportion of members expect improvements, and the level of satisfaction appears to decline with age, with only 1 in 20 members aged 20-30 being very satisfied.

As the association explores ways to increase satisfaction levels, it is carefully analyzing the data related to the features that help define the association's value proposition. The top five features considered to be "very valuable" by more than 50% of respondents related to professional liability insurance, the right to use Sonography Canada credentials, professional practice guidelines, continuing professional development materials, and the *Canadian Journal of Medical Sonography*.



Moving forward, the association is pouring through the many comments received from members to determine where it should focus its efforts. One thing is clear, credentialing will remain a core function for the association.

When it comes to Sonography Canada credentials, 67% of respondents indicated that they maintain their credentials because employers require them as a condition of employment, something Sonography Canada has and will continue to advocate for in the future.

It is also important to note that more than half of survey participants (56%) stated that they take pride in their credentials and maintain them as a demonstration of their commitment to the profession.

The survey also highlighted the need for continued education efforts to help clarify what regulation truly means for sonographers in provinces and territories where medical diagnostic sonography has been, or soon will be, officially recognized as a regulated profession.

Casey Fraser, CRGS, CRCS-AE, CRVS, Chair of Sonography Canada's Examination Committee had this to say: "*Sonography Canada is our country's official credentialing body for Diagnostic Medical Sonographers. We take great pride in this role and we invest a great deal of time and effort to develop, maintain and improve the credentialing process, the professional practice guidelines and the continuing professional development opportunities required to ensure quality patient care by competent sonographers across the country. Your membership is not only an investment in your association; it's an investment in your profession and career.*"

The survey data led Sonography Canada to develop a new strategic plan built on four key pillars aimed at focusing the efforts of our organization to better meet the needs of our membership across the country, and of our profession now and in the future. The four pillars are to:

1. support sonographers in their identified need for sustainable workloads and desire for opportunities to provide high quality patient care;
2. lead in the advancement of sonography professional practice across Canada;
3. support members through all stages of their professional practice with relevant, accessible programs and services that add and demonstrate tangible value; and
4. review and re-structure the Sonography Canada organization to be member-driven, proactive, innovative, and streamlined.

Supports the recommendation by Health Canada and provincial health authorities that **sick employees be encouraged to stay home.** Personnel who develop respiratory symptoms (e.g., cough, shortness of breath), those who have recently been out of country (within 14 days), and/or been in direct contact with someone with COVID-19 are typically being instructed not to report to work and to seek the necessary medical advice. Employers should ensure that sick leave policies are flexible and consistent with public health guidelines and that employees are aware of these policies.

6. Supports **waiving cancellation or administrative fees** normally incurred for patients/clients who choose not to proceed with an ultrasound examination during the COVID-19 pandemic, whether or not they have been diagnosed with the Coronavirus.

To keep up to date on the recommendations made by Health Canada, provincial health authorities, and other credible organizations, and to learn more about preventing the spread of COVID-19, please access the following links:

Health Canada

- COVID-19 Information
- Coronavirus disease (COVID-19): For health professionals
- *Canadian Pandemic Influenza Preparedness: Planning Guidance for the Health Sector*

Canada's Regional Health Authorities

- Alberta
- British Columbia
- Manitoba
- New Brunswick
- Newfoundland & Labrador
- Northwest Territories
- Nova Scotia
- Nunavut
- Ontario
- Prince Edward Island
- Québec
- Saskatchewan
- Yukon

Centres for Disease Control and Prevention (CDC)

- *Steps Healthcare Facilities Can Take to Prepare for Coronavirus Disease 2019 (COVID-19)*
- *Resources for Clinics and Healthcare Facilities*
- *Interim Guidance for Healthcare Facilities: Preparing for Community Transmission of COVID-19 in the United States*
- *What Healthcare Personnel Should Know about Caring for Patients with Confirmed or Possible COVID-19 Infection*
- *Frequently Asked Questions on Personal Protective Equipment*

World Health Organization

- Coronavirus disease (COVID-19) Pandemic Information

- *Rational use of personal protective equipment for coronavirus disease 2019 (COVID-19)*

Sonography Canada Statement:

Sonographers and COVID-19

On March 11, 2020, the World Health Organization (WHO) officially declared COVID-19 a pandemic. The Coronavirus has important implications for both patients and healthcare providers.

Diagnostic medical sonographers are an important part of Canada's healthcare team. We understand the need to maintain ongoing operations and to continue to provide Canadians with the diagnostic medical treatment they need. However, this must be done in keeping with infection prevention and control and occupational health standards in order to prevent unnecessary exposure to, and transmission of, the Coronavirus (COVID-19) during the provision of health services.

Unlike other imaging procedures (e.g., X-rays, MRIs, etc.), ultrasound examinations do not comply with Health Canada recommendations for social distancing during the COVID-19 pandemic. A two-meter spatial separation between the patient and the sonographer is not possible and examinations involve extended periods of exposure to the patient as most assessments require a minimum of 20 minutes to complete.

With this in mind, and in keeping with recommendations put forth by Health Canada and provincial health authorities, Sonography Canada:

1. Supports the recommendation to "**prioritize urgent and emergency visits and procedures now and for the coming several weeks**", thereby potentially delaying elective and non-urgent diagnostic medical imaging examinations, where possible.
2. Supports the recommendation that **places of employment ensure access to, and the use of, Personal Protective Equipment (PPE)** to prevent the acquisition and transmission of a disease such as COVID-19. In addition, ultrasound examinations of positive patients or those with respiratory symptoms should be completed portably, when possible, to limit exposure of others. Please consult your place of employment's practice guidelines for PPE information and cleaning procedures.
3. Encourages members to implement the **equipment and technical standards** outlined in the Sonography Canada *Professional Practice Guidelines and Member Policies* regarding safety and high-level transducer decontamination.
4. Invites members to **consult their place of employment's pandemic or emergency plan** to confirm how ultrasound examinations are to be addressed as part of the core department functions that must be maintained during a pandemic/emergency situation.
5. Supports the **screening of patients/clients before arriving and entering healthcare facilities** to reduce the risk of acquiring and transmitting the Coronavirus during ultrasound examinations. Please consult local guidelines for both active and passive screening processes.