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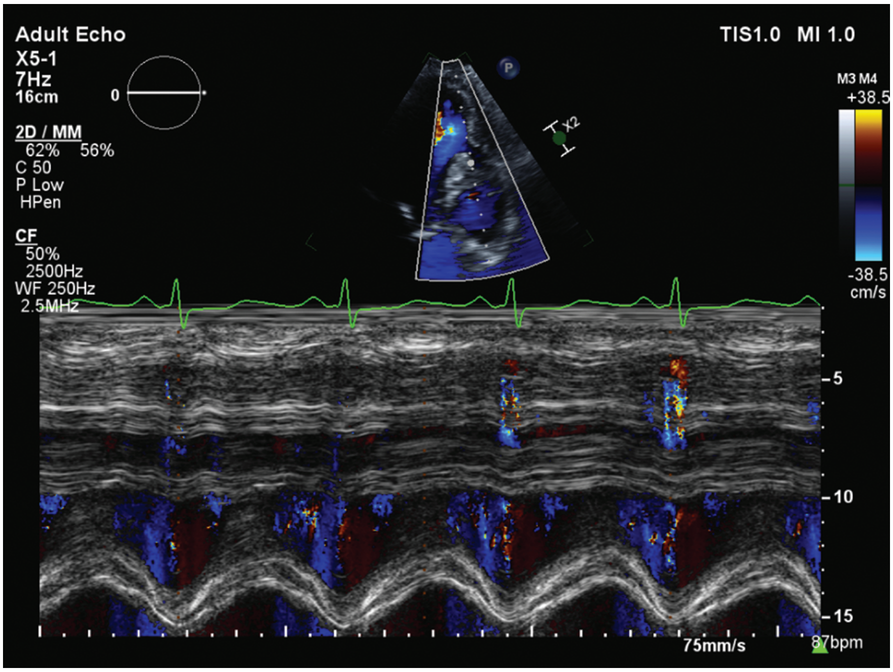

Universal Precautions and Infection-Prevention Protocol for Ultrasound Devices and Room during COVID-19 | *Nicole Marley, BSc, CRGS (Candidate), X Fatima Tul Zahra, MD, CRGS (Candidate), Raquel Teichroeb, BASc, CRGS (Candidate)*

An Echocardiographic Guide to Distinguish a Rare Cardiac Abnormality: Case Study of Left Ventricular Diverticulum and Review of the Literature | *Vikas Gulati, H.BSc, DMS and Marcello Na, H.BSc, DMS, MHI*

Evidence-Based Approaches to Enhance Teaching and Learning in Sonography | *Jane St Germain, MMUS, CRGS, CRVS, RDMS, RVT, Cert. Adult Ed.*

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About the Cover

This image is Figure 3 from Vikas Gulati and Marcello Na's article. An Echocardiographic Guide to Distinguish a Rare Cardiac Abnormality:Case Study of Left Ventricular Diverticulum and Review of the Literature

Message from the Editor-in-Chief

As we wrap up the year 2020, I reflect on this year of trials, tribulations, and celebrations. On September 9, 2020, Nova Scotia became the third jurisdiction in Canada to fully recognize and regulate diagnostic medical sonography as a distinct discipline under the Nova Scotia College of Medical Imaging & Radiation Therapy Professionals. This college represents over 700 health care professionals; this is excellent news for Nova Scotia's sonographers since it recognizes their profession and assures the public that sonographers are formally held to high standards for delivering ethical & competent care. The first province to attain the regulation of sonographers in Canada was Quebec, followed by Ontario on January 1, 2018.

The COVID-19 pandemic is still impacting our world. Canada has done better than some countries, but our numbers are increasing. There are fewer percentile deaths since health care providers are learning to manage this disease a bit better, and progress is being reported in the areas of possible vaccinations. Most ultrasound clinical sites are open with COVID-19 protocols such as donning & doffing appropriate personal protective equipment (PPE), universal precautions, and the disinfection of tools and spaces. As a result, the number of ultrasounds that can be performed has been impacted. Ultrasound schools have been open in most provinces, and most have transitioned to a virtual platform with on-campus simulation labs only. Most ultrasound programs are managing their curriculum, but there are challenges to obtaining clinical practicums and, therefore, a risk of program closures. This is an unfortunate trend since this will likely affect the number of graduating sonographers to enter practice and may further exacerbate staff shortages across the country.

With change there is always some learning we can benefit from. When it comes to the COVID-19 pandemic, a team of students from The Michener Institute of Education at UHN have shared a literature review on "Universal Precautions and Infection-Prevention Protocol for Ultrasound Devices and Room during COVID-19." This article shares the recommendations from reliable sources, and I hope it will be a valuable resource to all sonographers. Jane St. Germain, an educator at Algonquin College in Ottawa, also completed a literature review focused on "Evidence-Based Approaches to Enhance Teaching and Learning in Sonography." This is the first education-themed article in my tenure with CJMS, and I hope that all educators will find this information applicable to their practice. I also hope it will inspire more articles on the themes of clinical and academic education. Also worthy of mention is the work of Vikas Gulati & Seung Ju (Marcello) Na, who present an interesting case study of left ventricular diverticulum. I really enjoyed this case study, and I recommend it to all general sonographers. Even though cardiac sonography is not my specialty, I found it insightful and a worthwhile read.

In the first issue of 2019, I asked you, my colleagues, to help steer the CJMS in the direction that you envision. This is the 8th issue to be published since that date. We are delighted to be seeing many more manuscripts from sonographers in the cardiac, vascular, and generalist areas. We have seen more case studies, literature reviews, as well as some original research. Keep them coming! To ensure the continued success and progress of the only Canadian journal devoted to diagnostic medical sonography requires your contributions and engagement. The CJMS is a journal for members, by members. With this in mind, I would like to thank the authors, editorial team, reviewers, publisher, and Sonography Canada for your ongoing support of the CJMS.

Happy Holidays and wishing everyone a safe, happy, healthy, and prosperous new year!

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

Editor-in-Chief

Pushing the boundaries

Message de la rédactrice en chef

Alors que nous terminons l'année 2020, je réfléchis à cette année d'épreuves, de tribulations et de célébrations. Le 9 septembre 2020, la Nouvelle-Écosse est devenue la troisième juridiction du Canada à reconnaître et à réglementer pleinement l'échographie médicale diagnostique en tant que discipline distincte relevant du Nova Scotia College of Medical Imaging & Radiation Therapy Professionals. Ce collège représente plus de 700 professionnels de la santé ; c'est une excellente nouvelle pour les échographistes de la Nouvelle-Écosse puisqu'il reconnaît leur profession et assure au public que les échographistes sont formellement tenus de respecter des normes élevées en matière de prestation de soins éthiques et compétents. Le Québec a été la première province à se doter d'une réglementation des échographistes au Canada, suivi par l'Ontario le 1er janvier 2018.

La pandémie de COVID-19 continue d'avoir des répercussions sur notre monde. Le Canada a fait mieux que certains pays, mais notre nombre augmente. Le pourcentage de décès a diminué, car les professionnels de la santé apprennent à mieux gérer cette maladie et des progrès sont signalés dans le domaine des vaccinations possibles. La plupart des sites cliniques d'échographie sont ouverts avec des protocoles COVID-19 tels que le port et l'enlèvement de l'équipement de protection individuelle (EPI) approprié, les précautions universelles et la désinfection des outils et des espaces. En conséquence, le nombre d'échographies qui peuvent être effectuées a été modifié. Des écoles d'échographie ont été ouvertes dans la plupart des provinces, et la plupart sont passées à une plateforme virtuelle avec des laboratoires de simulation sur le campus uniquement. La plupart des programmes d'échographie gèrent leur programme d'études, mais il est difficile d'obtenir des stages cliniques et, par conséquent, il existe un risque de fermeture des programmes. Il s'agit d'une tendance malheureuse, car cela affectera probablement le nombre de diplômés en échographie qui entreront en pratique et pourrait aggraver encore la pénurie de personnel dans tout le pays.

Avec le changement, il y a toujours un certain apprentissage dont nous pouvons tirer profit. En ce qui concerne la pandémie COVID-19, une équipe d'étudiants du Michener Institute of Education de l'UHN a partagé une analyse documentaire sur les "Précautions universelles et le protocole de prévention des infections pour les appareils à ultrasons et la salle pendant COVID-19". Cet article partage les recommandations de sources fiables, et j'espère qu'il sera une ressource précieuse pour tous les échographistes. Jane St. Germain, éducatrice au Collège Algonquin d'Ottawa, a également réalisé une analyse documentaire sur les "Approches fondées sur des données probantes pour améliorer l'enseignement et l'apprentissage en échographie". C'est le premier article sur le thème de l'éducation que je publie dans le cadre de mon mandat au CJMS, et j'espère que tous les éducateurs trouveront ces informations applicables à leur pratique. J'espère également qu'il inspirera d'autres articles sur les thèmes de l'enseignement clinique et universitaire. Il convient également de mentionner les travaux de Vikas Gulati & Seung Ju (Marcello) Na, qui présentent une étude de cas intéressante sur le diverticule ventriculaire gauche. J'ai beaucoup apprécié cette étude de cas, et je la recommande à tous les échographistes généralistes. Même si l'échographie cardiaque n'est pas ma spécialité, je l'ai trouvée instructive et intéressante à lire.

Dans le premier numéro de 2019, je vous ai demandé, à vous mes collègues, de m'aider à orienter le CJMS dans la direction que vous envisagez. C'est le 8ème numéro publié depuis cette date. Nous sommes ravis de voir de nombreux autres manuscrits d'échographistes dans les domaines cardiaque, vasculaire et généraliste. Nous avons vu davantage d'études de cas, de revues de littérature, ainsi que des recherches originales. Continuez à nous les faire parvenir ! Pour assurer le succès et les progrès continus de la seule revue canadienne consacrée à l'échographie médicale diagnostique, nous avons besoin de vos contributions et de votre engagement. La CJMS est une revue pour les membres, par les membres. Dans cette optique, j'aimerais remercier les auteurs, l'équipe de rédaction, les réviseurs, l'éditeur et Sonography Canada pour leur soutien continu à la RCSJ.

Je vous souhaite de joyeuses fêtes et une bonne et heureuse année à tous !

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

Rédactrice en chef

Repousser les limites

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Raquel Teichroeb, BASc, CRGS (Candidate)

Universal Precautions and Infection-Prevention Protocol for Ultrasound Devices and Room during COVID-19

About the Author

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ABSTRACT

Coronavirus (SARS-CoV-2) is a lipid-enveloped virus that is responsible for the wide spread of COVID-19, a severe respiratory illness. Asymptomatic carriers in conjunction with high infection rates increase the risk of transmission. Prevention of infection in sonographers and their patients directly relies on disinfection protocols for both ultrasound machines and the proximate environment. A broad literature review was conducted using search engines and literature databases to find information regarding best Canadian evidence-based practices for proper disinfection. Research shows that low-level disinfectant is considered widely effective against SARS-CoV-2 and should be used to eliminate viral particles on shared surfaces. Whenever possible, single-use disposable items should be used to reduce cross contamination. Developing proper guidelines and educating sonographers will minimize the risk of exposure and improve ultrasound safety during this COVID-19 pandemic.

Introduction

The SARS-CoV-2 novel coronavirus, causing the COVID-19 disease, has affected many countries around the world since being declared a pandemic by the World Health Organization on March 11, 2020. By the end of March 2020, the United States had acquired the greatest number of documented cases worldwide,[1] while globally there were 372,856 documented cases displaying a 4.35% mortality rate.[2] As on June 3, 2020, 29,403 Ontarians were infected, resulting in an 8.0% mortality rate.[3] Prior to COVID-19, the last pandemic was due to the novel influenza H1N1 in 2009, which was considered an outbreak for approximately a year and resulted in approximately 60 million cases worldwide.[4]

Currently, COVID-19 is characterized as a respiratory illness with abrupt onset of symptoms, quick progression, and a high rate of infection.[2] The swift global spike in infections could be attributed to the high number of asymptomatic or pre-symptomatic individuals (i.e., in the incubation period),[5,6] combined with its high resistance.[7] At the time of writing this article, current research shows that COVID-19 is primarily transmitted through respiratory droplets from close proximity to an infected individual via either contact transmission or airborne transmission such as in aerosol-generating medical procedures (AGMP) (i.e., intubation).[2,5,7,8] The most common clinical presentations of symptomatic COVID-19 patients include pyrexia, cough, dyspnea, and lethargy, with progression causing pneumonia and hypoxia,[8] and some presenting with cardiac involvement and renal injury.[9] Laboratory data indicating COVID-19 may include lymphocytopenia, thrombocytopenia, elevated *lactate dehydrogenase* (LDH), or liver function tests (LFTs) exceeding pneumonia.[8,10]

According to data available at the time of writing, 3–10% of infected patients in heavily infected countries are healthcare workers, amplifying the burden of the pandemic on the healthcare system due to staff shortages.[10] The risks of exposure and cross-contamination in ultrasound are exceptionally high,[2,11] thus it is vital to adhere to infection control and prevention protocol for ultrasound devices and the examination room.

Methods

Articles were acquired using search engines such as PubMed and Google Scholar to obtain literature reviews. Government and educational websites provided information regarding disinfection protocols, demographics, and properties of the COVID-19 virus. Examples include Center for Disease Control and Prevention, Association for Medical Ultrasound, Canadian provincial government websites, and The Canadian Association of Radiologists. The last search was conducted on June 14, 2020.

Key terms used included disinfection, infection prevention, infection control, COVID-19, Coronavirus, SARS-COV-2, sonography, and ultrasound. Library links such as the Canadian National Catalogue and The Michener Institute of Education at UHN (The Michener) were added to Google Scholar for full text access to Canadian sources. Language limitations were used in Google Scholar for English articles. Publication date was limited in all databases to the past three years (2017–2020). Grey literature was commonly used due to the current and ongoing nature of this topic. Therefore, not all resources were peer-reviewed, resulting in poor availability of relevant and robust research.

Discussion

Disinfection Classification

Typically, there are three levels of disinfectants: high (HLD), intermediate (ILD), and low (LLD).[7] Selection of the disinfectant broadly depends upon suitability of the surface (environmental or medical instrument) and resistance of the organism.[7] SARS-CoV-2, belonging to the coronavirus family, are enveloped lipid-based viruses and are least resistant and susceptible to LLD (see Figure 1).[7]

Manufacturer guidelines should be consulted before using a new cleaning product in the event of a shortage.[5,6,11,13,14] However, one Canadian source states that manufacturer guidelines have been waived during the pandemic and any product that is effective against COVID-19 can be used.[15] Alternate disinfectants, such as detergent and water or diluted bleach, may be used in case of shortage but should be discussed before product depletion.[6,11,13,14]

Ultrasound Machine

COVID-19 can survive on hard inanimate surfaces for 48–96 h,[6,7,14,16] which makes disinfection of ultrasound

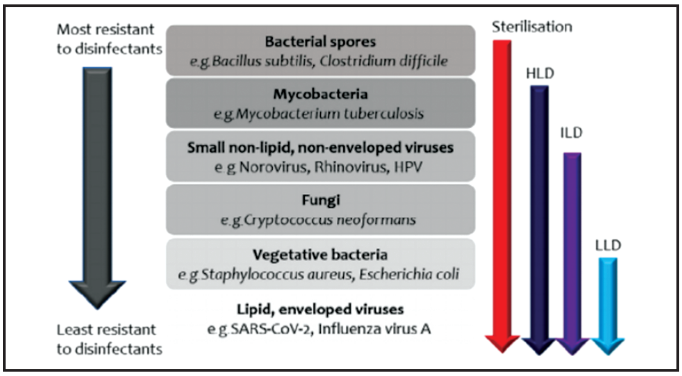

Figure 1. Levels of resistance to disinfectants by microorganisms.[6]

Table 1. Examples of Low-Level Disinfectants and Required Contact Time[12]

LLD Active Ingredients	Contact Time
1:500 Chlorine bleach solution (1 part bleach and 499 parts water)	10 min
Quaternary ammonium	10 min (follow manufacturer's instructions)
3% Hydrogen peroxide	10 min
0.5% Hydrogen peroxide (enhanced active formulation)	Follow manufacturer's instructions
Phenols	Follow manufacturer's instructions

LLD = low-level high-level disinfectant.

devices and surfaces within the room critical. Before cleaning or disinfecting any surface or equipment, use protective eyewear and gloves.[7] LLD is sufficient when disinfecting ultrasound machines as the SARS-CoV-2 virus is susceptible to these disinfectants; however, it is important to follow manufacturer's instructions before disinfection.[6,7]

Portable, handheld devices are preferred whenever possible.[7,10,15] These devices are easily transported into the patient's room, can be encased in a cover, require less time to be cleaned effectively, and do not contain a cooling fan that circulates air.[7,10,13,15] Portable devices can also be brought to the patient's home in cities where hospitals have reached capacity.[1,10] Before donning personal protective equipment (PPE), the entire device must be disinfected, dried, and inserted into sterile plastic covers using rubber bands to seal openings.[7,10,17] If the transducer is connected to the device wirelessly, a two-operator system may be used during the examination.[10] Operator one is responsible for the transducer by performing the examination and comes into contact with the patient.[10] Operator two is responsible for the device by freezing and storing images, changing parameters, and does not contact the patient.[10] After the examination is complete, remove the cover and clean device and transducer by wiping off gel or debris.[15,17] LLD should be used to disinfect all surfaces of the device, including transducer, cord, and screen, from least-soiled to most-soiled areas (see Table 2).[17] All surfaces must remain wet for the correct dwell time based on the product to ensure proper disinfection (for Cavi-wipes, 3 min).[6,11,13,15,19] Once completed, exit the room, place device on clean surface, and clean device again, once PPE is removed.[17] If the room is considered a high-risk area due to AGMP, hand off the device to another healthcare worker for the second cleaning.[15]

Cart-based machines are devices that are often based in the ultrasound department; however, most have wheels, allowing them to be transported for portable procedures. When using cart-based machines, the simplest way to avoid cross-contamination is by designating a machine(s) for only COVID-19 patients.[1,5–7,11,14,15] Remove all unnecessary accessories, such as baskets or extra transducer holders, from the machine.[11] Machines with touch screens are preferred to keyboards, as they are difficult to clean with liquid disinfectants and cannot be saturated.[1,15] The entire machine must be cleaned and disinfected before the patient enters the examination room or the sonographer entering the patient's room.[18] A non-sterile cover may be used to surround the entire machine or just the screen/keyboard, if available (see Table 2).[1,6,7,13–15] This can save cleaning time; however, it does not rid the need for routine disinfection.[7] There is also concern that covering the entire machine can overheat and compromise the machine.[1] Ultrasound performed during AGMP should be avoided; however, if mandatory, a cover is required for the entire machine.[2,13,15] Post-examination, unplug the machine, remove and dispose the cover, and clean the entire machine and transducer before leaving room.[2,13,15,19] All surfaces must be wiped down with LLD from least-soiled to most-soiled areas, including the stand, power cord, monitor, handles, screen, keyboard, trackball, knobs, transducer cord, transducer holder, and transducer.[6,7,11,14,19] Ensuring proper disinfection of all surfaces requires correct dwell time.[6,11,13,15,19] Once this is complete, exit the room and bring the machine to a clean, assigned storage area where it is not be contaminated.[11,19] There are conflicting views on whether the second cleaning of the entire machine is needed after leaving each patient's room,[13,15] or whether cleaning frequency should be determined by exposure or time/resources available.[14] The machine must be dry before reuse.[11]

Transducers

Transducers are the only part of the machine that should come into contact with the patient. Any extra transducer should be removed from the room if not needed.[7] Probe covers should be used for all patients;[2] however, due to lack of supplies, a glove in place of a transducer cover can suffice.[14] Post-examination, the probe cover must be removed and disposed in clinical waste.[7] Each transducer should be unplugged and must undergo cleaning and disinfection after every patient.[7,16] Cleaning involves removing any excess gel, debris, or bodily fluids from the transducer.[7,13,14,16] Any material left on the transducer can dilute or interrupt the disinfection process which kills the SARS-CoV-2 virus.[7] The transducer should be rinsed under running water and washed with a cloth or gauze and soap.[6,7] All soaps should be rinsed off with tap water and the transducer dried thoroughly.[6,7] Disinfection categorizes transducers into three groups based on Spaulding's classification of medical devices (see Table 2).[7] Noncritical transducers touch only intact skin and have a low risk of infection transmission.[7] These include transabdominal and lung transducers and require LLD.[7] If a probe cover is used and broke, HLD should be used.[14] However, another source states that there is no evidence that HLD is needed to protect against COVID-19 when touching intact skin.[13] Semi-critical transducers contact mucous membranes, bodily fluids, or non-intact skin and have a high risk of infection transmission.[7] These include transvaginal, transrectal, and esophageal transducers and require HLD (such as Trophon units) and a single-use probe cover.[7] COVID-19 RNA has been detected in feces, so extra precautions should be taken with transrectal ultrasounds.[7] Critical transducers are involved in invasive procedures, such as biopsies or aspirations, and carry the highest risk of infection transmission.[7] A sterile probe cover and sterilization must be used for these transducers.[7]

It is recommended to follow the manufacturer guidelines when using disinfectants as some may damage equipment and invalidate warranties.[7,13,16] Transducers can either be submerged in the disinfectant or applied with a wipe.[6,14] It is important to only submerge transducer if recommended for the appropriate length of time to ensure safety of both patient and transducer.[1] Changes to disinfection procedures should be minimally complex so that they are performed properly.[1] After use, transducers should always be stored in a cupboard or a case to prevent contamination.[7]

Gel

Gel is contaminated easily which can lead to infection outbreaks.[7] Single-use, non-sterile gel packets should be used in place of reusable bottles for external use on COVID-19 patients when available (see Table 2).[7,11,14,15] These should be discarded after every patient to avoid cross-contamination.[7] All extra gel bottles or warmers should be removed from patient rooms.[15] For internal procedures or if infection is a concern, sterile gel should be used.[7,14] If single-use gel packets are not available, bottles can be used, but if the patient is COVID-19 positive, it must be discarded after use.[14] Bottles must be sealed during examinations and disinfected with LLD after each patient.[7,14] Gel bottles must be discarded when empty and never topped off.[7,14] Gel should not be heated,[7,14] but if required, dry heat should be used, and gel warmers are disinfected regularly.[14]

Other Surfaces

Single-use covers on pillows should be used, disposed, and replaced after each patient.[19] After removing the paper sheet on the ultrasound bed, the bed should be wiped with LLD before re-covering with a clean paper sheet.[7] For non-disposable sheets and pillow covers, routine machine washing with detergent after each patient will suffice.[19] It is recommended to replace all fabric covered chairs with hard surface chairs to assist in disinfection.[6] Special attention should be given to disinfect high-contact surfaces with 60–70% alcohol sanitizing wipes, including door handles, stretcher rails, edges of bed, light switches, toilets, sinks, and soap/sanitizer dispensers.[6,19,20] The examination room floor should be disinfected with a chlorinated disinfectant (at least 2000–5000 mg/L) with a minimum wet contact time of at least 30 min before being swept with water.[2] Frequency of floor disinfection depends on foot traffic; one source recommends mopping every 2 h for every two to three patients.[19]

Additional Precautions

Air ventilation is crucial for reducing occupational exposure; rooms should be ventilated with portable fan unit two to three times each day for a minimum of 30 min at a time.[2] In China, the air in examination rooms for outpatients are disinfected after each examination with a hydrogen peroxide spray or an ultraviolet (UV) lamp used for 60 min, as the SARS-CoV-2 virus is sensitive to UV light.[2] Additionally, cloth privacy curtains can be swapped out for single-use, tear-away curtains or wipeable privacy screens for ease of cleaning and disinfection.[20]

Isolation rooms should be organized into the following areas: clean area (where staff eat, rest, and store their personal items), semi-contaminated area (where staff can write reports and complete clinical-related work), and contaminated area, which is the patient room.[2] Between each of these areas is a buffer, with four in

Table 2. Summary of Precautions, Disinfectant, and Dwell Time for Ultrasound Equipment and Rooms

Equipment	Types	Additional Precautions	Recommend Disinfectant	Minimum Dwell Time – if Applicable
US Machine	Portable: screen, cord &transducer	Completely encased in cover	LLD	3 min
	Cart-based – keyboard, screen, trackball, cord, handles, and stand	Cover mandatory in AGMP Cover keyboard and screen		
Transducer	Non-critical		LLD	3 min
	Semi-critical	Single-use probe cover	HLD	
	Critical	Single-use probe cover	Sterilization	
Gel		Single-use, non-sterile packets Discard when empty Do not heat	LLD	3 min
Other Surfaces	Floor		HLD	30 min
	Linens/pillow	Single-use cover	LLD	
	Bed	Single-use cover	LLD	
	Air	Ventilation UV lamp Hydrogen peroxide spray		30 min
				60 min
			LLD	
	High-contact surfaces	60–70% alcohol sanitizing wipes	LLD	

Legend: AGMP = aerosol-generating medical procedures; HLD = high-level disinfectant; LLD = low-level disinfectant.

total, two for entering and two for exiting, where sonographers don and doff their PPE,[2] reducing the risk of cross-contamination between the rooms.

To minimize exposure, nonessential procedures are advised to be deferred or cancelled, but in acute cases, portable ultrasound is arranged.[7,21] Patients are screened for acute respiratory infection, travel history, occupation, and contact with confirmed or suspected cases both before booking and at reception.[7,21] In Australia, confirmed COVID-19 patients are scheduled at the end of the day to allow proper disinfection time for the room and equipment,[6] but in the United States it is advised not to scan patients with active COVID-19 infection to reduce occupational exposure.[1] In the United States, ultrasound examinations are considered safe if postponed for 6–8 weeks after symptomatic recovery.[1]

Other Imaging Modalities

Ultrasound imaging is preferred during the pandemic since it is portable, can be performed in an isolated area, and is disinfected effectively and quickly.[2,9,10] In Canada and the United States, a chest CT is preferred whereas Italy and China favor lung ultrasound for imaging during the pandemic.[1,2,10,22] Computed tomography (CT) is not portable, therefore patient transportation introduces an increased risk of transmission.[2,9,10] Hospitals may reconstruct the area or plan a pathway to limit the number of entrances and exits on the route to CT room.[2] Hallways need regular disinfection, which requires extra time and resources.[24] To decrease the risk of cross-contamination, a dedicated CT machine and/or designated time slots are recommended for COVID-19 patients.[22,23] When deciding the imaging modality used on COVID-19 patients, risk of transmission and the time/resources required for disinfection must be weighed against the benefits.[22]

Conclusion

Ultrasound is an essential healthcare service, but the close physical contact of the patient and sonographer, as well as the length of contact time with patients, make the sonographer particularly vulnerable to the transmission of COVID-19.[6] High infection rates and magnitude of asymptomatic cases increase transmission of the virus.[16] Most literature recommends using LLD for disinfecting due to low-resistant properties of the virus.[6,7,14] An evidence-based method for cleaning and disinfecting the room, ultrasound machine, and transducer ensures a safer environment by reducing transmission for healthcare workers and patients alike. Recommendations are to use single-use disposable supplies such as gel, bed, and pillow covers. [7,11,14,15,19] Healthcare providers should receive specific training and education regarding transmission and prevention of the disease, appropriate use of PPE, and disinfection protocols.[5,14] Development of guidelines to prevent COVID-19 is important to improve ultrasound safety and minimize the risk of exposure to both patients and sonographers.[6,14]

Conflict of Interest

This work is original and is not in consideration by any other journal. The authors declare no conflict of interest.

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Article Name: Universal Precautions and Infection-Prevention Protocol for Ultrasound Devices and Room during COVID-19: A Literature Review

Author's Names: Nicole Marley, X Fatima Tul Zahra, Raquel Teichroeb

1. How long can SARS-CoV-2 survive on inanimate surfaces, such as an ultrasound machine or transducer?

a) 12-24 hours
b) 24-48 hours
c) 48-96 hours
d) It cannot survive on these surfaces

2. What level of disinfectant should be used to disinfect ultrasound equipment against SARS-CoV-2?

a) LLD
b) ILD
c) HLD
d) Sterilization

3. What precautions should be taken to protect an ultrasound machine when scanning a suspected or positive COVID-19 patient?

a) Use a designated machine
b) Cover the machine and probe
c) Remove all unnecessary accessories
d) All of the above

4. What steps must be taken to properly clean a non-critical transducer?

a) Clean then disinfect with HLD
b) Disinfect with HLD then clean
c) Clean then disinfect with LLD
d) Disinfect with LLD then clean

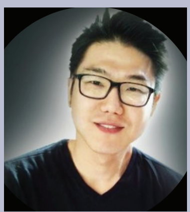
5. When scanning a suspected or positive COVID-19 patient and single-use gel packets are not available, what should you do?

a) Use sterile gel
b) Use a gel bottle as usual
c) Use a gel bottle and discard after use
d) Postpone the procedure

Case Report

Vikas Gulati, H.BSc, DMS
Marcello Na, H.BSc, DMS, MHI

An Echocardiographic Guide to Distinguish a Rare Cardiac Abnormality: Case Study of Left Ventricular Diverticulum and Review of the Literature



About the Author

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ABSTRACT

The ventricular diverticulum is a rare cardiac condition with characteristics of a localized aneurysm from the cardiac chamber. This abnormality may exist either in isolation or with other cardiac defects. Clinically, patients with such a condition are often asymptomatic; however, fatal complications can arise.[1] Diagnosis can be established by two-dimensional (2-D) echocardiography and supported by other diagnostic modalities. This article presents a case study with congenital left ventricular (LV) diverticulum from a 2-D echocardiographic approach and aims to guide cardiac sonographers to make an appropriate diagnosis from differential pathologies.

Introduction

Left ventricular (LV) diverticulum is a very rare cardiac malformation with prevalence ranging between 0.26 and 0.40%.[1] This congenital malformation can be classified as fibrous or muscular and can be presented as an isolated anomaly or associated with other cardiac and non-cardiac abnormalities.[2] Left ventricular diverticulum is distinguished by a local aneurysm of the chamber. Patients who are diagnosed with this lesion are usually asymptomatic throughout the clinical assessment, and it is typically discovered incidentally with an echocardiogram.[4] Due to the rare nature of the condition, LV diverticulum may be associated with complications such as embolism, heart failure, infective endocarditis, arrhythmias, intraventricular obstruction, ventricular rupture, and sudden death.[1] Even though there are many noninvasive diagnostic modalities available, only a handful of cases involving LV diverticulum are reported in the medical literature. As such, this can create a substantial challenge for physicians and sonographers to appropriately diagnose such a condition with imaging diagnostic methods. In this article, an adult case study is discussed and provides 2-D echocardiographic guidance to assist in the diagnosis of a rare LV diverticulum.

Case Report

A 75-year-old female with previously known severe aortic stenosis is admitted to the intensive care unit for respiratory failure. The patient exhibits a sedentary lifestyle with an extensive medical history of long-standing diabetes, a history of hypertension and dyslipidemia. She has no known history of coronary artery disease, stroke, renal insufficiency, or bleeding. She is not a smoker but anemic with a history of colon cancer and recurrent heart failure. Upon initial assessment, the blood pressure is measured at 135/80 mmHg with a heart rate of 75 bpm. Harsh systolic ejection murmur of grade 3/6 is heard upon auscultation over the right second intercostal space, which indicates aortic stenosis. The patient shows no peripheral edema.

Thorough transthoracic echocardiography (TTE) is performed to reassess the severity of aortic stenosis and cardiac function. Initially, two-dimensional (2-D) imaging shows a normal LV size (EDV index 60 mL/m^2) with severe concentric hypertrophy (14 mm interventricular wall and posterior wall measurements). The LVEF is calculated at 61% by Simpson's biplane method. There is a diverticulum at the level of mid-LV septum with a narrow neck opening measured at a width of 0.9 cm (Figure 1). Further assessment displays color Doppler communication through this area. Sweeping through the LV cavity from anterior to inferior planes via color Doppler is performed at the apical window to show the exact origin and

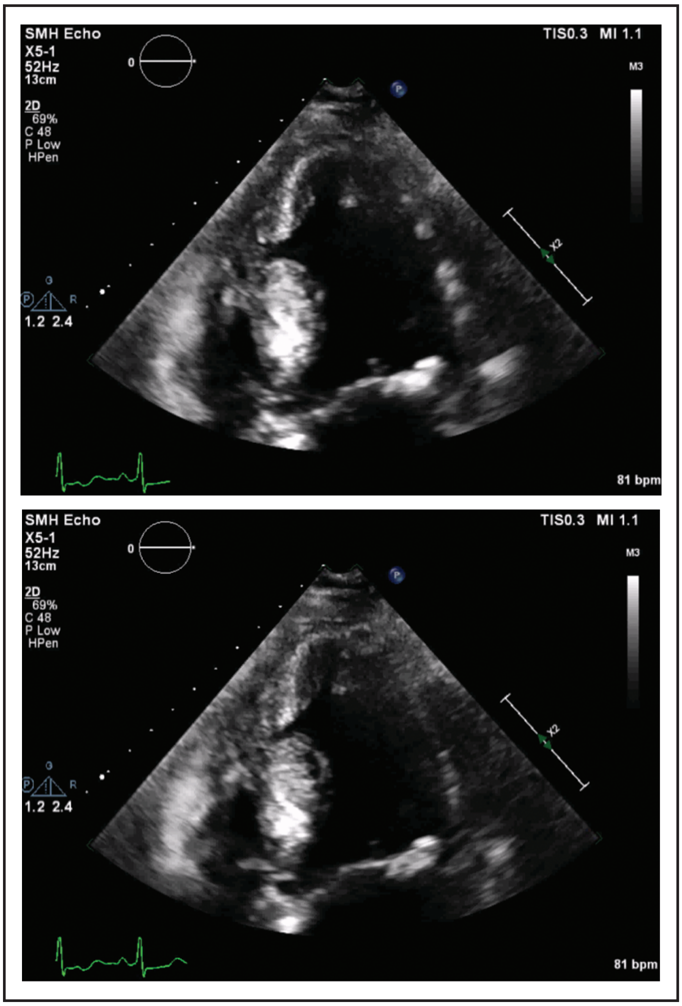

Figure 1. Muscular diverticulum 4-chamber (end-diastole and end-systole). Apical 4-chamber view depicting a muscular diverticulum, characterized by a finger-like protrusion into the inferoseptal wall of the LV. Mechanical activity is synchronous with the contractile function of the LV.[6] The diverticulum preserves its size and shape throughout the cardiac cycles, showing no aneurysmal or dyskinetic wall motions.[7]

LV = left ventricle.

extent of a small "perforation"-like structure. Color Doppler shows no communication from the LV to the right ventricle (RV). However, color Doppler with Nyquist limit decreased (i.e., color scale at 38.5 cm/s) displays filling of the finger-like protrusion through the narrow neck opening in the LV (Figure 2). This isolated myocardial out-pouch measures approximately 1.65 cm in length and appears to relatively maintain its elongated-shape and size throughout the cardiac cycles (Figure 3). There is mid-septal wall hypokinesis at the level of the LV diverticulum that is noted. However, it does not show any characteristics of aneurysmal or dyskinetic wall motion. Therefore, synchronous contraction is a critical point in differentiating between a muscular LV diverticulum versus an LV aneurysm.

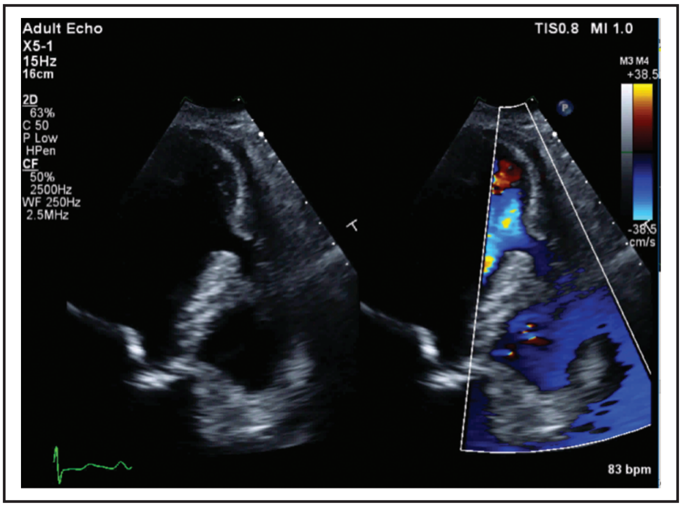

Figure 2. Muscular diverticulum split color. Off-axis 3-chamber view of a muscular diverticulum. Color Doppler demonstrates filling through the narrow neck and wider out-pouching into the anteroseptal wall of the LV.[3]

LV = left ventricle.

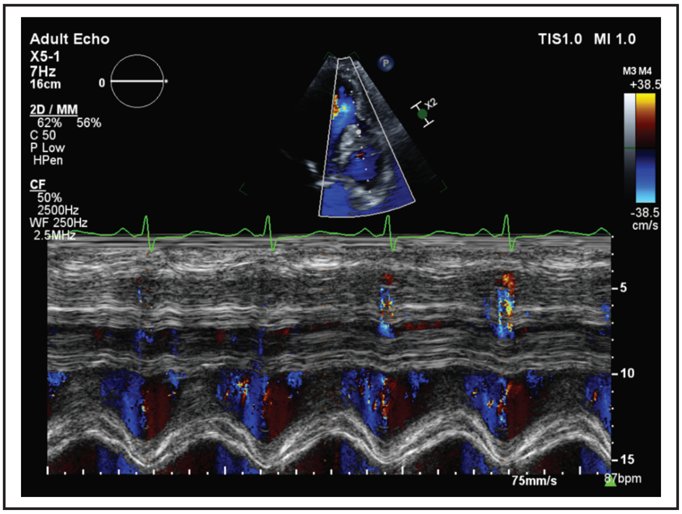

Figure 3. Muscular diverticulum with M-mode. M-mode imaging modality with color shows blood flow through a muscular diverticulum in an apical 3-chamber window. This modality allows the sonographer to appreciate the synchronous mechanical activity with the contractile function of the LV.[6] M-mode allows the sonographer to see how the diverticulum maintains its shape and size during cardiac cycles.

LV = left ventricle.

Agitated contrast echocardiography with *Definity* (Perflutren Lipid Microsphere, Lantheus Medical Imaging, N. Billerica, MA) shows preserved perfusion around this anomaly (Figure 4). No intracardiac thrombus is seen within this out-pouching. Normal RV size and systolic function are demonstrated. There is severe left atrial (LA) enlargement (volume index 81 mL/m^2). Severe calcific aortic valve stenosis is measured with a mean gradient of 63 mmHg at a stroke volume of 70 mL and an AVA of 0.58 cm^2 (DVI 0.19), with mild aortic regurgitation. Thickened mitral valve leaflets with moderate annular calcification are shown. A mean gradient through the mitral valve measures at 4 mmHg at a heart rate of 78 BPM, with mild to moderate mitral regurgitation. Lastly, mild tricuspid regurgitation is seen with an RVSP estimating at 47

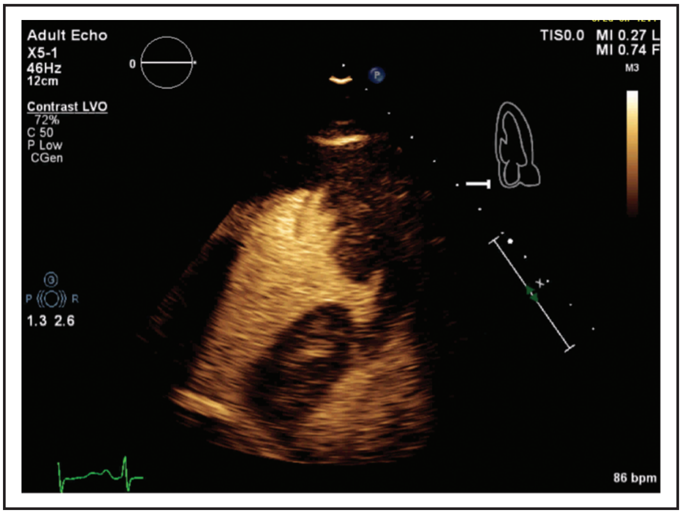

Figure 4. Muscular diverticulum with contrast. Off-axis apical 3-chamber view showing a muscular diverticulum in the anteroseptal wall. Contrast-enhanced harmonic imaging opacifies the anomaly, which helps to define the finger-like protrusion from the LV wall, and confirms no intracardiac thrombus.[3]

LV = left ventricle.

mmHg, assuming the RAP is at 8 mmHg. A TTE is performed to initially assess the patients' cardiac condition. Two-dimensional imaging indicates typical hypertensive hypertrophy of the LV, with severe concentric hypertrophy of 14 mm septal and posterior LV walls.

Discussion

A congenital LV diverticulum can be classified as fibrous or muscular. A fibrous diverticulum can be described as an isolated congenital aneurysm that is not associated with other malformations. It has a low prevalence rate and an unknown etiology.[7] A fibrous diverticulum can be difficult to diagnose, as patients characteristically are asymptomatic, or are present with nonspecific symptoms. The diverticula wall is primarily composed of thin fibrous connective tissue, with the absent majority of muscle fibers.[2] It is typically located at the apex or base of the LV. When present at the apex, it can lead to potential calcification and thrombi formation due to their akinetic or dyskinetic contractile function, possibly resulting in embolic accidents.[2, 7] When present at the base of the LV, it is found in the subannular region, often causing aortic insufficiency or mitral incompetence. One distinguishing feature of a fibrous diverticulum is that its connection to the ventricle is wide.[3]

A muscular diverticulum has a higher prevalence than a fibrous diverticulum. It is more frequently associated with other cardiac anomalies like ventricular septal defects and Cantrell's syndrome,[1] or extracardiac malformations, such as with the involvement of the pericardium, sternum, and diaphragm. As a result, it is rarely discovered as an isolated anomaly in adults since patients tend to present nonspecific symptoms attributable to other causes.[7] A muscular diverticulum has a mechanical activity synchronous with the LV architecture and its contractility, as it involves all three cardiac layers.[2] Its connection to the ventricle is narrow, appearing as an accessory finger-like protrusion through a narrow neck opening, and typically located at the apex, inferior, or anterior walls of the LV.[4]

Myocardial contrast echocardiography with agitated *Definity* (Perflutren Lipid Microsphere, Lantheus Medical Imaging, N. Billerica, MA) can aid in the detection of LV diverticula on an echocardiogram by enhancing the LV cavity. Injection of the contrast medium will show preserved perfusion around the anomaly, allowing the sonographer to assess the changes in size and shape throughout the cardiac cycles.[3] The opacification of the LV further assists the sonographer in detecting wall motions, thus aiding in the distinction between a true aneurysm and a diverticulum. The key differences between recognizing a true aneurysm versus a diverticulum on an echocardiogram will be discussed later in this article.

Left ventricular diverticula are considered to be a congenital malformation and diagnosis is made in the absence of coronary artery disease, local or systemic inflammation, cardiomyopathies, or any other underlying conditions that would result in myocardial injury.[4] It is a developmental defect that involves out-pouching in weak ventricular walls within the first 2 to 4 weeks of embryonic life. Primary causes of LV diverticula can be attributed to defects in the muscle or connective tissue, viral infections in utero, and excessive primordial cell-stimulation.[8] Of the two types of LV diverticula, the more frequent muscular diverticula are commonly associated with other midline and congenital cardiac defects (i.e., ventricular septal defect, tetralogy of Fallot, tricuspid atresia, and Cantrell's syndrome). As a result, muscular diverticula generally do not appear as an isolated anomaly in asymptomatic adults.[1] This is in contrary to fibrous diverticula, which instead are not accompanied by other midline or congenital cardiac defects, and therefore typically appear as an isolated disorder.[9]

Typically, LV diverticula are incidental findings during diagnostic assessments. However, they are clinically challenging to differentiate from LV aneurysms and pseudoaneurysms, as they all involve out-pouching of the ventricle. These main differential diagnoses have varying degrees of outcome; thus, it is imperative to have an accurate clinical analysis. As previously discussed, a muscular diverticulum is strictly a congenital anomaly characterized by a narrow neck and wider out-pouching. Histologically involving all three cardiac layers, it has preserved synchronous

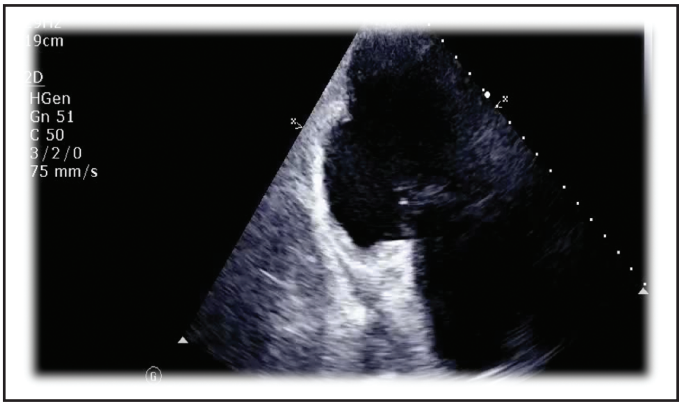

Figure 5. LV aneurysm. 2-chamber window showing a basal to mid-inferior wall aneurysm. The aneurysmal section appears echogenic due to scarring, characterized by a thinned myocardial lining and a wide neck connection. Intramural clots are often found in this region due to stasis of blood flow from akinetic or dyskinetic systolic motion.

contraction with that of the LV.[1] By comparison, an LV aneurysm is caused by either a congenital or acquired malformation. An area of the LV wall that is discretely thin compared to bordering myocardial segments characterizes an LV aneurysm. Moreover, its connection to the ventricle is wide as it balloons outwards and is primarily composed of fibrous connective tissue (Figure 5).[8] One strategic distinguishing factor that identifies an LV aneurysm apart from a muscular diverticulum is its akinetic, dyskinetic, or paradoxical motion during systole.[10] Thus, one can denote that an LV aneurysm more closely resembles a fibrous diverticulum but is typically caused by an acquired cardiac abnormality like coronary artery disease (i.e., transmural MI), as opposed to a congenital disorder. Complications involving an LV aneurysm can lead to thromboembolism, ventricular arrhythmias, congestive heart failure, and cardiac rupture.[8]

Pseudoaneurysms are a form of myocardial rupture of the ventricular free wall, contained by the pericardium or scar tissue. They are considered to have the worst prognosis when compared to other cardiac abnormalities involving LV out-pouching.[8] This is because pseudoaneurysms have the tendency to expand and spontaneously rupture, triggering cardiac tamponade and shock, which can result in high chances of mortality. To a lesser degree of severity, embolic events are also at risk of occurring due to the stasis of blood flow inside the cavity, leading to thrombus formation.[10] Thus, urgent surgical intervention is warranted with this differential diagnosis. Pseudoaneurysms typically result from acute myocardial infarction, but can also be caused by trauma, cardiac surgery, or infection.[11] Patients are often asymptomatic, and diagnosis is commonly made on an echocardiogram as an incidental finding. However, clinically differentiating it amongst other anomalies is difficult. On an echo, the cystic cavity of a pseudoaneurysm exhibits akinetic or dyskinetic wall motion.[10] The unaffected wall segments tend to compensate by exhibiting hyperkinetic motion. Unlike an aneurysm, which is distinguished by its thinned myocardial lining and wide neck connection to the ventricle,[11] a pseudoaneurysm has a narrow neck connection to the ventricle, leading to a saccular out-pouching that is contained by an overlying pericardium or scar tissue lining (Figure 6).[10] Characteristically, the narrow-neck of the anechoic orifice at end-systole is usually measured at less than 0.5 cm when compared to the maximum diameter of a ventricular aneurysm. Further dissimilarities involve the composition of the wall of a pseudoaneurysm, which consists of the pericardium, hematoma, and organizing thrombus. The integrity of the myocardium wall is not intact in a pseudoaneurysm. This is in contrast to a true aneurysm

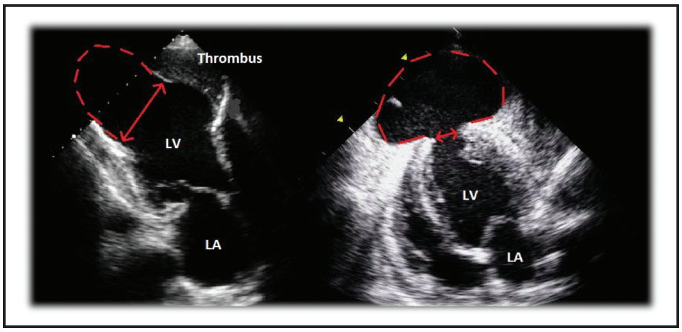

Figure 6. Left ventricular aneurysm versus pseudoaneurysm. An LV aneurysm is shown in 2-chamber view (left), characterized by a thinned myocardial lining and a wide mouth connection.[9] An LV pseudoaneurysm is displayed in 4-chamber view (right), distinguished by its narrow neck connection to the ventricle at the myocardial rupture site, leading to a saccular out-pouching that is contained by an overlying pericardium or scar tissue lining.[10]

LV = left ventricle.

Image source: https://twitter.com/emergencyecho/status/920031704265265152

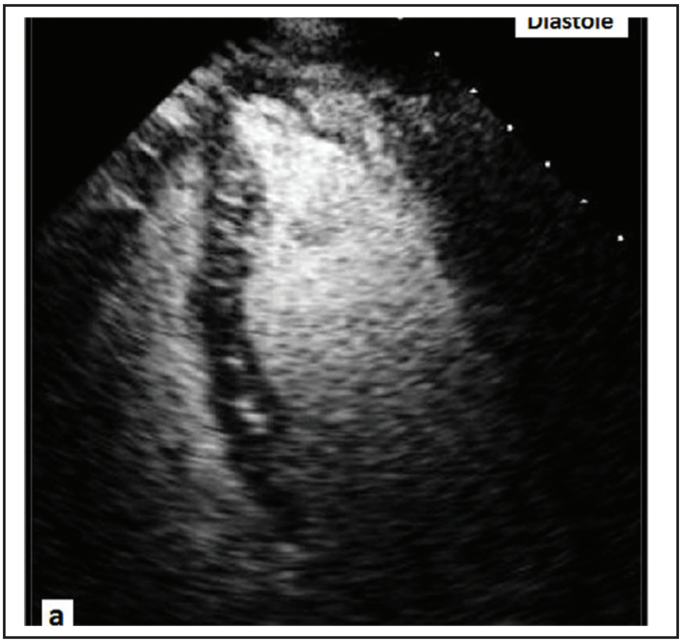

Figure 7. Left ventricular apical diverticulum.11 Apical LV diverticulum in 4-chamber view (diastole) with Definity contrast administered.

LV = left ventricle.[11]

of the LV, which contains the full thickness of the wall (endocardium, myocardium, and pericardium).[10]

In conclusion, clinical differential diagnosis amongst LV diverticula, aneurysms, and pseudoaneurysms is technically challenging on an echocardiogram due to characteristically similar LV out-pouching structures. The equivocal nature of such anomalies can be identified with a higher diagnostic yield through other supplemental noninvasive imaging modalities such as computed tomography (CT), cardiac magnetic resonance imaging (CMRI), and transesophageal echocardiogram (TEE).[9] Moreover, the sensitivity of an echo and TEE can be amplified through the administration of contrast-enhanced harmonic imaging. Certain electrocardiogram (ECG) changes, such as ST-segment elevation in the infarcted area, can also be used to more specifically recognize LV aneurysms and pseudoaneurysms.[10] The consequential effects for these abnormalities vary considerably, thus precise analysis is vital in their clinical evaluation, so that the appropriate treatment can be applied.[9]

Conflicting Interests

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Ethics Approval

Our institution does not require ethical approval for reporting individual cases or case series.

Informed Consent

Verbal informed consent was obtained from the patient(s) for their anonymized information to be published in this article.

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Article Name: An Echocardiographic Guide to Distinguish a Rare Cardiac Abnormality: Case Study of Left Ventricular Diverticulum and Review of the Literature

Author's Names: Authors: Vikas Gulati and Seung Ju (Marcello) Na HBSc, RDCS (AE), MHI (Candidate)

1. Left ventricular diverticulum is a rare cardiac malformation which can be classified as which of the following:

a. Fibrous or Muscular
b. Fibrous or Endocardial
c. Muscular or Myocardial
d. Epicardial or Endocardial

2. LV diverticulum can be associated with all of the following outcomes, EXCEPT:

a. Embolism
b. Arrythmias
c. Hypertension
d. Ventricular rupture

3. When the LV diverticulum is present at the apex of the LV, valvular regurgitation may result.

a. True
b. False

4. LV diverticulum is typically categorized by which of the following characteristics:

a. narrow neck and wider out-pouching
b. synchronous contraction with the left ventricle
c. paradoxical motion relative to the left ventricle
d. LV wall that is discretely thin compared to adjacent myocardial segments
e. a and b

5. Distinguishing between LV diverticulum, aneurysm and pseudoaneurysm on ultrasound requires close attention to all of the following except:

a. Presence of flow within the lesion
b. Location and shape of the lesion at its neck
c. Motion of the lesion relative to the left ventricle
d. Thickness of the lesion wall relative to the adjacent tissue

Jane St Germain, MMUS, CRGS,
CRVS, RDMS, RVT, Cert. Adult Ed.

Evidence-Based Approaches to Enhance Teaching and Learning in Sonography

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ABSTRACT

A postgraduate sonography program has adult students. To incorporate appropriate teaching and learning methods, educators should consider adult learning theories as well as different educational methods to design and develop the curriculum to engage the adult learners and have them ready for their clinical practicum. This literature review describes the adult learning theories, and introduces two methods of teaching; simulation-based learning and flipped classroom; to enhance learning and teaching.

Introduction

Sonography students' education is typically done in two phases; the first phase is attaining didactic knowledge as well as simulated scanning and professionalism skills including patient care, clinical history, and communication. When teaching in this environment, it is essential to apply strategies and innovative techniques that will engage the adult learners for deeper learning. This learning prepares the students for the clinical practicum (CP) which is the second phase, and affords the students the opportunity to merge theoretical knowledge with practical skills with real patients being practice ready.

Method

This literature review outlines evidence-based teaching methods proposed in today's advanced skills in health education. The review includes relevant, recent, and historical reference texts and articles.

Research was conducted using online library databases of Charles Sturt University, Australia; Algonquin College, Canada; and the internet including the Journal of the American Medical Association, Nurse Education Today, Medical Journal of Australia, The British Journal of Nursing, and Ultrasound Journal. Contributions were limited to documents published after 2010 unless historically significant. Key search words included adult education, simulation, ultrasound, sonography, healthcare, nursing, and andragogy.

Discussion

This literature review describes and discusses adult learning theories as well as the use of simulation-based education (SBE) and flipped classroom learning as they relate to adult learners in sonography.

Malcolm Knowles introduced four principles of andragogy and added a fifth principle in 1984.[1,2] The principles suggest that adults inherently possess incoming knowledge, problem-oriented, intrinsically motivated, self-directed, and need to be engaged and be able to relate the purpose to their learning.[1,2] The constructivist theory proposed by Boud, Keough and Waker suggests that knowledge is a continuum building onto itself with practice, analysis, and reflection supporting constructivism as a key theme in the CP.[3] This theory is defined as one that focuses building on one's incoming experience and knowledge. The behaviorist theory is defined as a method of learning which is based on conditioning.[1] Using this theory intends to provoke learning by applying a certain external stimulus.[1] An example of conditioning would be to have a positive reaction to desired behavior and a negative reaction to undesired behavior, provoking influence of one behavior over another.[1]

Simulation-Based Learning

SBE is intended to replicate setting-based tasks in the safety of a controlled environment, where the learners believe the setting is real, act as they would in the real setting and feel safe to make errors for learning from them. The SBE approach allows the students to develop knowledge and skills supported by both the constructivist and the behaviorist theories while andragogy strongly influences the flipped classroom method. Simulation has proven successful as a tool for teaching "psychomotor skills, clinical reasoning, clinical judgment, problem solving, and critical thinking through techniques such as role-playing and the use of interactive videos or mannequins".[4] The SBE approach is underpinned by numerous philosophies including experiential learning, novice to expert, behaviorist theories, and constructivist theories that inevitably help guide the students transform from the novice level to the expert level.[5,6] SBE can be delivered in many formats. These can include full-body mannequins, part-task trainers, simulated patients (standardized patients [SP]), computer-generated simulators, and hybrid systems.[7] An example of a low-fidelity simulation tool used in sonography is the ultrasound breast phantom used as a "part-task trainer".[7] This type of tool is typically made up of precast-gelatin, and allows for an experience that offers tactile feedback when scanning the simulated breast.[8] This form of trainer is relatively low-cost and assists in the development of psychomotor skills but relies heavily on the educator to provide guidance by communicating suggested improvements in the form of feedback, allowing for further development. High-fidelity ultrasound simulators (HFUS) may be computer-based software coupled with a virtual transducer housing a sensory device designed to offer the experience of real scanning. Unlike their counterpart, low-fidelity phantom tools, some HFUS may offer haptics through a specialized device that applies variable counter-force when scanning different body habitus. Some HFUS has what is termed "force-feedback"; this effect mimics the real-feel of scanning with an ultrasound transducer while programmed, real-time cases are viewed on a synchronized computer monitor.[9] Other important advances to simulation technology include built in curriculum-based teaching modules using real patient scans, real-time assisted guidance, and metric-based assessments.[9] This type of innovative equipment allows for as real a simulation as possible next to the human experience while providing objective, computer-generated feedback.

Gibbs explored the use of HFUS as a teaching tool and discovered improvement in learners' confidence levels.[10] The constructivist theory supports the SBE approach to learning as it continuously builds on the adult learners' prior knowledge and experience.[11,12]

Simulation can also use standardized patients (SPs). SPs are individuals who are trained to simulate a medical case in a consistent way, and are trained to give constructive feedback to the students. They are usually utilized in scenarios that deal with communication, professionalism, and in the ultrasound, may also be used as a body to scan. These patients allow the students to practice their skills in a safe environment: this practice allows the students to be better prepared for their CP. Debriefing a simulation is as important as the simulation itself. Debriefing is divided into three phases: pre-briefing or orientation, preparation, debrief where reaction, understanding, and summary can be explored in-depth.[13,14] Michele Chui from the University of Ottawa suggests that debriefing assists at producing positive changes in behavior and ultimately yielding learning outcomes.[14] Debriefing is conducted by the educator in a carefully planned, safe, and controlled environment allowing for direct facilitation of learning.[14]

Flipped or Inverted Classroom

Another educational approach to teaching in health sciences is the flipped or inverted classroom, and is defined as a model that reverses the traditional face-to-face delivery.[15] Considering the various ways learning materials can be delivered and with the advent of multi-media and technological advances in the early 1990s, there has been a paradigm shift in the way teaching can be performed.[16] Researches suggest that the use of technology in the flipped classroom "improves pedagogy"; however, it is supported by andragogy as it appeals to the adult learners in many ways.[17] Moving away from the traditional model, theoretical components are "front-loaded" in the form of online content that can be accessed for independent study.[18] In contrast, face-to-face component of the class offers active learning moving away from the traditional lecture-based classrooms.[16] The online component of the class appeals to the adult learners supported by Knowles' principles that adults are self-directed and intrinsically motivated to learn.[1] Transitioning from the teacher model to the facilitator model has been a natural evolution. Flipped classrooms offer adults the ability to explore independently the learning content outside of the traditional classroom setting with the intention that the classroom be devoted to collaborative learning, discussion, elaboration, and active-learning activities.[19] This is advantageous for teaching health sciences as it has proven to assist in merging practice with theory while encouraging critical thinking skills.[16] The inverted classroom format, supported by the andragogy theory, appeals to the adult learners in several ways.[1,18,19] Associated principles include the readiness to learn and internal motivation. For example, when a class is flipped and the students are directed to review lectures, websites, articles, or other media prior to in-class sessions, they are self-directed and they are accountable for their own learning. Learning outside of the classroom becomes student-centered and self-directed to a degree rather than being educator-centered.[16] Tierney and Konecny, emphasize the use of the flipped component assists in teaching students to be accountable while enhancing their learning experience.[16] Another characteristic of flipped learning that appeals to the adults is the flexibility of content delivery.[16] Adults may be employed or have family responsibilities and the flexibility of the online component allows for them to work on lessons at their own pace, independent of the face-to-face component.[16] In 2017, a study relating to ultrasound suggested that online, pre-class tutorials introduced to medical students in the clinical learning environment, contributed positively to the learning experience and outcomes.[20] During the study, an online physical examination course was offered in the flipped portion of the curriculum while students performed live scanning in the practical environment.[20] Both methods contributed to learning outcomes by enhancing knowledge, skills, and interpretation of the scan.[20]

SBE creates and captures an environment based on reality where students can rehearse scenarios or employ technological equipment apart from the real-world setting.[21] Resources are required including booking allotted times and space for laboratory lessons, hiring SPs and faculty, and purchasing medical simulation devices. The flipped environment, for example, may offer an online environment where students independently access materials on their personal computers, but this may not always assure the ability to sustain student motivation.[16]

Both inverted classrooms and SBE methods are similar as they allow for practice and feedback.[7] With SBE, feedback is constructed during the simulation exercise and debriefing allows for more in-depth teaching in group format.[14] Compared with SBE, the face-to-face component of the flipped classroom permits for authentic assessment, practical learning activities, discussion, and feedback during the face-to-face component.[16] Both methods focus on active learning rather than passive learning and both require extensive design and development of the curriculum. Another similarity between SBE and inverted classrooms is the need for detailed planning. Designing and developing curricula for flipped classrooms and SBE are complex and require a high level of consideration in order to provide the desired learning outcomes.[16] Additionally, learning outcomes may also be at risk for certain participants based on learning styles and personality when using teaching approaches that require group interaction in both SBE and the flipped classroom. This presents a challenge in engaging participants who tend to be more introverted.[14] Chui mentions that this can be overcome by establishing a safe learning environment, establishing roles, and planning seating arrangements in advance.[14]

Summary

Evidence-based approaches to teaching and learning can enhance education in the health professions and benefit learners. Adult learning theories are essential to designing and building curricula to enhance knowledge and skills; it better prepares students for their CP and can be used for assessments. Anybody using these methods should have a thoughtful and critical assessment of the evidence to use these methods, the educators' expertise, curriculum design, development, and the outcomes required from the curriculum. Converting a lecture-based curriculum to a different methodology is also resource intensive. Considering adult learning theories along with SBE and flipped classroom methods enhance students' learning, their confidence, and allow the students to learn from their mistakes in a safe environment that does not harm patients.

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Article Name: Evidence-Based Approaches to Enhance Teaching and Learning in Sonography

Author Name: Jane St Germain, MMUS, CRGS, CRVS, RDMS, RVT, Cert. Adult Ed.

1. Sonography clinical placement opportunities allow the adult learners to engage themselves more and fully in the learning process. What is the main intention of the clinical practicum?

a. To help sonographers with their daily tasks
b. To merge theoretical knowledge with practical skills
c. To understand unionized versus non-unionized environments
d. To keep up with the scheduled case load

2. Which famous educational theorist proposed the four principles of andragogy and added a fifth principle in 1984?

a. Kurt Lewin
b. Ivan Pavlov
c. Malcolm Knowles
d. Benjamin Bloom

3. The clinical placement allows the students to build on their incoming experience and knowledge. What theory is implied with the continuum of knowledge building onto itself with practice, analysis, and reflection?

a. Constructivist theory
b. Behaviorist theory
c. Cognitivist theory
d. Socialist theory

4. Which one of the following may offer haptics as forced-feedback to create a real-feel when performing simulated scanning?

a. Low-fidelity simulators
b. High-fidelity ultrasound simulators
c. Part-task trainers
d. Gelatin phantoms

5. In addition to enhancing the learning experience, which of the following is another outcome of learning in a flipped classroom?

a. Flexibility
b. Readiness to learn
c. Accountability
d. All of the above

Correction

Figure 4 in Cathy Ridsale's article from Issue 3 was incorrectly labeled. We're reprinting the correct image below and apologize for the error and any confusion it may have caused.

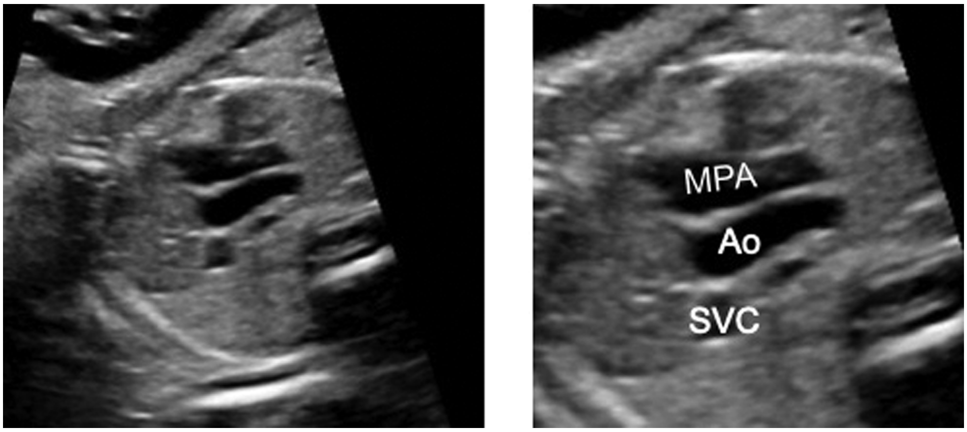

Figure 4. 3 vessel view (3VV) demonstrating the relationship of Ao, MPA, and SVC superior vena cava. The 3VV is used to rule out abnormalities of the Ao and MPA. Both should be approximately the same size and they should run parallel to each other in this view.[5]

Sonography Canada Échographie® Canada

Sonography Canada: A Focus on Members. An Emphasis on Action

In the past year, Sonography Canada has been focused on delivering on its commitment to members through tangible and practical actions and initiatives. While we have a Strategic Plan for 2020 to 2022, we also had to be nimble and adaptable to respond to the ever-changing healthcare environment as well as the evolving needs and concerns expressed by our membership.

Appreciation for the profession of Diagnostic Medical Sonography continued to grow in 2020 as sonography became regulated in Nova Scotia, communications and advocacy efforts were stepped up in response to the COVID-19 pandemic, and we launched our new #SonographersSaveLivesCampaign.

While face-to-face interactions between sonographers and patients continued to be necessary during the pandemic, face-to-face events like Sonography Canada's annual conference were not possible. We are proud of our position statement and proactive communications advocating for and supporting safe sonography practices during the pandemic. We are equally satisfied with our ability to adapt and successfully transition our continuing professional development and governance initiatives to a virtual environment. Thank you to the organizing teams, guest speakers and sponsors who were behind the success of our first-ever virtual Annual General Meeting, our SonoCon Education Day, our SonoCon 2020 Summit, our 2020 Town Hall, and Sonography Canada's new webinar series. Thank you also to our membership for their willingness to embrace and engage in these new online opportunities.

We also stepped up our game as we adopted new technology solutions to improve, expand and facilitate administrative processes and networking opportunities for members. Our CPD tracker became fully functional. The BCUS helped us significantly expand our video library with the donation of over 50 SonoSaturday video recordings. Online registration and remote proctoring for entry-to-practice exams became possible, and we are in the final stages of creating the new SonoTalk online community portal for members.

Much has been accomplished and more is yet to come as we maintain our focus on members and our emphasis on action!

Sonographie Canada : Un regard sur les membres. L'accent sur l'action

Au cours de la dernière année, Sonography Canada s'est efforcé de respecter son engagement envers ses membres par le biais d'actions et d'initiatives tangibles et pratiques. Bien que nous ayons un plan stratégique pour 2020 à 2022, nous avons également dû faire preuve de souplesse et d'adaptabilité pour répondre à l'évolution constante du milieu des soins de santé ainsi qu'aux besoins et aux préoccupations exprimés par nos membres.

L'appréciation de la profession d'échographiste diagnostique médical a continué à croître en 2020, alors que l'échographie était réglementée en Nouvelle-Écosse, que les efforts de communication et de promotion ont été intensifiés en réponse à la pandémie de COVID-19 et que nous avons lancé notre nouvelle campagne #SonographersSaveLivesCampaign.

Si les interactions en face à face entre les échographistes et les patients ont continué à être nécessaires pendant la pandémie, les événements en face à face comme la conférence annuelle de Sonography Canada n'ont pas été possibles. Nous sommes fiers de notre déclaration de principe et de nos communications proactives qui préconisent et soutiennent des pratiques d'échographie sûres pendant la pandémie. Nous sommes également satisfaits de notre capacité à nous adapter et à réussir la transition vers un environnement virtuel de nos initiatives de formation professionnelle continue et de gouvernance. Nous remercions les équipes organisatrices, les conférenciers et les commanditaires qui ont contribué au succès de notre toute première assemblée générale annuelle virtuelle, de notre journée d'éducation SonoCon, de notre sommet SonoCon 2020, de notre hôtel de ville 2020 et de la nouvelle série de webinaires de Sonography Canada. Nous remercions également nos membres pour leur volonté de s'engager dans ces nouvelles opportunités en ligne.

Nous avons également intensifié notre action en adoptant de nouvelles solutions technologiques pour améliorer, étendre et faciliter les processus administratifs et les possibilités de réseautage pour les membres. Notre tracker CPD est devenu pleinement fonctionnel. Le BCUS nous a aidé à élargir considérablement notre vidéothèque grâce au don de plus de 50 enregistrements vidéo de SonoSaturday. L'inscription en ligne et la surveillance à distance des examens d'entrée en pratique sont devenues possibles, et nous sommes en train de finaliser la création du nouveau portail communautaire en ligne SonoTalk pour les membres.

Beaucoup a été accompli et il en reste encore à venir, car nous continuons à mettre l'accent sur les membres et sur l'action !

Celebrating
20 years of sonography
credentials in Canada

Celebrating 20 years of sonography credentials in Canada

IN THE YEAR 2000, CARDUP WAS BORN

The concept of Canadian examinations and a national registry existed in the early 1980s. By 1999, the need for a Canadian registry became acute to address accreditation requirements, bilingual policies, and provincial regulatory issues. In addition, surveys of employers and others by the Canadian Society of Diagnostic Medical Sonographers (CSDMS) conducted in 1993 & early 2000 indicated a 70% positive response for the development of a Canadian registry.

Prior to the creation of the Canadian Association of Registered Diagnostic Ultrasound Professionals (CARDUP) in 2000, the only credential available to Canadian sonographers was the American credential conferred by the American Registry for Diagnostic Medical Sonography® (ARDMS). ARDMS is a widely respected certification agency, but its standards are based upon the needs of the profession in the United States.

ARDMS CREDENTIALS DID NOT MEET 3 IMPORTANT CRITERIA:

1. A Canadian focus to ensure certification relevant to Canadian practice.
2. A practical examination to ensure that registered sonographers were clinically competent when entering the Canadian workplace.
3. A bilingual exam available to Canadian candidates in both official languages.

MEETING CANADIAN NEEDS

ARDMS was approached with a request to develop examinations to address these Canadian needs. It was unable to accede to this request. As a result, CARDUP was created.

CARDUP accomplishments since 2000:

1. A nation-wide survey of Canadian employers
2. Canadian credentials for the generalist, cardiac, and vascular sonographer
3. A *National Competency Profile* for each of the three sonography specialties
4. A practical examination called the *Clinical Skills Assessment*
5. An Exam Committee to produce high-quality examination questions referenced to the National Competency Profiles
6. Bilingual knowledge-based written exams
7. A psychometric evaluation to ensure the statistical validity and defensibility of the examination

CANADIAN CREDENTIALS

CRGS®: Canadian Registered Generalist Sonographer
CRCS®: Canadian Registered Cardiac Sonographer
CRVS®: Canadian Registered Vascular Sonographer