Canadian Journal of Rural Medicine
CJRM CMR
Journal canadien de la médicine rurale

CASE REPORT

Bacterial endocarditis diagnosed with point-of-care ultrasound in a rural emergency department

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This article has been peer reviewed.

INTRODUCTION

Bacterial endocarditis (BE) is defined as the infection of a native or prosthetic heart valve, the surface of the endocardium or an intracardiac device.[1] It is rare but notoriously difficult to diagnose promptly with devastating morbidity and mortality for delayed definitive management. It may be even more difficult in rural resource-limited settings, without the investigative capabilities of a tertiary care centre. BE is a condition infrequently seen in rural emergency departments. There are few epidemiologic studies on its rural incidence. One study in rural New York found 4.4 cases/100,000 person years for people 18 years or older.[2] The worldwide incidence estimates range from 3 to 10/100,000 people yearly.[3] However, despite its rarity, BE can be life-threatening. In-hospital mortality reaches 20% and 6-month mortality reaches 30%,[1] which is worse than many malignancies. Delayed or missed diagnosis is extremely common, which contributes to the high morbidity and mortality, as definitive management is delayed.[1] The clinical presentation is quite varied and non-specific,[1] and, as Osler observed, 'Few diseases present greater difficulties in the way of diagnosis than malignant endocarditis, difficulties which in many cases are practically insurmountable.'[4] A study in Japan noted that it took a median of 14 days for definitive diagnosis of BE, which resulted in 65% of patients receiving inappropriate antibiotics. Unsurprisingly, 80% of those who died in the study were recipients of inappropriate antibiotics.[5]

However, with increasing emergency department use of point-of-care ultrasound (POCUS), physicians now have an additional tool that can help them more promptly diagnose BE.[6]

CASE REPORT

A 34-year-old female presented to our rural emergency department with a 3-week history of progressive pedal oedema and worsening 'rash' to her lower legs bilaterally. She denied any other symptoms such as chest pain, shortness of breath, B symptoms and increased bleeding, or bruising. She did admit to intravenous drug use with various opiates. Her past medical history was otherwise unremarkable.

Access this article online

Quick Response Code:

Website: www.cjrm.ca

DOI: 10.4103/CJRM.CJRM_75_19

Received: 12-09-2019 **Revised:** 08-10-2019 **Accepted:** 28-10-2019 **Published:** ***

How to cite this article: Micks T, Sue K. Bacterial endocarditis diagnosed with point-of-care ultrasound in a rural emergency department. Can J Rural Med 2020;25:154-7.

Her initial vital signs were as follows: blood pressure 95/65, heart rate 132 bpm (sinus), temperature 36.7°C (peripheral) and 38.6°C (rectal), respiratory rate 20/min and SpO_2 96% on room air.

Physical examination revealed an unkempt female with poor hygiene. Her 'rash' was bilateral petechiae extending from her forefoot to her knees, in addition to pedal oedema. There were no signs of petechiae or ecchymosis elsewhere. Her cardiovascular examination revealed a normal S1/S2, no S3/S4 and no obvious murmur. She had good air entry to both bases with no associated wheezes, rhonchi or crackles. She did not have any splinter haemorrhages or Janeway lesions. Her examination was otherwise unremarkable.

Her initial investigations revealed a white blood cell count of 25 × 10^9/L, haemoglobin of 79 g/L and platelets of 45 × 10^9/L. Her sodium was 116 mmol/L, potassium was 4 mmol/L, chloride was 74 mmol/L, creatinine was 331 µmol/L, urea was 26.5 mmol/L, troponin was 14 ng/L and erythrocyte sedimentation rate was 47. Her initial venous blood gas was pH 7.40/$PaCO_2$ 34 mmHg/HCO_3 22 mmHg/base excess –3 mmol/L with a lactate of 3.5 mmol/L. Her chest X-ray revealed multiple septic emboli.

POCUS was performed revealing a vegetative lesion on her tricuspid valve [Figure 1], confirming the diagnosis of BE. She was started on intravenous piperacillin-tazobactam 4.5 g and vancomycin 2 g, as per our septic protocol, and transferred to the nearest intensive care unit. The next day, her Gram stain revealed Gram-positive cocci in clusters, likely representing *Staphylococcus aureus*.

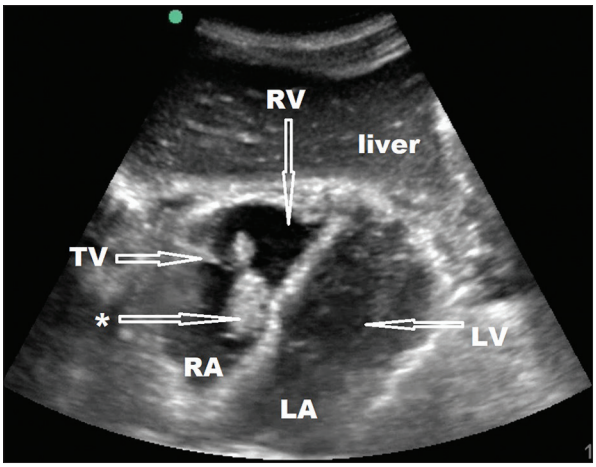

Figure 1: Ultrasound – subxiphoid view of the heart (*-vegetative lesion extending over both sides of the tricuspid valve, TV: Tricuspid valve, RV: Right ventricle, RA: Right atrium, LV: Left ventricle, LA: Left atrium).

DISCUSSION

Despite the rarity of BE, it is a clinical entity with high morbidity and mortality, for which prompt diagnosis and definitive treatment can make a major difference in outcome.[5] Factors that place the rural population at higher risk include an older age demographic with higher rates of diabetes.[7] Other risk factors include intracardiac devices,[8] prosthetic valves,[9] haemodialysis,[10] cancer,[1] congenital heart disease[1] and intravenous drug use.[1,2] Most cases have delayed diagnosis and delayed definitive treatment, due to challenges in diagnosis.[5] Clinical manifestations are notoriously non-specific. Pathognomonic signs, such as Janeway lesions and Osler nodes, are rare.[1] Even a murmur is only present in 85% and a fever in 90% of patients presenting with BE.[1] Furthermore, 10% have blood cultures that show no growth.[1]

Rural emergency departments are often resource limited, with some lacking even basic laboratory investigation capabilities.[11] However, portable ultrasound machines are becoming ubiquitous, even in these settings.[12] For native-valve endocarditis, bedside echocardiography is moderately sensitive (75%) and specific (over 90%) for detecting vegetation.[6] POCUS can also provide information on the mechanism and haemodynamic severity of the valve lesion, along with assessment of left and right ventricular function.[1] In the case where POCUS does not show a vegetation, but clinical suspicion is high, the next step should be a transoesophageal echocardiogram (TEE),[1] which will generally require transport to a larger centre. Transport may be complicated by weather and the availability of a medical evacuation team, so the authors recommend transporting such a patient to a higher level of care as soon as possible, before the patient deteriorates or the transportation window closes. This should occur regardless of whether a TEE is locally available, and regardless of whether the TEE is positive or negative, as the patient will need to be in a location where cardiac surgery is available for definitive treatment.[13] Broad-spectrum intravenous antibiotics (coverage

Table 1: Modified Duke Criteria[15]			
Definitive BE		Probable BE	No BE
Pathological criteria	Clinical criteria	Clinical criteria	
Microorganism identified by culture or histology	Two major criteria, OR	One major and one minor, OR	Firm alternate diagnosis
Pathologic lesions: Vegetation or abscess presence confirmed by histology	One major and three minor, OR	Three minor	Resolution of symptoms and signs with antibiotic therapy for 4 days or less
	Five minor		No pathologic evidence of BE at surgery or autopsy, with antibiotic therapy for 4 days or less

BE: Bacterial endocarditis

Box 1: Major and minor criteria for Table 1
Major criteria
Blood culture positive for BE
Typical microorganisms consistent with BE from two separate blood cultures
Streptococcus viridans, *Streptococcus bovis*, HACEK group, *Staphylococcus aureus*, Enterococci
Microorganism consistent with BE from persistently positive blood cultures
At least two positive blood cultures drawn >12 h apart, OR
All three or a majority of four or more separate blood cultures positive, with first and last drawn at least 1 h apart
Single positive blood culture for *Coxiella burnetii* or antiphase I IgG antibody titre >1:800
Evidence of endocardial involvement
Echocardiogram positive for BE
New valvular regurgitation
Minor criteria
Predisposition, predisposing heart condition or injection drug use
Fever, temperature >38°C
Vascular phenomena, major arterial emboli, septic pulmonary infarcts, mycotic aneurysm, intracranial haemorrhage, conjunctival haemorrhages and Janeway lesions
Immunologic phenomena: Glomerulonephritis, Osler nodes, Roth spots, rheumatoid factor
Microbiological evidence: Positive blood culture but does not meet a major criterion

BE: Bacterial endocarditis

required for methicillin-susceptible *S. aureus*, methicillin-resistant *S. aureus*, Streptococci, HACEK species, *Bartonella* and non-HACEK Gram-negative pathogens) should be started immediately while awaiting transport. Blood cultures should be drawn and sent together with the patient. If clinical suspicion is lower, the authors suggest coverage with the same broad-spectrum intravenous antibiotics while awaiting results from three blood cultures drawn.[14] At the same time, they suggest continuing search for an alternate diagnosis and monitoring for additional signs from the Modified Duke Criteria [Table 1], [Box 1] to emerge.[14,15] If an alternate diagnosis is found, or symptoms resolve within 4 days of antibiotic therapy, one can rule out BE.[15] If BE is confirmed, the patient will need to be transported to a cardiac centre for potential surgery.[13]

CONCLUSION

This case highlights a diagnosis made promptly in a rural emergency department using POCUS as an adjunct to history, physical examination and other investigations, which may have limited availability in rural and remote settings. Nevertheless, there remain barriers to using POCUS rurally, including insufficient training, funding, quality assurance and an inability to maintain skills as cited by rural physicians.[16] Corrective measures must be taken so that the benefits of POCUS are extended to patients in rural Canada where, arguably, it has the greatest potential for benefit when access to advanced imaging is not readily available.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship: Nil.

Conflicts of interest: There are no conflicts of interest.

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The SRPC would like to express our support for all of those responding to COVID-19 who are committed to providing safe and quality care to patients across Canada.

We encourage all members to join the RuralMed and or Rural Anesthesia Listservs. A lot of good, detailed COVID-19 information has come from these email lists and has proven to be a great resource.

A working group with representatives from all the provinces and territories that have isolated fly-in communities has been formed to share concerns and offer advice.

We will keep you posted on further initiatives.
Together we can work towards keeping everyone connected, safe, and up to date.

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