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Comprehensive management of acute pulmonary embolism in primary care using telemedicine in the COVID-era

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SUMMARY

A healthy, active woman in her 70s reported intermittent exertional dyspnoea for 2 months, notable during frequent open-water swimming. Symptoms were similar to an episode of travel-provoked pulmonary embolism 3 years prior. She denied chest pain, cough, fever, extremity complaints and symptoms at rest. Due to the COVID-19 pandemic, her healthcare system was using secure telemedicine to evaluate non-critical complaints. During the initial video visit, she appeared well, conversing normally without laboured breathing. An elevated serum D-dimer prompted CT pulmonary angiography, which identified acute lobar pulmonary embolism. After haematology consultation and telephone conversation with the patient, her physician prescribed rivaroxaban. Her symptoms rapidly improved. She had an uneventful course and is continuing anticoagulation indefinitely. The pandemic has increased the application of telemedicine for acute care complaints. This case illustrates its safe and effective use for comprehensive management of acute pulmonary embolism in the primary care setting.

BACKGROUND

Since the early 2000s, telemedicine has seen increasing adoption in both primary and specialty care settings.¹ Telemedicine tools such as real-time patient–physician video or telephone visits and asynchronous secure messaging via a patient portal integrated within an electronic health record system can increase efficiency and healthcare access.^{1–3} These benefits come with challenges to implementation, including familiarity with technology, establishment of patient–physician relationship and availability of support infrastructure.^{3–5} The COVID-19 pandemic caused by SARS-CoV-2 has accelerated the adoption and reliance of telehealth to provide timely, low risk and accessible care.^{6,7} This may include triage, diagnosis and management of acute pulmonary embolism.

Initial care for acute, symptomatic pulmonary embolism is shifting away from hospital-based care to outpatient management for select low-risk patients.^{8–10} International consensus exists across major societies in recommending outpatient management for low-risk pulmonary embolism.^{11–15} The definition of ‘outpatient management’, however, varies widely in the literature.¹⁶ Most outpatient management studies of acute pulmonary embolism have been undertaken in the emergency department or secondary care settings. Little research attention has been directed on pulmonary embolism

management in the primary care setting.^{17–19} How the recent expansion of telemedicine in primary care can be applied to the diagnosis and treatment of patients with acute pulmonary embolism has not been well studied. We explore the utility of telemedicine in a case of comprehensive clinic-based outpatient pulmonary embolism management using video visit, telephone follow-up and secure messaging in a health system with an integrated electronic health record.

CASE PRESENTATION

A healthy, active woman in her 70s with a remote history of provoked pulmonary embolism presented to her primary care physician (PCP) with 2–3 months of dyspnoea on exertion during the COVID-19 pandemic. The patient is an active open-water swimmer and initially noticed reduction in exercise tolerance, both in the water and when walking up inclines, which she attributed to deconditioning. She also endorsed palpitations and occasional dizziness, but denied chest pain, cough, fevers, syncope and dyspnoea at rest. She had no recent surgery, periods of reduced mobility or known history of malignancy. However, she had a history of provoked pulmonary embolism in the setting of air travel 3 years prior, for which she had completed 3 months of dabigatran. The initial evaluation for this current episode was conducted through secure video visit as in-person visits were limited during the early COVID-19 pandemic. Through video, the PCP noted no acute distress and no laboured breathing.

INVESTIGATIONS

Initial outpatient laboratory work-up was ordered on day 1 and completed on day 3. It showed normal complete blood count, thyroid stimulating hormone and elevated D-dimer of 2.41 µg/mL (normal <0.49 µg/mL). Results were transmitted to the patient, who sent a secure message to her PCP reporting mild improvement in symptoms and inquiring about next steps. They discussed by messaging the likelihood of pulmonary embolism. He ordered advanced imaging by CT pulmonary angiography. It was performed the next day (4 days after presentation) and demonstrated new partial filling defects of the distal right upper lobe pulmonary artery. Prior hypercoagulable work-up was negative. COVID-19 testing was declined based on self-assessed low-risk exposure from strict social distancing adherence.



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TREATMENT

At the end of the imaging study, the patient waited on campus while the radiologist called the PCP with the results. The PCP then spoke by phone with haematology, who advised indefinite anticoagulation therapy in the setting of recurrent pulmonary embolism. Age-appropriate cancer screening and COVID-19 testing were also recommended. The PCP called the patient, discussed the results and directed her to the pharmacy on campus to pick-up the rivaroxaban he ordered. He also submitted a referral for a haematology appointment.

OUTCOME AND FOLLOW-UP

The pharmacy-led anticoagulation management service provided next-day patient education by telephone and supplemental instructions sent by secure messaging. She had a secure video visit with haematology 1 week after her pulmonary embolism diagnosis. This second haematologist agreed with the earlier recommendation of indeterminate anticoagulation. After 1 month of rivaroxaban, the patient learnt that its reversal agent was less accessible in many hospitals than idarucizumab, the agent designed for dabigatran reversal. She then requested switching to dabigatran, with which she has continued treatment. She has experienced no bleeding complications nor recurrence of venous thromboembolism.

DISCUSSION

The COVID-19 pandemic has accelerated the utilisation of telemedicine as healthcare systems grappled with restrictions on in-person evaluation.²⁰ The Centers for Medicare and Medicaid Services and the US Department of Health and Human Services have also incentivised telehealth with waivers related to reimbursement and liability.^{21 22} One cross-sectional analysis found a 35.3% increase in telemedicine use along with a 21.4% decrease in office visits and fewer laboratory testing during the second quarter of 2020, suggesting both structural changes in healthcare delivery and associated challenges.²³

The diagnosis of pulmonary embolism in primary care

Many professional societies recommend evidence-based, high-value diagnostic strategies for the evaluation of patients with suspected acute pulmonary embolism using validated clinical prediction rules (eg, Wells criteria) and selective probability-driven D-dimer measurements.^{24–27} Such a risk-stratified approach has been externally validated in the primary care setting.^{28 29} The PCP in our case followed this internationally endorsed approach.

The time from initial presentation in primary care to diagnosis of acute pulmonary embolism varies widely. The evaluation can be prolonged if a pulmonary embolism diagnosis is not pursued until after diagnostic tests for other conditions (eg, chest radiographs for pneumonia) fail to explain the symptoms. Most in-person work-ups for acute pulmonary embolism (starting with the initial presentation) are completed within 7 days, though about 25% run longer.^{30 31} We would not expect a telemedicine approach to greatly differ in duration. Our patient's diagnostic evaluation was completed within 5 days, which is within the normal range of in-person work-ups described in the literature. The British Thoracic Society guideline recommends that 'patients with suspected (pulmonary embolism) should, where reasonably practical, undergo investigation on the same day of presentation to exclude a diagnosis of (pulmonary embolism).'¹⁴ US guidelines across multiple specialties do not include similar temporal parameters.^{24 26 32–34}

Eligibility for telemedical care of acute pulmonary embolism

Telemedicine for pulmonary embolism management in the primary care setting has not been well described in the literature. Our case sheds light on this novel approach. This patient was particularly well-suited to video-based outpatient diagnosis and treatment because of her familiarity with technology, established PCP relationship, access to advanced imaging and laboratory testing, as well as prior pulmonary embolism and anticoagulation experience. Additionally, the patient's ready access to close follow-up and her PCP's timely responses via secure messaging and telephone both facilitated outpatient management.

Although the PCP did not document any formal risk evaluation in the electronic health record, the patient appears to have met low-risk criteria for outpatient management from the American College of Chest Physicians: 'clinically stable with good cardiopulmonary reserve; no contraindications...; expected to be compliant with treatment; and the patient feels well enough to be treated at home.'¹³ She also likely met outpatient criteria of the Hestia clinical decision rule, if we assume that continued ocean swimming and absence of dyspnoea at rest suggest haemodynamic stability and pulse oximetry $\geq 90\%$, though this correlation has not been studied.³⁵

Home measurement of her vital signs would have helped complete her outpatient eligibility assessment. Obtaining heart rate, respiratory rate, blood pressure and temperature at home have been possible for many years. The ability to accurately measure pulse oximetry at home is a more recent development, following the advent of reliable portable devices.³⁶ Smart phones may also soon be used for pulse oximetry measurements.³⁷ The increasing availability of reliable home vital sign measurements may open the door for research on selective in-home use of risk stratification triage tools, like the Hestia decision rule and the Pulmonary Embolism Severity Index.^{9 35 38} Some insurance companies cover the costs of remote patient monitoring devices, such as pulse oximeters and blood pressure monitoring devices. Reimbursement may continue to expand with the modernisation of telehealth.

Comprehensive primary care-based pulmonary embolism management

This case report adds to the emerging literature describing comprehensive pulmonary embolism management in the primary care setting, including 3 in-person cases.^{17–19} All 3 patients did well and developed no recurrent venous thromboembolism or bleeding complications. These cases met Pulmonary Embolism Severity Index and Hestia eligibility criteria for outpatient management. As in our current case, their PCPs also had ready telephone access to on-call haematologists and pulmonologists for consultation. The patients received prompt anticoagulation therapy with supplemental education and long-term monitoring by pharmacy-led anticoagulation management services, a centralised model adopted by many institutions.³⁹

The promises and limitations of telemedicine

The scope of telemedicine has progressed since the American College of Physicians 2015 recommendation on telemedicine use in primary care citing the technology's potential to improve access to care and patient satisfaction and to reduce cost.³ As the COVID-19 pandemic catalysed telemedicine's rapid expansion from niche to necessity and revolutionised the structure of primary care,^{23 40} important limitations including access, quality and adoption must be considered. While telemedicine aims to increase access to care, particularly in rural and underserved

areas, persistent inequities exist, including age, socioeconomic status, disability, level of education, smart device literacy, bandwidth and broadband access.^{4 41–43} Systematic reviews and meta-analyses reveal that telemedicine is likely comparable with in-person visits for certain services, such as mental health and rehabilitation, although is likely less effective for others, such as dermatology.⁴⁴

With regard to acute pulmonary embolism management, the current literature is sparse on using telemedicine to evaluate acute complaints in general.^{45 46} The benefits of quick access via telemedicine are pitted against the absence of a complete physical examination. For this patient, missing critical objective components include a complete set of vital signs and detailed cardiopulmonary and extremity examinations. While additional testing including a 12-lead ECG and two-view chest radiograph may partly remedy initial examination shortcomings, these are predicated on timely access to diagnostic testing. As discussed above, the emergence of reliable tools for home vital sign measurements may help broaden the capacity of telemedicine. Elements of a proposed pathway for the telemedical evaluation of possible deep vein thrombosis may be adaptable for a similar pulmonary embolism pathway.⁴⁷

Telemedicine expanded in 2020 as a convenient means of providing healthcare without increasing the risk of SARS-CoV-2 exposure. Given an eligible patient in the right care setting supported by adequate resources and infrastructure, this case raises the possibility that telemedicine may be used safely and effectively to diagnose and manage select cases of acute pulmonary embolism without the need for transfer to a higher level of care. However, one case report cannot justify wholesale a new pattern of care. Research should be undertaken to establish the safety and effectiveness of this approach and to identify patients who are best suited for telemedicine management. How well triage tools like the Pulmonary Embolism Severity Index

and the Hestia criteria might perform to identify patients with acute pulmonary embolism eligible for telemedical care without complete physical examination data is unknown. Expanding these questions beyond acute pulmonary embolism to other acute care conditions raises questions about which patients with which complaints in which care settings are eligible for comprehensive telemedical care. More research is needed to help us understand the possibilities and limitations of telemedicine in the management of patients with high-acuity complaints, including pulmonary embolism, and to ensure equitable patient access and outcomes. Preference for using telemedicine will likely remain higher after the pandemic, but the degree to which it is used or useful in a non-pandemic period is not yet clear.

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Patient's perspective

I loved the flexibility of speaking with my PCP in a video visit. Having the visit virtually was convenient and by far the safer approach in a pandemic, many months before COVID-19 vaccinations were available. I was especially glad to avoid a trip to the emergency room — at no point did I have that 'dread' feeling that compels one to hightail it to the ER.

Learning points

- ▶ Telemedicine, including real-time patient–physician video visits, and asynchronous secure message exchange, was used to successfully coordinate outpatient primary and specialty care for a patient with acute pulmonary embolism without transfer to the emergency department or hospital.
- ▶ This virtual approach to low-risk pulmonary embolism management is a particularly convenient means of providing healthcare without increasing the risk of SARS-CoV-2 exposure or the burden on the emergency department.
- ▶ This novel approach to the management of acute pulmonary embolism has never been studied and is not ready for broad clinical application. More research is needed to help us understand the possibilities and limitations of telemedicine in the management of patients with acute pulmonary embolism and other acute care complaints and diagnoses.

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