

Facilitated Management of Suspected Deep Vein Thrombosis by Emergency Department-Based Paramedics

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Abstract

Objectives: To describe an evidence-based algorithm formulated to overcome crowding in the emergency department (ED), whereby patients referred for suspected deep vein thrombosis (DVT) undergo investigation and initial treatment by an advanced care paramedic (ACP) without having to wait for an ED bed.

Methods: Seventy-three patients referred to the ED for suspected DVT by their family physician were met in the waiting room by an ACP, who calculated the clinical probability of DVT using Wells' criteria and ordered tests and treatment according to a standard algorithm. Each case was reviewed by an emergency medicine physician at the time of discharge. Length of ED stay, tests performed, and outcome were compared with patients with similar signs and symptoms who presented before introduction of the process. Patients who consented were followed at 3 months. The satisfaction of patients, ACPs and emergency medicine physicians was evaluated.

Results: Mean ED length of stay when the work-up included a D-dimer test decreased from 379.31 min. before, to 284.74 min. after introduction of the process, with no difference in the percentage of DVT-positive ultrasound scans (14.0% vs. 13.9%). Of the 52 patients who consented to follow-up, data was collected on 36. Eight (22.2%) were prescribed anticoagulation drugs and 26 (72.2%) rated the process as efficient. Thirty-two (88.9%) were very satisfied or satisfied with the process. A telephone survey of 30 family practitioners showed that 70% had used the process. Their average satisfaction rating on a 10-point scale was 8.99 (range 8.75-10). Of the 23 emergency medicine physicians surveyed, 22 (96%) had used the pathway and 21 (95%) felt it was worthwhile, as did 8 of the 9 ACPs (89%) interviewed.

Conclusions: DVT investigation and management can safely be conducted by ACPs, resulting in decreased length of ED stay for patients and satisfaction of patients, ACPs, and family and emergency medicine physicians.

MeSH Words: Paramedic, deep vein thrombosis, clinical pathway

Introduction

Overcrowding in the emergency department (ED) blocks available beds. As a result, patients wait a longer time for emergency services [1] while part of the staff sits idle until the block is cleared and new patients can be admitted. To break the "gridlock", we formulated a process whereby the subset of waiting patients who do

not necessarily require an ED bed are managed by staff that is less busy during times of overcrowding.

The staff of the ED at the Queen Elizabeth II Health Sciences Centre in Halifax, Nova Scotia, Canada includes advanced care paramedics

(ACPs) whose duties consist of facilitating procedural sedation and analgesia, casting, and transferring critically ill patients to other areas in the institution. At times of bed blockage, with no new patients coming in, they are often left with little to do. The ACPs possess excellent skills in assessing the acuity of acute illness [2] and are ideally suited to determine which patients could be safely managed without ED beds and should be seen directly by an emergency physician.

Primary care practitioners often refer patients with suspected deep vein thrombosis (DVT) to the ED. Most of these patients are afforded a high triage score (i.e., low urgency relative to sicker patients) and frequently have to wait several hours for an emergency bed. Apart from the inconvenience of waiting in the ED, a prolonged sitting position may propagate existing clots in patients with DVT, worsening their condition and potentially increasing the risk of pulmonary embolism or post-phlebotic syndrome [3,4].

In addition, the investigation of possible DVT varies considerably among practitioners [5] and may entail the sometimes unnecessary use of compression ultrasound (CUS). This adds to the load of the already overburdened ultrasound department, often at the expense of regularly scheduled patients. Similarly, d-dimer tests may be used inappropriately in an attempt to exclude DVT in cases of high pre-test probability [6,7].

The aim of the present study was to describe an algorithm developed at our center to improve care in the ED, as follows:

- 1) Facilitate the management of patients with suspected DVT who can be safely managed in the waiting room.
- 2) Expand the role of ACPs in facilitating the care of patients with DVT who do not need to see an emergency medicine physician.
- 3) Standardize the ED care of patients with DVT through an evidence-based clinical pathway.
- 4) Develop a template that could be used to streamline the ED management of patients with various presentations who may be amenable to a similar process.

Methods

The algorithm for the improved ED management of patients with suspected DVT was formulated

by a multidisciplinary team [8], including a family physician, emergency medicine physician, ACP, and hematology nurse. The team first developed a dual set of evidence-based tools: to assist family physicians in calculating the clinical risk of DVT according to the criteria of Wells et al.[7] and in determining the most appropriate test to investigate DVT according to the specific situation; and to assist ACPs in reviewing the clinical stability of the patient, reevaluating the referring assessment of the family physician, and ordering appropriate tests to confirm or refute the diagnosis of DVT. Channels were created by which family physicians could conveniently order a CUS or d-dimer test from their office so that the patient could avoid an ED visit if possible. When this was not feasible, a process was designed to have the patient met by an ACP at presentation to the ED, without having to wait. Using a preplanned algorithm (Fig. 1), the ACP could then steer the patient through the process, ordering each subsequent test on the basis of the results of the previous one, up to discharge or hematology clinic referral. The emergency medicine physician on duty was given the option of reevaluating the patient before he/she left the department.

Special attention was addressed to strategies identified in the literature that maximize the chances of a successful change in established practices [9-18]. First, we sought to ensure that all parties involved in the process would benefit more from using the process than not using it. The perspectives of each party were carefully examined, and their input on how the process should work was solicited. The team conducted "dry runs" of clinical scenarios wherein selected stakeholders were asked to identify issues that might arise. We made sure that all stakeholders could voice their concerns at any time during the development and pilot phases. A written description of the process and the rationale for its creation was distributed in draft form to all staff identified as potential participants. In addition, we outlined the plan-do-study-act (PDSA) concept of continually improving a process as opportunities for doing so are identified [19] and provided clear pathways by which stakeholders could offer suggestions and feedback. Posters describing the process (Fig. 1) were displayed prominently in the ED, with instructions to write suggestions or identify problems at each stage.

ED DVT Process Flow



Capital Health

Suspected DVT

- Family Physician suspects a DVT, Call EP, CN, RN or ACP to refer patient.
- EP/CN/ACP instructs triage to call ACP at **4969** on the arrival of the patient. (ACP to check periodically in case this has been missed).
- ACP reviews referral form/checklist from FP (if available), inform EP and with their consent, continue plan at appropriate stage. If not, patient to wait in triage lineup.

Determine DVT Probability Score Using Wells Criteria

- Draw blood for d-dimer, CBC, BUN, creatinine and INR.

WELLS CRITERIA		
Clinical Model for Predicting the Pretest Probability of Deep-Vein Thrombosis		
Present	Clinical Characteristic	Score
<input type="checkbox"/>	Active cancer (patient receiving treatment for cancer within the previous 6 months or currently receiving palliative treatment)	1
<input type="checkbox"/>	Paralysis, paresis, or recent plaster immobilization of the lower extremities	1
<input type="checkbox"/>	Recently bedridden for 3 days or more, or major surgery within the previous 12 wk requiring general or regional anesthesia	1
<input type="checkbox"/>	Localized tenderness along the distribution of the deep venous system	1
<input type="checkbox"/>	Entire leg swollen	1
<input type="checkbox"/>	Calf swelling at least 3 cm larger than that on the asymptomatic side (measured 10 cm below tibial tuberosity)	1
<input type="checkbox"/>	Pitting edema confined to the symptomatic leg	1
<input type="checkbox"/>	Collateral superficial veins (nonvaricose)	1
<input type="checkbox"/>	Previously documented deep-vein thrombosis	1
<input type="checkbox"/>	Alternative diagnosis at least as likely as deep-vein thrombosis*	-2
Total Score		

If score is less than 2, patient is in the 'unlikely' category.
If score is 2 or more, patient is in the 'likely' category.

Unlikely < 2

D-dimer

- Ask patient to wait in the waiting room for d-dimer result.
- ACP to periodically check for D-dimer result.

Likely ≥ 2

Positive

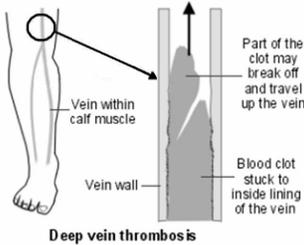
CUS

To Order A Compression Ultrasound (CUS)

- Before 15:00, EP will usually call radiology for a 'same-day' CUS.
- After 15:00, AND the next day a week day, give patient US requisition and ask them to go to the 3rd floor Dickson Centre at 0:800 the next day. (These will be followed by the hematology RN).
- Fax emerg sheet to **6418** for hematology nurse to follow up.
- Phone **7985** and give details to hematology nurse.
- On days followed by weekends or holidays, have the patient return to the HI ED the next day for a CUS at time booked by DPC. They will be seen by the ED ACP after this CUS.

For all patients for whom CUS is to be delayed until next day:

- Review ACP checklist to ensure patient is stable for discharge.
- Give fragmin 200 u/kg subcutaneous. (if already on warfarin – check with EP, but fragmin likely still indicated)



Negative

Positive

Review Well's score

Likely

Review D-dimer

Unlikely

Positive

Negative

Request CUS in 1 Week

- In the case of negative CUS in patients with 'likely' score AND positive d-dimer, a repeat CUS in a week is indicated. This will be organized by the hematology clinic. Fax Emerg sheet, d-dimer and ultrasound wet report to 6418. Inform the patient to call **473-7985** if they have not been contacted in 5 days.

Negative

DVT Diagnosed

- Inform EP, and with his consent, give fragmin 200 u/kg subcutaneous, as per protocol. (If not already given within 24 hours).
- Send blood for CBC, BUN, creatinine and INR.
- Call 7985 with patient name, diagnosis and HUN number.
- Prior to 13:00 page **1212** and discuss with the hematology nurse.
- After 13:00, discharge patient with instructions to return to hematology clinic at 10:00 the following day.
- Fax ED chart, DVT form, blood results and CUS report to **6418**. (any day of week).
- On days that are not followed by a clinic day, (Saturday, or Sunday before a public holiday).
- The EP must page the hematologist on call to arrange outpatient follow-up at MDU the next day.
- Call **8577** to inform MDU to expect the patient. Tell the patient to go to MDU (4th floor Victoria) at 10:00, the next day

DVT Ruled Out

- Discuss with patient, inform EP, and with his consent, discharge to FP follow-up. Patient to follow up with FP within 2 days, unless they have been instructed otherwise.

The process was introduced for use in our ED on March 15, 2006. Seventy family practitioners participated in the pilot study. For length of ED stay and patient outcome data, the study sample consisted of patients with suspected DVT who were referred to the ED for investigation of DVT from August to December 2006. This was compared with patients who were referred to the ED with similar indications from August to December 2005. Study patients who consented to follow up were interviewed after 3 months. Other data examined included tests performed and number and appropriateness of referrals to the DVT clinic, with time periods (dictated by the availability of data), compared to the same period the year before introduction of the pathway. We also conducted satisfaction surveys of other stakeholders involved in the process.

The study was approved by the institutional research ethics board.

Results

Data from 73 patients identified during the study period (starting 4 months after introduction of the process) was compared to that of 68 patients from the same period the previous year.

The average length of stay in the ED for DVT work-up that included d-dimer testing decreased from 379.31 minutes prior to introduction of the process to 284.74 minutes during the study period, a difference of 94.57 minutes. We were unable to obtain data for patients referred to the ED after undergoing d-dimer tests performed by their family physician.

The number of d-dimer tests ordered by family physicians increased from 52 before introduction of the process to 74 (an increase of 42%) for the same period, one year later.

The number of referrals to our center's DVT clinic rose from 181 in 2005 to 211 in 2006 for a rate of 14.2%.

Referrals specifically from the ED increased from 35 in 2005 to 63 in 2006, with 18 patients in 2005 (51.4%) and 55 (87.3%) in 2006 who were referred for one-week follow-up CUS. This proportion of patients most eligible for referral to the DVT clinic for follow-up investigation (based on high pre-test likelihood

of DVD, positive d-dimer test, negative CUS) thus rose by 35.9%.

There was no difference in the percent of CUS scans that were positive for DVT between the months of December 2005 (before introduction of the process; 14.0%) and December 2006 (9 months after its introduction; 13.9%).

Of 52 referrals who consented to follow-up, 15 were lost to follow-up. Of the 37 remaining, one had died in the interim of an unrelated cause contacted. Of the 36 surveys completed, six had had a definite diagnosis of DVT made, while in two, for whom the diagnosis was deemed 'inconclusive', warfarin treatment was prescribed as if DVT had been confirmed. 26 (72.2%) reported that they had found the process efficient, 5 found it inefficient, two could not recall the efficiency, and three had no opinion. 20 patients (56%) reported that the whole procedure had taken less time than they expected, 6 found it as long as expected, 6 longer than expected, two could not remember, and two had no opinion. Eighteen patients reported being very satisfied, 14 satisfied (total 88.9% very satisfied or satisfied), two dissatisfied and two had no recollection.

In addition, we surveyed a random sample of 30 family physicians out of the pilot group of 70. Twenty-one (70%) reported having used the pathway for their patients. Those who had were asked to rate it on a scale of 1 (poorest) to 10 (best) in terms of improving their ability to manage suspected DVT. Scores ranged from 8.75 to 10, with an average of 8.99.

A survey of all 23 emergency medicine physicians at our center showed that 22 (96%) had used the pathway. Of these, 21 (95%) felt the process was worthwhile and improved patient care. A similar survey of all 9 ACPs showed that 89% felt the process was worthwhile and improved patient care.

Discussion

This observational study suggests that patients referred to the ED for suspected DVT can be safely and effectively managed by ACPs, without the need for ED beds. Further research is necessary to determine if this process can be adapted for referrals for other conditions such as cellulitis or undifferentiated shortness of breath.

We found that 4 months after the process was introduced, patient waiting time in the ED decreased by an average of 94.57 minutes. Nevertheless, most patients still waited over 4 hours, leaving much room for further improvement. This may have been at least partly due to the learning curve, given that the process was new to the department and a considerable number of eligible patients were missed and placed in line for traditional ED triage. Indeed, the biggest impediment to optimal success of the process was the failure to "trigger" it at triage.

Surprisingly, there was no reduction in the percentage of negative (i.e., potentially unnecessary) CUS scans in association with the process. The reasons remain unclear, although this finding may demonstrate a failure of the d-dimer test to reassure concerned family physicians. Indeed, the number of d-dimer tests ordered by family physicians increased by 42%. It is possible that use of the algorithm raised physician levels of suspicion for DVT in the community, so that more patients (especially those with a low pre-test risk of disease) were investigated. This may have resulted in a greater number of DVTs being ruled out by a negative d-dimer test in the family physicians' office, but a higher absolute number of false-positive results, leading to an absolute increase (but relative decrease) in negative CUS scans, with a lower proportion of investigated patients being referred for CUS.

The increase in the proportion of patients eligible for referral to the DVT clinic for follow-up indicates that clinic visits were being used more appropriately and that the evidence-based criteria for clinic follow-up (pre-test likelihood of DVT, positive d-dimer, negative CUS) were being followed more regularly. This finding was supported by anecdotal reports from the hematology nurses.

Limitations of the Study

The study was limited by its observational design. We were unable to ascertain how many ED visits were avoided by offering the tool to family practitioners, or whether the tool actually increased resource use by inappropriately raising the level of suspicion for DVT among family practitioners.

Of the more than 100 patients who were processed, only 52 consented to follow-up. On further investigation, we found that ACPs, although generally very supportive of the initiative, were not inclined to take the time to read the 5-page consent form to patients simply to ask permission for a 3-month follow-up call. This issue has been taken up with our institutional review board.

We successfully surveyed 100% of the emergency medicine physicians and ACPs involved in the process but only 43% (30/70) of the family practitioners, limiting the generalizability of the findings. Furthermore, the findings were compared to a "control" period before onset of the study, so data on caregiver opinions were unavailable: The scoring systems used in the surveys were designed to evaluate the post hoc opinions of the caregivers on whether the pathway had improved patient care compared to previous practice and to ensure that patients and providers were comfortable with the new process.

Finally, by comparing the study patients with patients referred the year before, we were unable to conduct demographic comparisons to adequately rule out selection bias.

Conclusion

The ED management of patients referred with suspected DVT can be safely and efficiently facilitated by ED-based ACPs. Further research may yield other presentations whose management is amenable to a similar process.

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