

## Things We Do for No Reason: Intermittent Pneumatic Compression for Medical Ward Patients?

Jürgen L Holleck, MD<sup>1,2\*</sup>; Craig G Gunderson, MD<sup>1,2</sup>

<sup>1</sup>Department of Internal Medicine, Yale University School of Medicine, New Haven, Connecticut; <sup>2</sup>Department of Medicine, Veterans Affairs Connecticut Healthcare System, West Haven, Connecticut.

The “Things We Do for No Reason” series reviews practices that have become common parts of hospital care but may provide little value to our patients. Practices reviewed in the TWD-FNR series do not represent “black and white” conclusions or clinical practice standards, but are meant as a starting place for research and active discussions among hospitalists and patients. We invite you to be part of that discussion.

### CLINICAL SCENARIO

A 74-year-old man with a history of diabetes and gastrointestinal bleeding two months prior, presents with nausea/vomiting and diarrhea after eating unrefrigerated leftovers. Body mass index is 25. Labs are unremarkable except for a blood urea nitrogen of 37 mg/dL, serum creatinine of 1.6 mg/dL up from 1.3, and white blood cell count of 12 K/ $\mu$ L. He is afebrile with blood pressure of 100/60 mm Hg. He lives alone and is fully ambulatory at baseline. The Emergency Department physician requests observation admission for “dehydration/gastroenteritis.” The admitting hospitalist orders intermittent pneumatic compression (IPC) for venous thromboembolism (VTE) prophylaxis.

### BACKGROUND

The American Public Health Association has called VTE prophylaxis a “public health crisis” due to the gap between existing evidence and implementation.<sup>1</sup> The incidence of symptomatic deep venous thrombosis (DVT) and pulmonary embolism (PE) in hospitalized medical patients managed without prophylaxis is 0.96% and 1.2%, respectively,<sup>2</sup> whereas that of asymptomatic DVT in hospitalized patients is approximately 1.8%.<sup>2,3</sup> IPC is widely used, and an international registry of 15,156 hospitalized acutely ill medical patients found that 22% of United States patients received IPC for VTE prophylaxis compared with 0.2% of patients in other countries.<sup>4</sup>

### WHY YOU MIGHT THINK IPC IS THE BEST OPTION FOR VTE PROPHYLAXIS IN MEDICAL WARD PATIENTS

The main reason clinicians opt to use IPC for VTE prophylaxis is the wish to avoid the bleeding risk associated with heparin. The American College of Chest Physicians antithrombotic guideline 9th edition (ACCP-AT9) recommends mechanical prophylaxis for patients at increased risk for thrombosis who are either bleeding or at “high risk for major bleeding.”<sup>5</sup> The guideline considered patients to have an excessive bleeding risk if they had an active gastroduodenal ulcer, bleeding within the past three months, a platelet count below 50,000/ml, or more than one of the following risk factors: age  $\geq$  85, hepatic failure with INR  $>$ 1.5, severe renal failure with GFR  $<$ 30 mL/min/m<sup>2</sup>, ICU/CCU admission, central venous catheter, rheumatic disease, current cancer, or male gender.<sup>5</sup> IPC also avoids the risk of heparin-induced thrombocytopenia, which is a rare but potentially devastating condition.

Prior studies have shown that IPC reduces VTE in high-risk groups such as orthopedic, surgical, trauma, and stroke patients. The largest systematic review on the topic found 70 studies of 16,164 high-risk patients and concluded that IPC reduced the rate of DVT from 16.7% to 7.3% and PE from 2.8% to 1.2%.<sup>6</sup> Since the publication of this systematic review, an additional large randomized trial of immobile patients with acute stroke was published, which found a reduction in the composite endpoint of proximal DVT on screening compression ultrasound or symptomatic proximal DVT from 12.1% to 8.5%.<sup>7</sup> Another systematic review of 12 studies of high-risk ICU patients found that IPC conferred a relative risk of 0.5 (95% CI: 0.20-1.23) for DVT, although this result was not statistically significant.<sup>8</sup> Finally, a Cochrane review of studies that compared IPC combined with pharmacologic prophylaxis with pharmacologic prophylaxis alone in high-risk trauma and surgical patients found reduced PE for the combination.<sup>9</sup>

### WHY IPC MIGHT NOT BE AS HELPFUL IN MEDICAL WARD PATIENTS

IPC devices are frequently not worn or turned on. A study at two university-affiliated level one trauma centers found IPC to be functioning properly in only 19% of trauma patients.<sup>10</sup> In another study of gynecologic oncology patients, 52% of IPCs were functioning improperly and 25% of patients experienced some discomfort, inconvenience, or problems with external pneumatic compression.<sup>11</sup> Redness, itching, or discomfort was

\*Corresponding Author: Jürgen L. Holleck, MD; E-mail: Jurgen.Holleck@va.gov; Telephone: 203-932-5711, ext. 4412.

Additional Supporting Information may be found in the online version of this article.

Received: June 1, 2018; Revised: October 11, 2018; Accepted: October 18, 2018

© 2019 Society of Hospital Medicine DOI 10.12788/jhm.3114

TABLE 1. University of California (UC) San Diego “3 Bucket” Model Updated from the CHEST AT-8 Model

<b>Low Risk:</b> Observation status with expected LOS < 48 hours. Minor ambulatory surgery unless multiple strong risk factors, Medical patients ambulating in hall and not moderate or high risk. Ambulatory cancer patients admitted for short chemotherapy infusion.	No prophylaxis but ambulate and reassess intermittently
<b>Moderate Risk:</b> Most general, thoracic, open gynecologic or urologic surgery patients. Active cancer or past VTE or known thrombophilia in medical patients with LOS>48 hours. Medical patients with decrease in usual ambulation AND VTE risk factors: myocardial infarction, stroke, congestive heart failure, pneumonia, active inflammation/infection, dehydration, age >65.	Pharmacologic prophylaxis (UFH or LMWH)
<b>High Risk:</b> Hip or knee arthroplasty, hip fracture surgery, multiple major trauma, spinal cord injury or major spinal surgery, abdominal-pelvic surgery for cancer.	IPC and pharmacologic prophylaxis (UFH or LMWH)

cited by 26% of patients, and patients removed IPCs 11% of the time when nurses left the room.<sup>11,12</sup> In another study, skin breakdown occurred in 3% of IPC patients as compared with 1% in the control group.<sup>7</sup>

Concerns about a possible link between IPC and increased fall risk was raised by a 2005 report of 40 falls by the Pennsylvania Patient Safety Reporting System,<sup>13</sup> and IPC accounted for 16 of 3,562 hospital falls according to Boelig and colleagues.<sup>14</sup> Ritsema et al. found that the most important perceived barriers to IPC compliance according to patient surveys were that the devices “prevented walking or getting up” (47%), “were tethering or tangling” (25%), and “woke the patient from sleep” (15%).<sup>15</sup>

IPC devices are not created equally, differing in “anatomical location of the sleeve garment, number and location of air bladders, patterns for compression cycles and duration of inflation time and deflation time.”<sup>16</sup> Comparative effectiveness may differ. A study comparing a rapid inflation asymmetrical compression device by Venaflow with a sequential circumferential compression device by Kendall in a high-risk post knee replacement population produced DVT rates of 6.9% versus 15%, respectively ( $P = .007$ ).<sup>16,17</sup> Furthermore, the type of sleeve and device may affect comfort and compliance as some sleeves are considered “breathable.”

Perhaps most importantly, data supporting IPC efficacy in general medical ward patients are virtually nonexistent. Ho’s meta-analysis of IPC after excluding surgical patients found a relative risk (RR) of 0.53 (95% CI: 0.35-0.81,  $P < .01$ ) for DVT in nine trials and a nonstatistically significant RR of 0.64 (95% CI: 0.29-1.42,  $P = .27$ ) for PE in six trials.<sup>6</sup> However, if high-risk populations such as trauma, critical care, and stroke are excluded, then the only remaining study is a letter to the editor published in 1982 that compared 20 patients with unstable angina treated with IPC with 23 controls and found a nonsignificant reduction in screened VTE.<sup>18</sup> Given the near complete lack of data supporting IPC in medical patients, the ACCP-AT9 guideline rates the strength of evidence recommendation to use IPC only in medical patients who are currently bleeding or at high risk of major bleeding as “2C,” which is defined as “weak recommendation” based on “low-quality or very low-quality evidence.”<sup>19</sup> Similarly, the latest American College of Physicians guidelines (2011) recommend pharmacologic prophylaxis for medical patients rather than IPC, except when bleeding risk outweighs the likely benefit of pharmacologic prophylaxis. The guidelines specifically recommend against graduated com-

pression stockings given the lack of efficacy and increased risk of skin breakdown.<sup>20</sup>

IPC is expensive. The cost for pneumatic compression boots is quoted in the literature at \$120 with a range of \$80-\$250.<sup>21</sup> Furthermore, patients averaged 2.5 pairs per hospitalization.<sup>22</sup> An online search of retail prices revealed a pair of knee-length Covidien 5329 compression sleeves at \$299.19 per pair<sup>23</sup> and knee-length Kendall 7325-2 compression sleeves at \$433.76 per pair<sup>24</sup> with pumps costing \$7,518.07 for Venodyne 610 Advantage,<sup>25</sup> \$6,965.98 for VenaFlow Elite,<sup>26</sup> and \$5,750.50 for Covidien 29525 700 series Kendall SCD.<sup>27</sup> However, using these prices would be overestimating costs given that hospitals do not pay retail prices. A prior surgical cost/benefit analysis used a prevalence of 6.9% and a 69% reduction of DVT.<sup>28</sup> However, recent data showed that VTE incidence in 31,219 medical patients was only 0.57% and RR for a large VTE prevention initiative was a nonsignificant 10% reduction.<sup>29</sup> Even if we use a VTE prevalence of 1% for the general medical floor and 0.5% RR reduction, 200 patients would need to be treated to prevent one symptomatic VTE and would cost about \$24,000 for IPC sleeves alone (estimating \$120 per patient) without factoring in additional costs of pump purchase or rental and six additional episodes of anticipated skin breakdown. In comparison, the cost for VTE treatment ranges from \$7,712 to \$16,644.<sup>30</sup>

## WHAT SHOULD WE DO INSTEAD?

First, one should consider if VTE prophylaxis is needed based on risk assessment. According to the Agency for Healthcare Research and Quality (AHRQ), the most widely used risk stratification model is the University of California San Diego “3 bucket model” (Table 1) derived from tables in ACCP-AT8 guidelines.<sup>31</sup> The Caprini risk assessment model has been validated for surgical patients, but AHRQ offers caveats related to the complexity of the tool, the difficulty many sites have integrating it into order sets, and the negative experience of the Michigan Hospital Medicine Safety Consortium. The consortium enrolled 43 hospitals with the great majority using the Caprini risk assessment model, but it failed to reduce VTE in medical patients.<sup>31</sup> Alternatively, the ACCP-AT9 guidelines recommend the Padua prediction score for risk assessment of medical patients (Table 2). VTE occurs in 0.3% of low-risk patients (Padua score <4) and 11.0% of high-risk patients (Padua score  $\geq 4$ ). If IPC is used in the low-risk populations with a predicted VTE rate of 0.3, then 666 patients would need to be treated to prevent one VTE. Treating 666 patients would cost

TABLE 2. **Padua Prediction Score to Assess Risk Factors for VTE in Hospitalized Medical Patients (score <4 = low risk; score ≥4 = high risk)**

Risk Factor	Points
Active cancer	3
Previous VTE (excluding superficial vein thrombosis)	3
Reduced mobility	3
Thrombophilia	3
Trauma and/or surgery in past month	2
Age ≥ 70	1
Heart or respiratory failure	1
Acute myocardial infarction or stroke	1
Acute infection or rheumatologic disorder	1
Obesity BMI ≥ 30	1
Ongoing hormonal treatment	1

\$79,920 for IPC sleeves alone plus \$5,500-\$7,500 per pump and result in 20 additional episodes of skin breakdown. Therefore, IPC should be reserved for high-risk populations with contraindications to pharmacologic prophylaxis.

## RECOMMENDATIONS

- The VTE risk of general medicine ward patients should be assessed, preferably with the “3 bucket” or Padua risk assessment models.
- For low-risk patients, no VTE prophylaxis is indicated. Ambulation ought to be encouraged for low-risk patients.
- If prophylaxis is indicated, then bleeding risk should be assessed to determine a contraindication to pharmacologic prophylaxis. If there is excessive bleeding risk, then treatment with IPC may be considered even though there are only data to support this in high-risk populations such as surgical, stroke, trauma, and critical care patients.
- If using IPC, then strategies that ensure compliance and consider patient comfort based on type and location of sleeves should be implemented.
- Combined IPC and pharmacologic prophylaxis should be used for high-risk trauma or surgical patients.

## CONCLUSIONS

No current evidence supports IPC efficacy in general medical ward patients despite its widespread use; thus, prospective trials in this population are needed. Given costs, potential side effects, and uncertain efficacy in general medical ward patients, IPC should be reserved for surgical, trauma, critical care, or stroke patients. It may be considered for moderate to high-risk medical patients with excessive bleeding risk. Our clinical scenario patient bled within the past three months (odds ratio for bleeding 3.64; 95% CI, 2.21-5.99).<sup>32</sup> On the basis of the in-

creased risk, a dutiful hospitalist might be tempted to order IPC. However, given that our patient is ambulatory, is toileting frequently, and has an expected observation stay of less than 48 hours, he is considered low risk for VTE (Table 1). Additionally, his Padua score of two confirms his low risk status (Table 2). No VTE prophylaxis would be indicated.

*Do you think this is a low-value practice? Is this truly a “Thing We Do for No Reason?” Share what you do in your practice and join in the conversation online by retweeting it on Twitter (#TWDFNR) and liking it on Facebook. We invite you to propose ideas for other “Things We Do for No Reason” topics by emailing TWDFNR@hospitalmedicine.org.*

Disclosures: The authors have nothing to disclose.

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