

Graduated Compression Stockings: Updating Practice, Improving Compliance

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Graduated compression stockings (GCS) have long been used to prevent deep venous thrombosis in hospitalized patients. The validation of published research findings regarding the use of GCS, and the implementation of practice changes pertinent to medical-surgical nursing are examined.

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Deep vein thrombosis (DVT) and pulmonary embolus (PE) are highly prevalent and associated with significant morbidity and mortality (Best et al., 2000; Carroll, 1993; Church, 2000; Geerts et al., 2001; Selby & Geerts, 2000). In its evidence report related to venous thromboembolism, the Agency for Healthcare Research and Quality (AHRQ) states that venous thromboembolism is a major national health problem and is responsible for 50,000 deaths and 300,000 to 600,000 hospitalizations per year in the United States (AHRQ, 2001). Venous pooling, along with other factors, predisposes immobile persons to forming blood clots (Carroll, 1993; Church, 2000). One time-honored measure for preventing DVT and PE is the use of graduated compression stockings (GCS). GCS can enhance venous return, reduce venous distension, and prevent stasis by providing graded compression with the greater pressure applied more distally (Best et al., 2000; Benko, Cooke, McNally, & Mollan, 2000; Church, 2000; Muir, Watt, Baxter, Grosset, & Lees, 2000; Slattery & McCabe, 1993).

Stocking fit is of utmost importance in order for the pressure gradient to be effective. In one study, 98% of the stockings tested failed to produce the ideal pressure gradient and a significant number produced a tourniquet effect that was associated with an increased incidence of DVT (Best et al., 2000; Williams et al., 1996). Also, ill-fitting GCS can cause complications such as ischemic compromise on the heels and feet (Benko et al., 2000; Church, 2000; Kay & Martin, 1986; Merrett & Hanel, 1993) and peroneal nerve injury (Carroll, 1993).

GCS therapy has not been as effective in clinical practice as it has been in research studies, in part because of poor patient compliance (Geerts et al., 2001). Patients complain that the stockings are painful, hot, and itchy. There are two types of stockings, thigh high and knee high, that are typically used in acute care facilities. Several studies have found that in the clinical setting knee-high stockings are as effective as thigh high, safer because they are more often fitted accurately, and more comfortable for the patient (Porteous, Nicholson, Morris, James, & Negus, 1989; Williams et

al, 1996). In one investigation, thigh-length GCS wrinkled significantly more ($p < 0.05$), and patients reported significantly more discomfort than with the knee-length GCS after only 1 hour of wear ($p < 0.05$) (Benko et al., 2000). Patients and nurses report that knee-high stockings are easier to apply, keep in proper position, and less likely to bind than thigh-high stockings (Benko et al., 2000; Best et al., 2000).

Statement of the Problem

The authors' facility has used GCS for many years. During a recent hospital stay, one of the authors developed two severe pressure ulcers after ill-fitting stockings were applied during a surgical procedure. This experience increased awareness that something as beneficial as GCS may not be as benign as formerly thought, and that the use of GCS was a practice that required closer examination.

Staff perceptions about GCS were gathered and explored. A number of complaints were expressed. Anecdotal reports included a perception that the incidence of GCS-related pressure ulcers had increased. Informally, patients had been heard to complain about how hot the stockings are, how hard they are to apply, and how they twist and feel tight. Nurses complained that patients did not like the stockings. The team decided to investigate the use of GCS in the institution in order to understand the issues more fully.

Theoretical Framework

Bloch's Framework for the Evaluation of Nursing Care (1975) was used as a conceptual framework. Bloch describes a Structure-Process-Outcome model by which to evaluate nursing care. Structure involves the factors of the system and describes the providers of

care. Process is what the providers do, or the interventions delivered. Outcomes represent the patient and actual or potential problems as a result of the care provided.

Structure

Examining the structure related to the use of GCS at the facility was the first step in the investigation. Structure issues related to GCS use included nursing practice standards, patient education materials, products, and physician orders.

Nursing practice standards. Nursing service online policies and procedures were reviewed to determine the facility's guidelines for using GCS. Clear nursing policies and procedures regarding GCS were not found. The policy instructed staff to refer to the manufacturer's guidelines for fit and use of the stockings. Although this makes sense since the manufacturer has a chart that describes how to measure the legs and select hose size, the charts were not displayed on any of the units. In addition, the manufacturer includes patient instructions with each pair of stockings, but the package must be opened to read the instructions. Institutional guidelines related to type selection or frequency of removal for observing the extremities were not found.

Patient education. The manufacturer includes patient instructions with every pair of GCS. These instructions include information about laundering, the sizes and colors available, and ordering information. Information about how to apply GCS, when to remove, skin inspection, or when to discontinue use is not covered. These instruction cards were often discarded when the package was opened and therefore were not available when patient education was needed. The online patient education sheet provided partial information, but did not provide information about how

to apply the hose or information about selecting size.

Product availability. Purchasing patterns, product availability to staff, and use patterns were reviewed. The hospital had a contract with one company to provide all GCS. That contract included all sizes (small, medium, large) in all lengths (short, regular, long) in both styles (knee high and thigh high) for a total of 19 sizes. However, when GCS purchases for January to December 2000 were analyzed, only "regular" lengths were being purchased by the hospital. When asked, the purchasing manager stated that no one had ever requested additional sizes. When nurses were asked why they had never requested other sizes, they stated that they thought no other sizes were available at the institution.

The storage of supplies was problematic. Unit supplies are kept in a locked computerized storage system on each nursing unit. These storage systems have a limited capacity and cannot store all 19 varieties that are manufactured by the company. The range of sizes stocked was different on every unit, including those units with similar patient populations. Of particular surprise were the units that stocked a single size. One unit stocked only large thigh highs while another stocked only medium knee highs. Most of the units stocked thigh highs in a greater variety than knee highs. If the hose were not stocked on the unit, the nurse needed to know what sizes were available and call central supply to get the appropriate size delivered.

Another "stock" issue concerned measuring tapes. While a supply was available in central supply, tapes were not routinely stocked in the storage units. This made proper measurement and fit of stockings even more difficult for the staff.

Physician orders. At the facility, physicians use a computerized system to enter their orders. This system has automatic prompts for many order sets, such as for orders for DVT prevention. Physicians may also place orders individually (they can enter a single order for GCS). Physicians are prompted to screen all patients for DVT risk when initial admission orders are entered into the computer. The protocols attached to that screening recommend GCS for most of our patients. Some protocols or order sets specify knee high, some thigh high, but most do not specify a length.

Process

Next, actual unit practices were studied.

Nursing practices. Fifteen nurses from all units were interviewed. Very few of the nurses were able to verbalize a rationale for selecting knee versus thigh-length stockings. Only two of the nurses said that they measured the patient's leg to determine size. There was no consistency related to removal, skin inspection, and assessments of GCS use. When asked when they actually remove GCS, only 33% of the nurses said that they removed them to assess the patient's skin. Most assumed that hose were removed at bath time; however, most of the institution's patients are not bathed by the registered nurse. Therefore, the RNs actually did not really know if the unlicensed assistant or the patient knew that the hose could or should be removed at that time. A review of documentation showed that an assessment of the lower-extremity skin or circulation often was not done.

Physician practices. It was noted that surgical residents tended to over order (for example, patients who were completely ambulatory with no obvious risk factors sometimes had orders for

GCS). Medical residents were inconsistent about including GCS in their DVT prophylaxis. Physician interviews revealed that surgeons considered GCS to have more therapeutic value than medical physicians. All physicians considered determining appropriate fit to be a nursing measure. Physicians assumed that nurses removed the hose regularly to assess for complications, but did not know when or how often.

Outcomes

Finally, the results of the care provided with respect to GCS were examined.

Patient report. On a single day, the charts of all patients on 12 medical-surgical units were reviewed. Of these 151 patients, 34 had orders for GCS. The number was a surprise; it had been assumed that a larger proportion of the patients were at risk for DVT and would have had GCS orders. Of the 34 patients with GCS orders, stockings had never been applied or had been removed because they were no longer necessary in 8 of the patients.

Of the remaining 26 patients, interviews and a brief assessment on 23 of the patients were performed. Only 2 of the 23 patients could report undergoing any assessment prior to the removal of GCS. Sixteen patients had thigh-high hose. Of those with thigh highs, 8 complained of a problem with fit (too short, too long, or they roll down), and 8 reported discomfort (hot, itchy, or painful). Two of seven patients with knee highs complained of problems with fit, and one complained of discomfort. Only 16 patients (4 knee high and 12 thigh high) had their hose on at the time of the assessment. Five patients with thigh highs and two with knee-highs needed a hose size that was not available. Five had wrinkled hose (all thigh high). Seven with

thigh-high and one with knee-high hose had a tourniquet effect at the knee. Skin assessment of all 24 patients revealed 14 pressure ulcers (most were stage I); several patients had more than one pressure ulcer. Four pressure ulcers were on heels, three on tops of the feet, and seven at an area of tourniquet effect. Although the sample size was far too small to demonstrate statistical significance, it supports the data from several studies as well as anecdotal observations that there are many concerns regarding the use of GCS in actual practice.

Discussion

GCS therapy is not the low-risk intervention that it is commonly believed to be. To ensure therapeutic benefit, a number of conditions must be satisfied. The patient must have the appropriate fit, which necessitates having all sizes available. Nurses must follow standardized protocols for measuring, applying, and assessing for potential complications. Finally, patients must be willing to wear the garments as ordered.

Suggestions and interventions. Recognizing the seriousness of this problem, identified issues in the areas of structure, process, and outcomes were addressed.

Structure

Nursing practice standards. The online policy was revised to include guidelines for:

- Size selection
- Frequency of hose removal
- Hose application
- Nursing assessment and documentation

Patient education. The current online fact sheet was determined to provide adequate information on GCS that could be supplemented by the nurses with information from the nursing policy.

Product availability. The value analysis committee at the facility

reviews all requests for product purchases for cost, effectiveness, and clinical efficacy. They reviewed the team's request and the literature, and decided to purchase all eight sizes of knee-high GCS and to eliminate thigh highs.

The storage space for supplies on the nursing units is an ongoing problem. Since the computerized storage system on many nursing units does not have space for all eight sizes plus paper tape measures, two options were offered. The units could choose to keep no GCS in their supply area, but could have nursing staff measure the patient and then order the appropriate size from central supply. Alternately, the units could choose to store all eight sizes, but only if they had the space for all eight in their storage system. All units would be expected to stock measuring tapes. These recommendations were presented to the nursing quality management committee and to the entire nurse manager group. Both groups supported the recommendations.

Physician orders. It was recognized that physician orders for GCS would need to change. The information systems department was notified that computer orders for thigh high would be deleted. Another way to change the nursing practice pattern and to increase physician awareness of potential risks was to add computer orders for GCS to include frequency of removal, reportable observations, and discontinuation criteria. This concept was discussed with the nursing quality management committee and was enthusiastically endorsed. In addition, each time an order for GCS is entered, a sizing chart with fitting instructions is generated on the unit printer.

Process

Changing practice patterns was the most difficult aspect of

this effort. As noted above, several systems were modified to ensure change and to make the desired practice the path of least resistance. Several educational mechanisms were used to communicate with the nursing staff including fliers, a one-page insert, posters on each unit, and an article in the nursing newsletter.

Studies are in process at this time at other facilities that question the effectiveness of GCS in various patient populations (AHRQ, 2001; Muir et al., 2000). These studies will undoubtedly influence physician ordering practices in the future.

Outcomes

In evaluating the use of GCS, the primary issue is, of course, patient outcomes. Unfortunately, due to the complexity of tracking patient complications, the actual incidence of GCS-related complications was unknown. Many caregivers did not recognize the potential complications of GCS and tended to use their time to assess other patient concerns. The team hopes to refocus the nurses' assessments for patients with GCS. Outcomes that can and will be monitored to ensure practice changes include ordering patterns, purchasing patterns, patient satisfaction, and nursing knowledge.

Conclusion

Nursing staff needs constant encouragement to examine critically bedside practice, and to strive to provide evidence-based care. This study is one example of how that idea was put into practice. A seemingly benign, even traditional practice was questioned, and a change in practice, supported by literature and by a nursing team's investigation, was implemented.

Many unanswered questions regarding the use of GCS remain. Potential areas for future research

include: What is the direct role of GCS in DVT prevention? Is once-a-shift removal and assessment adequate to avoid complications? Are patients having additional complications that only become apparent after discharge?

While the use of GCS seems without risk, this intervention is associated with hidden dangers, as was discovered in clinical practice. Ill-fitting GCS can be a direct cause of DVT and pressure ulcers, as well as patient noncompliance with treatment. It is important that all nurses:

- Measure legs with a tape measure to ensure correct fit of GCS.
- Assess the lower extremities regularly.
- Recognize potential complications.
- Intervene early with the occurrence of complications.

Providing knowledgeable care at the bedside is key to preventing serious, possibly deadly, complications, even with a treatment as well known and routine as graduated compression stockings. ■

References

- Agency for Healthcare Research and Quality. (2001). *Prevention of venous thromboembolism after injury*. Evidence Report/Technology Assessment: Number 22. Silver Spring, MD: AHRQ.
- Best, A.J., Williams, S., Crozier, A., Bhatt, R., Gregg, P.J., & Hui, A. (2000). Graded compression stockings in elective orthopaedic surgery: An assessment of the in vivo performance of commercially available stockings in patients having hip and knee arthroplasty. *The Journal of Bone and Joint Surgery-British Volume, 82-B*, 116-118.
- Benko, T., Cooke, E.A., McNally, M.A., & Mollan, R. (2000). Graduated compression stockings - knee length or thigh length. *Clinical Orthopaedics and Related Research, 383*, 197-203.
- Bloch, D. (1975). Evaluation of nursing care in terms of process and outcomes: Issues in research and quality assurance. *Nursing Research, 24*(4), 256-263.
- Carroll, P. (1993). Deep venous thrombosis: Implications for orthopaedic nursing. *Orthopaedic Nursing, 12*(3), 33-43.

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the conflict for organizational staff members related to fiduciary duty will be minimized greatly. ■

References

- Asch-Goodkin, J. (2000). To err is human. *Contemporary Pediatrics*, 17(1), 13.
- Brennan, T. (1999). Hospital peer review and clinical privilege actions to report or not report. *JAMA*, 282(4), 381.
- Foley, M. (2000). *Written testimony of the American Nurses Association. Senate Committee on Health, Education, Labor, and Pensions on Medical Errors*, January 26, 2000. [On-line]. Retrieved from <http://nursingworld.org/goval/federal/legis/testimon/2000/mf01.htm>
- Frieden, J. (2000). Physicians leery of error-reporting proposal. *Family Practice News*, 30(2), 9.
- Gardner, J., & Hallam, K. (1999). IOM report lit a fuse: Medical errors are not new, but the very public ruckus over them is; that worries providers. *Modern Healthcare*, 29(2).
- Hill, C. (2001). *Hospitals face new JCAHO patient safety standards on July 1*. [On-line]. Retrieved from: <http://www.jcaho.org/news/nb333/html>
- Institute of Medicine. (2000). In L. Kohn, J. Corrigan, & M. Donaldson (Eds.), *To err is human: Building a safer health system*. Washington, DC: National Academy Press.
- Ishenstein, H. (2000). Safety first. *Modern Physician*, 4(2), 24.
- Joint Commission on Accreditation of Healthcare Organizations. (2001). *Joint Commission Standards in support of patient safety and medical/health care reduction*. [On-line]. Retrieved: http://www.jcaho.org/standard/fr_ptsaf_ety.html
- Leape, L. (1997). Error in medicine. In A. Kovner & D. Neuhauser (Eds.), *Health services management readings and commentary* (6th ed.) (pp. 274-293). Chicago: Health Administration Press.
- Morris, A. (2000). Developing and implementing computerized protocols for standardization of clinical decisions. *Annals of Internal Medicine*, 132(5), 373-383.
- Nowicki, M. (1998). Do healthcare managers have an ethical duty to admit mistakes? *Healthcare Financial Management*, 52(10), 62-64.
- Osborne, J., Blais, K., & Hayes, J. (1999). Nurses' perceptions: When is it a medication error? *JONA: The Journal of Nursing Administration*, 29(4), 33-38.
- Prager, L. (1998). AMA to oppose accreditor's error reporting system. *American Medical News*, 41(26), 11.
- Rovner, J. (2000). Washington wakes up to medical mistakes. *Business & Health*, 18(1), 19.

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- Church, V. (2000). Staying on guard for DVT & PE. *Nursing 2000*, 30(2).
- Geerts, W., Heit, J., Clagett, G., Pineo, G., Colwell, C., Anderson, F., & Wheeler, H. (2001). Prevention of venous thromboembolism. *Chest*, 119, 132S-175S.
- Kay, T., & Martin, F. (1986). Heel ulcers in patients with long-standing diabetes who wear antiembolism stockings. *Medical Journal of Australia*, 145, 290-291.
- Merrett, N., & Hanel, K.C. (1993). Ischaemic complications of graduated compression stockings in the treatment of deep venous thrombosis. *Postgraduate Medical Journal*, 69, 232-234.
- Muir, K.W., Watt, A., Baxter, G., Grosset, D.G., & Lees, K.R. (2000). Randomized trial of graded compression stockings for prevention of deep-

vein thrombosis after acute stroke. *Quarterly Journal of Medicine*, 93, 359-364.

- Porteous, M.J., Nicholson, E.A., Morris, L.T., James, R., & Negus, D. (1989). Thigh-length versus knee-length stockings in the prevention of deep vein thrombosis. *British Journal of Surgery*, 76, 296-297.
- Selby, R., & Geerts, W. (2000). Venous thromboembolism: Risk factors and prophylaxis. *Seminars in Respiratory and Critical Care Medicine*, 21, 493-501.
- Slattery, M., & McCabe, L. (1993). Deep vein thrombosis prevention in surgical patients. *The Online Journal of Knowledge Synthesis for Nursing*, 1, document #5.
- Williams, A.M., Davies, P.R., Sweetnam, D., Harper, G., Pusey, R., & Lightowler, C.D. (1996). Short note: Knee-length versus thigh-length graduated compression stockings in the prevention of deep vein thrombosis. *The British*

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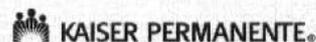
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