

Introduction of the Lanarkshire Oximetry Index in community nursing

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Abstract

The aim of this project was to improve access to appropriate, timely and safe application of high compression bandaging for clients with suspected venous leg ulcers (VLUs) with the use of the Lanarkshire Oximetry Index (LOI) when an ankle-brachial pressure index (ABPI) has not been done. An additional aim was to decrease concerns generalist community nurses (GCN) had in relation to the application of high compression bandaging and its effect on blood flow in the lower limbs. This clinical practice improvement project builds on the work done by Field¹ researching why district nurses in the United Kingdom do not apply high compression bandaging. This current project involves community nurses in NSW.

The literature review highlighted that there was no research that specifically investigated nurses' concerns and confidence in their ability to apply high compression bandaging without interfering with the client's blood supply. Bianchi *et al.*² published a paper that demonstrated a method of increasing nurses' confidence in their ability to apply high compression bandaging without placing the patients' limb at risk. This method of detecting the arterial status, the LOI, is conducted by the use of a pulse oximeter.

Following the implementation of the LOI project, the survey results showed that use of the LOI is achieving a reduction in the time delay for investigations to be performed to ensure safe application of high compression bandaging for clients who have not already had an ABPI. Use of the LOI results in an increase in nurses' confidence that high compression bandaging has been applied in a safe manner. In summary, the project highlighted the benefits of the LOI method. This method can be used to assess the arterial status of the limb in combination with a complete assessment of the client and the wound before high compression bandaging is applied.

Since the conclusion of this project, the LOI has become standard practice in SESIH SHN CH and GCNs have now performed 300 LOIs. Using this tool three clients with critical limb ischemia have been picked up and had urgent surgical intervention. The LOI is now being introduced into the public hospital system.

Introduction

Venous leg ulcer (VLU) management forms a large proportion of direct client care in South East Sydney Illawarra Area Health Service (SESIH) Southern Hospital Network (SHN) Community Health (CH)³. Many clients are referred to CH with the general term 'leg ulcer' as the diagnosis. However, this descriptive term is not a definitive diagnosis and delays can occur whilst an accurate diagnosis of the wound is made. Furthermore, the aetiology of the leg ulcer defines the treatment and 70% of all leg ulcers are reported to have a venous insufficiency⁴.

The treatment of choice for venous insufficiency is the application of high compression bandaging⁵. Yet, while this is the treatment required for venous ulcers⁵, it is contraindicated for arterial ulcers. In the absence of comprehensive investigations, care of leg ulcers may be inadequate, or even dangerous if inappropriate high compression bandaging is applied. Therefore, it seems reasonable to offer an additional assessment of the limb for which high compression is being considered to determine if treatment can be given safely in the home. If this assessment can be done by the generalist community nurse (GCN), then this would be advantageous for the client.

The effectiveness of compression bandaging is reliant on the practitioner's skill level in this procedure – over 80% of high compression bandaging is applied by community or practice nurses⁷. The nurse's perception of their skills and ability is therefore linked to their confidence and concerns regarding the application of high compression bandaging. Inappropriate compression bandaging can lead to:

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- Trauma to the skin – as shown in work by Coull, Tolson & McIntosh who state that “it is not known how much pressure is required to cause skin or tissue damage, and this will vary between individuals”⁶.
- Intolerance of compression bandaging by the client⁷.
- Disruption of the blood supply to the bandaged limb, leading to trauma and possible death of all or part of the limb⁸⁻¹¹.

The application of high compression bandaging is not always being used regularly in the community, as shown in a study by Field¹ who investigated why nurses did not always apply high compression therapy. This study revealed that many nurses were fearful of causing compression damage and felt unsure of the accuracy of the ankle brachial pressure index (ABPI) result. In addition, Moffatt¹² showed that individual nurses may produce very different compression results when bandaging the same client and using the same bandage technique but with different products.

Therefore, to ensure effective and safe healing of venous ulcers using high compression bandaging, nurses must be trained in simple investigation and techniques required to ensure that compression is not applied inappropriately to limbs with arterial compromise. These investigations and techniques could include the ABPI or the Lanarkshire Oximetry Index (LOI) to determine the presence of arterial insufficiency.

Review of screening tools

There are two relevant assessment processes that can be used by GCNs in the community setting – the ABPI and the LOI. Both of these screening tools are used to assess the blood flow to the lower limb prior to the application of high compression either in the form of bandaging or stockings¹³.

Figure 1. ABPI in practice.



ABPI

The ABPI is a quantifiable measurement of lower leg arterial blood supply. It is a comparison of the systolic pressure in the upper arm to the systolic pressure at the ankle. The systolic pressure signal is picked up by an “ultrasonic probe which reflects sound waves off the moving red blood cells, the reflected waves are detected by the probe and amplified into an audible sound”¹⁴. The resultant signal (or waveform) “represents the velocity of blood flow through the vessel”¹⁵ (Figure 1).

The ankle pressure should be nearly equal to or slightly higher than the arm pressure in the absence of arterial occlusive disease; an ABPI is done in conjunction with a full client assessment so that arterial disease can be ruled out¹⁶. However, for a number of reasons, the recording of an ABPI may not be feasible nor may it be accurate. These include the facts that – the client must lay flat for 20 minutes; the GCN must be skilled in finding and identifying the brachial, posterior tibial and dorsalis pedis arteries using a hand held Doppler; and the Doppler signal can be impeded if the client has swollen feet.

Proficiency in the use of a hand held Doppler is difficult to achieve, with adequate training requiring an intensive 6 week programme¹⁷. It has been recommended that a nurse should perform a minimum of 10 ABPI per week to retain the proficiency level to obtain an accurate result¹⁸. In addition, an ABPI cannot be used whilst compression bandaging is in place to check if the application of high compression bandaging has compromised the arterial blood flow to the limb.

LOI

The LOI is a non-invasive procedure using a pulse oximeter. It is similar to ABPI and is a measurement which indicates whether it is safe to apply compression to the limb of a patient with lower leg ulceration or venous hypertension. A pulse oximeter is used in place of a hand held Doppler to determine the index. The protocol compares the blood flow in the central region (highest reading in either arm) to the flow in the lower leg. A blood pressure cuff is placed on the limb to be measured and a sensor is placed on a digit at the distal end of that limb (finger or toe).

The sensor detects the percentage of circulating oxygenated haemoglobin and sends a signal to a pulse oximeter. When the signal is received, the pulse oximeter shows a display of either a waveform of the pulse or a column of lights which indicates the blood flow to the tissue. The blood pressure cuff is then inflated and occlusion of the arteries by the pressure cuff will be indicated by a loss of signal. The procedure is repeated to compare the central reading (highest of the reading in either arm) to the leg for which high compression

bandaging is being considered¹³. Evidence suggests it is as accurate as an ABPI¹³. The LOI is also quick and simple to use to assist in confirming a diagnosis. However, there are some limitations to obtaining a LOI, including the client having extremely dystrophic toe nails or severe cyanosis¹⁹. At this time, the LOI is not the mainstay of assessment procedures as it is a relatively new procedure. It is being used in the United Kingdom by district nurses (Figures 2 & 3).

Comparing the ABPI to the LOI

The LOI has some advantages when compared to the ABPI. Initially, the clients do not have to lie flat for an LOI¹⁹. Also, although there is no research to support the assertion LOI is a simpler technique for staff to learn and use, it does not have as many steps to obtain the signal needed to compare the blood flow and skill is not needed to identify the signal type, so it is a simpler method for a GCN to learn.

Bianchi & Douglas¹³ concluded that an LOI is as accurate as an ABPI. An additional feature of the use of the pulse oximeter is that it can be used whilst compression bandaging is in place. This technique will ensure that there has been no compromise to arterial blood flow to the limb by the application of high compression bandaging.

Table 1 indicates that, in the community health setting, the LOI may have advantages over an ABPI. Therefore, the LOI was the preferred method chosen to be trialled and subsequently implemented by SESIH SHN CH management for use in the community setting.

Methodology

The scope of this project was limited to the SESIH SHN CH area which is a coastal strip south of the Sydney metropolitan area, covering some 72 kilometres. The northern area is

Figure 2. LOI in practice.



highly urbanised and the southern part is largely rural²⁰. The timeframe for this project was from May 2006 until October 2006. Ethics approval for this project was given from the University of Wollongong, Monash University as well as approval from SESIH SHN management.

The participants for the project consisted of the 80 GCN working in the SESIH SHN CH, 63 registered nurses (RNs) (n=60 female, n=3 male) and 17 enrolled nurses (ENs) (n=17 female). A pulse oximeter is not standard equipment used in CH, therefore six were purchased for this project to be used following the 2006 LOI education session.

Training in the LOI method

Training included the introduction of the venous leg ulcer (VLU) management policies, and a written procedure for LOI. A video was shown on the LOI method in use followed by practical training in LOI conducted in small groups. A written evaluation of the training session was completed by GCNs. This evaluation of the training showed that 48% (n=22 of the 45) of GCNs were confident or very confident at being able to perform the LOI method at the completion of training. During the project period – May 2006 to October 2006 – the GCN who had not attended study day had one-on-one training in the LOI method at their request.

Using a Likert scale (not at all, slightly, through to greatly) 34 of the 45 GCNs (75%) indicated that the use of the LOI procedure would influence their VLU management practice greatly. Those GCNs who were trained in the LOI method indicated that this procedure would be of benefit in their work practice.

Following the May 2006 study day, the intervention group of GCNs were expected to implement the use of the LOI if

Figure 3. Using a pulse oximeter to check blood flow following the application of high compression bandaging.



Table 1. Comparison of ABPI to LOI.

Considerations	LOI	ABPI	Differences
Cost	Pulse oximeter (\$1000 per unit as at August 2006)	Hand held doppler with probe (\$1700 per unit as at August 2006)	Purchase of a pulse oximeter results in a cost saving of \$700 per unit at 2006 prices
OH&S	Client sits for LOI with legs raised to waist height	Client lays flat	To perform the LOI requires a GCN to bend/stretch less than when performing the ABPI in the home setting – typically a client is in chair (LOI) versus double bed (ABPI) which is what is normally available in the home setting
Time	Client sits for about 5 mins before testing commenced	Client lays flat for 20 mins before testing commenced	LOI has a time saving of at least 15 mins per test in comparison to ABPI procedure
Ease of use to find signal	Place the sensor on one of the digits	Locate the pulse Place the probe at a 45° angle Identify the sound you are hearing as triphasic, biphasic or monophasic	LOI is simpler to use and more reliable, with less steps required and does not require specialised training to identify the correct signal
Flexibility	A pulse oximeter can be used to check the arterial flow to the limb after applying high compression bandaging	A doppler cannot be used to check the arterial flow to the limb after applying high compression bandaging	A pulse oximeter used in LOI can therefore provide a simple safety check for the nurse following application of high compression bandaging to a lower limb.

they received a referral for a client to apply high compression bandaging and the patient had not had an ABPI. GCNs could also use the pulse oximeter on previously referred patients if they were concerned that the application of high compression bandaging had interfered with a clients' arterial blood flow on the affected limb.

Survey results

The initial survey was designed to establish the extent of specific problems associated with VLU management from the GCNs' point of view.

Two groups of GCNs completed the surveys. The first group consisted of 45 GCNs who had attended the May 2006 study day and were given the opportunity to participate in the clinical practice improvement project (45 of a total of 80 GCNs employed). In the survey of this group, 45 out of the possible 45 (100%) responses were received from GCNs on the day. This group was considered a convenience sample of the eligible population and, as such, it may not have been representative of the larger group. Therefore, to ensure a true cross section of GCNs was represented in the survey responses, demographics were analysed (Tables 2 & 3). The second group was composed of 37 GCNs who attended a nurses meeting in October 2006. Survey responses from both groups can be seen in Table 4.

Results of the survey showed that there was a cross section of responses from GCNs from all three geographical sectors and both full-time and part-time staff, and consisting of RNs and ENs.

Discussion

These surveys gathered information about the extent of the problems from the GCNs' point of view during 2006. It showed that there was a widespread perception amongst the GCNs of problems associated with the application of high compression bandaging. These problems had led to a delay in the application of this therapy for some clients. Whilst the survey responses can be regarded as subjective as they relied

Table 2. Employment experience in community health.

Experience	No. GCNs:		
	Total	Survey 1	Survey 2
Less than 1 year	10	2 (20%)	3 (30%)
Between 1-5 years	18	12 (66%)	7 (38%)
Between 5-10 years	22	5 (22%)	10 (45%)
Over 10 years	30	26 (86%)	17 (56%)

Table 3. GCN employment.

Survey results	RN full-time	RN part-time	EN full-time	EN part-time	Totals
Area 1 Survey 1	5/10 (50%)	4/16 (25%)	1/1 (100%)	4/9 (44%)	14/36 (38%)
Area 1 Survey 2	6/10 (60%)	7/16 (43%)	1/1 (100%)	2/9 (22%)	16/36 (44%)
Area 2 Survey 1	6/7 (85%)	4/10 (40%)	0/0	1/3 (33%)	11/20 (55%)
Area 2 Survey 2	3/7 (42%)	4/10 (40%)	0/0	1/3 (33%)	8/20 (40%)
Area 3 Survey 1	8/8 (100%)	8/12(66%)	4/4 (100%)	0	20/24 (83%)
Area 3 Survey 2	6/8 (75%)	5/12 (41%)	2/4 (50%)	0	13/24 (54%)

Table 4. Response to surveys.

Question	Survey 1	Survey 2
Are you a case manager for clients requiring high compression bandaging? (Only RNs are case managers)	Yes 28 /35 No 7/35 N/A 10 ENs	Yes 27/31 No 4/31 N/A 6 ENs
Have you ever had a client referred for the application of high compression bandaging for management for suspected VLU who did not already have an ABPI report?	Yes 30/35 No 5/35	Yes 28/31 No 3/31
Since introduction of LOI project, have you ever had a client referred for the application of high compression bandaging for management for suspected VLU who did not already have an ABPI report?	N/A	Yes 5/31 No 26/31 N/A
Have any of the clients had to wait for an ABPI to be done?	Yes 34 /35	Yes 6/31
How long have clients had to wait in weeks for ABPI to be attended?	1-6 weeks	N/A
Have you attended LOI when an ABPI was not attended?	N/A	Yes 5/6
How long have clients had to wait in weeks for LOI to be attended?	N/A	1 week
How often would you receive a new referral requiring compression bandaging for suspected VLU management?	Monthly	Monthly
Have you ever applied compression bandaging to a client for VLU management? <i>Case managers:</i> <i>Non-case managers:</i>	Yes 40/45 35 10	Yes 26/37 31 6
Have you ever been worried that the compression bandaging applied may have decreased the blood flow to the limb, i.e. been too tight?	Yes 21/40 No 19/40	Yes 13 /26 No 13 /26
Did you use the pulse oximeter to check the oxygen saturation levels to the digits (toes) before and after the high compression therapy was applied?	N/A	Yes 10/13
Using a Likert Scale (1=not at all, 3=moderately, 5=completely), indicate the degree your concern had decreased by using the pulse oximeter	N/A	Median decrease in the degree of concern was 4, with the range being 3-5 and the mode 5

on GCNs' memory, the fact that the majority of respondents reported having experienced problems strongly supports the view that this impacted on the delivery of care to clients with suspected VLUs across the SESIH SHN CH service.

An additional issue noted (from the survey and during the educational project) was the concern of GCNs that they had applied excessive pressure to the affected clients' limb. This issue was supported by the literature search, with authors reporting that applying consistent, effective, high compression bandaging was a challenge for most GCNs. The use of the LOI can provide a means to verify that excessive pressure had not been applied to a limb, although it doesn't indicate the level of sub-bandage pressure applied or if the application of high compression bandaging has been effective, only that the blood flow to the bandaged limb is not compromised.

It may be argued that the issues addressed in this project could have been overcome with the introduction of the formal ABPI assessment process being performed by the GCNs. This is the process used by GCNs in some health services. This option was considered but opposed by SESIH SHN CH management at the beginning of the project.

During the relatively short period of the clinical practice improvement project, the beginnings of a change in practice for the GCNs working in SESIH SHN CH have been observed. Applying this innovative approach to assisting the GCNs in their clinical practice demonstrates how research conducted in the UK may change the VLU management in an Australian health service.

Future projects

The LOI project has the potential to make a significant difference in how GCNs approach VLU management in the community setting. Interest in the project has already been shown from other health sites and areas, including interstate.

Conclusion

This study demonstrates that LOI is a method which is useful in a community health setting because it can be performed as a safe alternative to an ABPI. It can also help in achieving a reduction in the time delay for investigations to be performed to ensure safe application of high compression bandaging for clients who have not already had an ABPI. The study also showed an increase in nurses' confidence that high compression bandaging has been applied in a safe manner. Therefore, the aims of the clinical improvement project in the use of the LOI as part of the management of VLUs have been achieved.

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