The Effects of Clinical Nursing Practice Guideline for Swaddling on Pain Relief from Heelstick in Neonates*

Nittaya Sinpru, Fongcum Tilokskulchai, Kannikar Vichitsukon, Payon Boonyarittipong

Abstract

Purpose: This paper aimed to investigate the effects of clinical nursing practice guidelines (CNPG) for swaddling as a means to relieve pain from neonatal heelsticks.

Design: Experimental research design

Method: Participating infants were Neonatal inpatients in the studied hospital chosen based on the following criteria; gestational age 37–42 weeks, body weight 2,500–4,000 grams, no diagnosis of sepsis, and age > 48 hours. Sixty neonate patients were recruited and randomly assigned into equally experimental and control groups. Heart rate and oxygen saturation were measured using Pulse Oximeter. Pain score was evaluated by Neonatal Facial Coding System, NFCS. The data were analyzed using Analysis of Covariance, ANCOVA.

Main finding: The results showed that neonates swaddled according to the CNPG had lower mean heart rates and lower mean pain scores during a heelstick than those swaddled according to the standard nursing care practices (P < .05). However, there were no significant differences in mean oxygen saturation between the two groups during a heelstick. It was also observed that neonates in the CNPG group were in a calm state longer, and entered a sleep state more easily.

Conclusion: The results suggest that neonatal swaddling based on CNPG is an effective tool to reduce pain during a heelstick blood sampling.

Keywords: swaddling, clinical nursing practice guidelines, pain relief, neonates, heelstick procedure
Introduction

The neonatal heelstick is the gold standard blood sampling procedure in newborns during which they undergo repeated diagnostic and therapeutic procedures. This practice is regularly performed in both full-term and preterm newborns. It has been reported that every neonate has to experience the procedure at least once; usually at 48 hours after birth, to screen for hypothyroid.1 Neonates under phototherapy endure the pinprick every 12 hours to determine the bilirubin value until the treatment is over. The procedure is also routinely carried out in neonates who require intravenous feedings to monitor their blood glucose levels.2 From October 2005 to September 2006, 2,553 full-term newborns at the Bangkok Metropolitan Administration Medical College and the Vajira Hospital required phototherapies. The newborns experienced on average 1.5 heelsticks per day for3 consecutive days.

A recent study reported that neonates have a neurological capability to sense pain by 20 weeks of gestational age. However, they lack the ability to cope with and manage pain as effectively as adults.3 They may react to pain both anatomically and physically, with signs of inconsolability, alteration in heart rate, and increased consumption of oxygen and changes in facial expressions. Changes in facial expression to watch for include tightly squeezed eyes, bulging brows, an open, stretched mouth, deepened nasolabial furrow, a taut, cupped tongue and a quivering chin.3,4,5,6 The repeated pain they endure may lead to several short and long-term effects in neonates.7 Short-term effects include instability of vital signs, a breakdown in stored protein, fat, and carbohydrate, hyperglycemia, altered functions of immune system, impaired growth and development, alterations in feeding patterns and sleep/wake status. The accumulation of pain may also cause potential long-term effects of ongoing stress in neonates physiologically, including delayed maturation that may affect personality, behavior and perception of pain. Potential long-term psychological problems of repetitive painful experience from heelsticks include, but are not limited to, slowed learning ability, and risks in developmental delays.8

The main goals for pain management in newborns are to reduce pain, shorten painful procedures, and make post-procedure pain disappear quickly. Currently, these goals can be routinely achieved with and without the use of anesthesia. In newborns, the pain relief method without the use of anesthesia is favorably practiced. Common practices for pain management in neonates are performed by patient positioning, massages, touches, swaddling, pacifier soothing, and holding.9
Swaddling is a technique to reduce an expenditure of energy through reduction of movements of the infants. A number of published research articles reported swaddling as a way to calm irritable infants. It is done in infants to decrease their physiological stimulation, prolong their daytime sleep states, and as well as reduce their pain.4,10,11,12,13

Several studies have also shown that swaddling was performed in neonates to reduce pain during heelstick procedures. However, the studies did not correlate the findings with neonates’ gestational age and the swaddling duration. Additionally, detailed procedures for swaddling are still lacking and desirable. It was also unclear how the effect of swaddling on pain relief was systematically measured. It is widely accepted that present day nursing care procedures must be based on the evidence-based clinical nursing practice guidelines. However, there have been thus far no studies concentrating on nursing care for reducing pain from neonatal heelsticks and other painful events. Moreover, there are no well-defined protocols describing swaddling as a clinical practice for pain relief during the heelstick procedures in neonates. Herein, we propose the systematic study on the effects of clinical nursing practice guideline-based swaddling on pain relief during neonatal heelsticks. The study utilized physiological indicators, i.e. heart rates and oxygen saturation, and behavioral indicators such as facial expressions, which have been found to be significantly greater in pain situations than in non pain situations in neonates,15 to evaluate the degree of pain relief during the neonatal heelstick.

Purpose of the Study

The purpose of this study was to evaluate the efficiency of a clinical nursing practice guideline for swaddling as a way to relieve pain during neonatal heelsticks by observing infants’ heart rates, oxygen saturation values, and pain scores. The results were compared with those of neonates swaddled using standard nursing care.

Hypothesis

1. Neonates swaddled following a clinical nursing practice guidelines will have lower mean heart rates during neonatal heelsticks than those swaddled using standard nursing care.

2. Neonates swaddled with clinical nursing practice guidelines will have higher mean oxygen saturation during neonatal heelsticks than those swaddled based on standard nursing care.

3. Neonates swaddled based on clinical nursing practice guidelines will have lower mean pain scores during neonatal heelsticks than those swaddled using standard nursing care.
Methods

This study was conducted to determine the effects of a clinical nursing practice guideline for swaddling on pain relief from heelsticks in neonates.

Population and Sampling

Neonates (n = 60) admitted to the Neonatal Unit at the Bangkok Metropolitan Administration Medical College and the Vajira Hospital were involved in the study. All neonates were between 37 and 42 completed weeks of gestational age, 48 hours of postnatal age, and with bodyweight between 2,500 and 4,000 grams. Data were collected from July 2007 to September 2007.

Inclusion criteria

The neonates involved in this study were chosen based on clinical evaluations. They are as followed:

1. Infants with APGAR scores of 10 evaluated at 5 minutes after birth.
2. Infants without birth defects, neural tube defects (NTD) and a diagnosis of sepsis caused by infection.
3. Infants without pain medication administered prior to participating in the study.
4. Infants scheduled to have at least one blood sampling by heelsticking.

Exclusion criteria

1. Infants who received a heelstick prior to this study.
2. Infants whose heelsticks require longer time than the clinical nursing practice guideline–based procedure.

In performing the study, research assistant 1 randomly assigned sample groups using raffles, while second research assistant 2 performed the heelstick procedures. Then the primary investigator evaluated the pain response in neonates including pain scores throughout the study. The primary investigator collected the data without knowledge of the previously assigned neonates’ groups.

Instrumentation

The experiments were conducted using two sets of equipments as follows:

1. Experimental procedures: Two pieces of cloth with dimensions of 1 meter x 1 meter, and 1 meter x 1 foot were used for swaddling. Heelsticks were performed using heelstick sets. An evidence–based clinical nursing practice guideline was used as a reference.

2. Data collection: Demographic data form for patients were used. Observation forms for assessing pain in neonates were generated based on a modification of the Neonatal Facial Coding System; NFCS\textsuperscript{16} with Inter–rater Reliability of the NFCS = 0.9 and Intra–rater Reliability of the NFCS = 1. An oxymiter for recording heart rates (±1% accuracy) and oxygen saturation (±2% accuracy), and a video recorder were used for data collection and recording the neonates respectively.
Procedure

The study was conducted with approval from the Faculty of Graduate Studies, Mahidol University, and the Director of the Bangkok Metropolitan Administration Medical College and the Vajira Hospital. The protocol including the consent forms was approved by the Human Research Ethical Committee of Bangkok Metropolitan Authority, and protection of human subjects prior to the study. Research assistant 1 assigned neonates into 2 groups using raffles. The demographic data were collected by the primary investigator using the medical charts. All participating neonates were cleaned, fed, diapered and dressed to reduce discomfort unrelated to the study. The sensor probe of the pulse oximeter was then attached to the neonate’s foot. The baseline behavioral state, oxygen saturation, and heart rate were recorded beginning from 3 minutes before heelsticking. A video recorder was used to record a close-up view of the neonate’s face and the procedures showing a clock and a pulse oximeter at all times.

Neonates in the control group received standard nursing care-based swaddling. Each neonate was wrapped in a 1 meter x 1 meter piece of cloth. The swaddling was performed by research assistant 1. The video recording started before the heelstick for baseline data, a heelstick was then administered by research assistant 2 at 3 minutes after the beginning of the recording. The heelstick procedure based on the clinical nursing practice guidelines was followed strictly. A blood sample was collected and the heelstick wound was covered with a bandage. The neonate was then unswaddled. The video recording continued for 5 minutes after the heelstick, with a total period of video recording from the beginning to the end of the experiment of approximately 8 minutes.

All neonates in the study group were swaddled according to the clinical nursing practice guidelines using two pieces of cloth of both sizes; 1 meter x 1 meter and 1 meter x 1 foot. First, the neonate was laid on a blanket in a neonatal warmer in the side lying position and completely swaddled with one side of the blanket brought over one arm, passed between the chest and the other arm, and then tucked under the body, with one foot sticking out for a heelstick. The other side of the blanket was wrapped around both extended arms, tightly tucked under the infant. The swaddling was performed by research assistant 1. The experimental procedures were performed 10 minutes after the neonate was swaddled. A continuous video recording of swaddled neonates for baseline data started from 3 minutes before the heelstick. Then the neonates underwent a heelstick process while being recorded. The procedure was
performed by research assistant 2. A blood sample was obtained and a bandage was applied to cover the wound. Video recording continued for 5 minutes after the heelstick was administered, with about 8 minutes of total recording time.

After the procedures were completed, the sensor probe was removed from the neonate foot. The neonates were soothed if crying and then returned to the parents. The pain score data were analyzed by viewing closed-up facial expressions of neonates using a slow motion and stop-frame feedback system without prior knowledge of the neonates’ assigned group. The scores were obtained using the modified NFCS. The video recording was played and paused every 15 seconds as appeared on the monitor. The heart rate, oxygen saturation level, and pain score were recorded. The data obtained from 3 minutes prior to the heelstick were recorded and used as background, while the values obtained in the 5-minute period after the heelstick were study values. Twelve heart rate values, 12 oxygen saturation values, and 12 pain score values were collected prior to the heelsticks (4 values in 1 minute) and 20 values of each set of data were collected after the procedure. The data were reported as an average of 4 values in 1 minute (3 values before and 5 values after the heelstick).

**Data Analysis**

The data collected from 60 subjects were analyzed as described below.

1. Frequency distributions, percentage ranges, and mean values were used to describe demographic data.

2. Analysis of Covariance: ANCOVA was used to analyze the difference of heart rate scores, oxygen saturation scores, and pain scores in the infants who were swaddled based on the clinical nursing practice guidelines and the standard nursing care, respectively.

**Results**

The results of this study are as follow:

**Table 1** Comparisons of Characteristics of Newborns between two groups.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>N</th>
<th>M</th>
<th>S.D.</th>
<th>( \chi^2 )-value</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male Control groups</td>
<td>13</td>
<td>38.77</td>
<td>1.27</td>
<td>.268</td>
<td>.210</td>
<td>.417**</td>
</tr>
<tr>
<td>Female Control groups</td>
<td>17</td>
<td>38.83</td>
<td>1.17</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male Experimental groups</td>
<td>15</td>
<td>30.69</td>
<td>254.15</td>
<td></td>
<td>.427</td>
<td>.335**</td>
</tr>
<tr>
<td>Female Experimental groups</td>
<td>15</td>
<td>31.02</td>
<td>322.65</td>
<td></td>
<td>.871</td>
<td>.193**</td>
</tr>
<tr>
<td>GA at Birth (week)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control groups</td>
<td>30</td>
<td>50.90</td>
<td>2.89</td>
<td></td>
<td>.426</td>
<td>.336**</td>
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<tr>
<td>Experimental groups</td>
<td>30</td>
<td>50.30</td>
<td>2.42</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Birth Weight (g)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control groups</td>
<td>30</td>
<td>9.24</td>
<td>2.68</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Experimental groups</td>
<td>30</td>
<td>9.53</td>
<td>2.52</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

GA = gestational age; PCA = postconceptional age; **ns** = not significance.
1. Infants swaddled based on the clinical nursing practice guidelines had lower mean heart rates during neonatal heelsticks than those swaddled based on standard nursing care at the significance level of .05 (Table 2 and Figure 1).

**Table 2** Analysis of Covariance: ANCOVA of mean heart rates in the experimental group and the control group.

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Covariate Variable</td>
<td>1</td>
<td>1615.0973</td>
<td>1615.973</td>
<td>15.292</td>
</tr>
<tr>
<td>Between group</td>
<td>1</td>
<td>960.182</td>
<td>960.182</td>
<td>9.086*</td>
</tr>
<tr>
<td>Error</td>
<td>57</td>
<td>6023.340</td>
<td>105.673</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>59</td>
<td>9404.066</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*P < .05

2. There were no significant differences in mean oxygen saturation during heelsticks between the infants swaddled based on clinical nursing practice and those swaddled based on the standard nursing care (Table 3 and Figure 2).

**Table 3** Analysis of Covariance: ANCOVA of mean oxygen saturation in the experimental group and the control group.

![Figure 1](https://example.com/figure1.png) **FIGURE 1.** Comparison of mean heart rate between two in groups.
3. Infants swaddled based on the clinical nursing practice guidelines had lower mean pain scores during heelsticks than those swaddled with standard nursing care at the significance level of .05 (Table 4 and Figure 3).

**Table 4** Analysis of Covariance: ANCOVA of mean pain scores in the experimental group and the control group.

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>df</th>
<th>SS</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Covariate Variable</td>
<td>1</td>
<td>.461</td>
<td>.461</td>
<td>.217</td>
</tr>
<tr>
<td>Between group</td>
<td>1</td>
<td>65.732</td>
<td>65.732</td>
<td>30.952*</td>
</tr>
<tr>
<td>Error</td>
<td>57</td>
<td>59.888</td>
<td>1.051</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>59</td>
<td>186.823</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*P < .05
Discussion

In this section, the results of the study are discussed according to the central hypotheses as described below.

Hypothesis 1: Neonates swaddled based on the clinical nursing practice guidelines will have lower mean heart rate stimulated by heelstick than those swaddled using standard nursing care.

The results of this study supported the hypothesis that a mean heart rate in the clinical nursing practice guidelines group will be lower than the scores evaluated at 1, 2, 3, 4, and 5 minutes of the neonates in the standard nursing care group. This finding agrees well with the previous studies by Kacome and Campos.4

The body and limbs of neonates in the standard nursing care group were able to move and respond to pain freely, which in turn stimulated nerve impulse in tissues. While neonates swaddled using the clinical nursing practice guidelines in the first group were restrained and therefore their physical response to pain was minimized. The process subsequently reduces the number of afferent stimuli in tissues, the spinal cord, the thalamus, and the cerebral cortex resulting in a decreased response in the sympathetic nervous system. The lowered pre-stimulus heart rates also promotes sleep.12,14,19,20,21 In summary, clinical nursing practice guideline-based swaddling reduces the painful stimulation caused by neonatal heelsticks.

![Figure 3. Comparison of mean pain scores between two in groups.](image-url)
Hypothesis 2: Neonates swaddled following the clinical nursing practice guidelines will have higher mean oxygen saturation stimulated by heelsticks than those swaddled based on the standard nursing care.

The finding of this study did not support the hypothesis 2 concerning the mean oxygen saturation scores. The mean oxygen saturation scores of infants in both groups were not significantly different. Previous studies by Chin-Mei Huang et al.\textsuperscript{12} and Tantapong\textsuperscript{11} reported similar results. It can be rationalized that the change in oxygen saturation level was small and cannot be differentiated by the method used in this study.\textsuperscript{5,18,23} However, physiologic responses to tissue-damaging stimuli indicated global distress but are not specific to pain in neonates.\textsuperscript{22} Physiological changes in neonates can also be associated with other stimuli not only heelsticks.\textsuperscript{17} As a result, behavioral responses such as facial expressions and characteristics of the neonates were introduced to further corroborate our findings in physiological responses to pain in neonates.\textsuperscript{15}

Hypothesis 3: Neonates swaddled based on the clinical nursing practice guidelines will have lower mean pain scores from the neonatal heelstick than those swaddled using standard nursing care.

Using behavioral expression as a way to evaluate pain scores in neonates; pain scores of the neonates swaddled according to the clinical nursing practice guidelines were lower than the scores evaluated at 2, 3, 4, and 5 minutes of the neonates in the control group. The results strongly supported the hypothesis that the neonates in the first groups will have lower pain scores than the neonates in the standard nursing care-swaddling group. Our finding agrees well with previous studies by Kacome\textsuperscript{13} and Tantapong.\textsuperscript{11} As rationalized previously, neonates swaddled according to the clinical nursing practice guidelines were well restrained and showed higher tolerance to pain from heelsticks compared to those swaddled according to the standard nursing care. Therefore neonates swaddled based on the clinical nursing practice guidelines were comforted during the procedure showing less facial expressions as a result of pain. Moreover, neonates swaddled according to the clinical nursing practice guidelines entered the sleep-state more quickly giving lower pain scores as evaluated using facial expressions.\textsuperscript{16} In summary, swaddling according to a clinical nursing practice guidelines can help relieve pain during neonatal heelsticks.
Conclusion

The finding of this study revealed that clinical nursing practice guideline-based swaddling can relieve pain stemming from the heelsticks. The conclusion was supported by lower mean heart rates and pain scores in neonates swaddled according to a clinical nursing practice guideline than those swaddled using standard nursing care. Based on the results of this study, we recommend that neonatal nurses should follow clinical nursing practice guidelines for swaddling neonates to relieve pain during the heelstick blood sampling. The neonates should be swaddled 10 minutes prior to the heelstick procedure and remain swaddled until at least 5 minutes after the blood sampling is completed. This practice will help the neonates remain in a calm state for longer as well as enter the sleeping state more easily. More importantly, the practice will also help relieve pain from the heelsticks in neonates.

Last but not least, this study may serve as a standard practice for pain management in neonates during the blood sampling procedure. Nursery staff can better understand how to evaluate the pain in neonates accurately by observing physiologic and behavioral changes. Furthermore, this study will catalyze more studies of pain relief in neonates during medical procedures without the use of anesthesia. This study may open up a possibility to integrate the swaddling technique based on the clinical nursing practice guidelines into neonatal holistic health care. The swaddling technique can potentially be applied to relieve pain caused by other neonatal procedures such as immunizations and mucus suctions. Future studies may include the use of other techniques namely touching and positioning to soothe the infants during neonatal heelsticks and other common painful medical procedures.
ผลของการห่อตัวตามแนวปฏิบัติการพยาบาลทางคลินิกเพื่อลดความเจ็บป่วยจากการเจาะเลือดบริเวณส้นเท้าในทารกแรกเกิด*

นิตยา ศินปุรุ เพองค่า ศิลากฤชัย
กรณินารี วิจารสุขนฤ พจน์ บุญญภูทิพย์

Corresponding author:
นิตยา ศินปุรุ
Email: nit200175@hotmail.com

บทความย่อ
วัตถุประสงค์ เพื่อศึกษาผลของการห่อตัวตามแนวปฏิบัติการพยาบาลทางคลินิกเพื่อลดความเจ็บป่วยจากการเจาะเลือดบริเวณส้นเท้าในทารกแรกเกิด

รูปแบบการวิจัย การวิจัยเชิงทดลอง
วิธีดำเนินการวิจัย ศึกษาในกรุุรกเบิกที่มีราคามีอายุต่ำกว่า 30 วัน maturity ตั้งแต่ 37-42 สัปดาห์ จำนวน 60 คน และทำการสัมผัสอย่างไม่รู้เรื่องกับทารกที่กำลังเจริญเจริญ จำนวน 60 คน และทำการสัมผัสอย่างไม่รู้เรื่องกับทารกที่กำลังเจริญเจริญ

ผลการวิจัย ทำแบบเบื้องต้นเมื่อได้รับการเจาะเลือดบริเวณส้นเท้า กลุ่มที่ได้รับการห่อตัวตามแนวปฏิบัติการพยาบาลทางคลินิกมีอัตราการเจ็บป่วยต่ำกว่า กลุ่มที่ได้รับการห่อตัวตามแนวปฏิบัติการพยาบาลทางคลินิกมีอัตราการเจ็บป่วยต่ำกว่า กลุ่มที่ได้รับการห่อตัวตามแนวปฏิบัติการพยาบาลทางคลินิกมีอัตราการเจ็บป่วยต่ำกว่า กลุ่มที่ได้รับการห่อตัวตามแนวปฏิบัติการพยาบาลทางคลินิกมีอัตราการเจ็บป่วยต่ำกว่า กลุ่มที่ได้รับการห่อตัวตามแนวปฏิบัติการพยาบาลทางคลินิกมีอัตราการเจ็บป่วยต่ำกว่า กลุ่มที่ได้รับการห่อตัวตามแนวปฏิบัติการพยาบาลทางคลินิกมีอัตราการเจ็บป่วยต่ำกว่า กลุ่มที่ได้รับการห่อตัวตามแนวปฏิบัติการพยาบาลทางคลินิกมีอัตราการเจ็บป่วยต่ำกว่า กลุ่มที่ได้รับการห่อตัวตามแนวปฏิบัติการพยาบาลทางคลินิกมีอัตราการเจ็บป่วยต่ำกว่า กลุ่มที่ได้รับการห่อตัวตามแนวปฏิบัติการพยาบาลทางคลินิกมีอัตราการเจ็บป่วยต่ำกว่า กลุ่มที่ได้รับการห่อตัวตามแนวปฏิบัติการพยาบาลทางคลินิกมีอัตราการเจ็บป่วยต่ำกว่า กลุ่มที่ได้รับการห่อตัวตามแนวปฏิบัติการพยาบาลทางคลินิกมีอัตราการเจ็บป่วยต่ำกว่า กลุ่มที่ได้รับการห่อตัวตามแนวปฏิบัติการพยาบาลทางคลินิกมีอัตราการเจ็บป่วยต่ำกว่า

ข้อเสนอแนะ พยาบาลและเจ้าหน้าที่ที่ปฏิบัติงานในหน้าที่ทำการของทารกแรกเกิดควรดำเนินการห่อตัวตามแนวปฏิบัติการพยาบาลทางคลินิกเพื่อป้องกันการเจ็บป่วยได้ 10 นาที หลังเจาะได้แล้ว 5 นาที เพื่อลดความเจ็บปวดให้กับทารกที่ได้รับการเจาะเลือดบริเวณส้นเท้า

คำสำคัญ การห่อตัว / แนวปฏิบัติ / การลดความเจ็บปวด / การทำแท้งเกิด / การเจาะเลือดบริเวณส้นเท้า
References


