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*Original Article*

# Comparison of femoral nerve block and acupuncture analgesia for acute preoperative pain in elderly patients with femoral neck fracture: a retrospective study

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**Abstract:** Objective: This study was to compare the efficacy of femoral nerve block (FNB) and acupuncture for acute preoperative pain in patients with femoral neck fracture (FNF). Methods: From June 2017 to June 2019, 130 patients with FNF were included in this study. Sixty-six patients received FNB treatment (FNB group) and sixty-four patients received acupuncture treatment (Acupuncture group). The clinical information, visual analog scale (VAS) scores, nursing quality scores, sleep quality scores, delirium numbers, and perioperative complications were collected and compared between the 2 groups. Results: The resting VAS score and the exercise VAS score decreased after FNB or acupuncture in both groups. Thirty minutes after analgesia, the resting VAS scores in the FNB group and the acupuncture group were 27.3±8.0 and 27.9±7.8, respectively (P=0.67); while exercise VAS scores were 60.2±10.4 and 59.5±9.8, respectively (P=0.73). In addition, there was no statistical difference in the VAS score between the two groups on day 1 and day 2 after admission. There was no statistical difference in nursing quality, sleep rhythm disorder, sleep quality, or times of mental disorder between the two groups. Conclusion: FNB analgesia and acupuncture analgesia are safe and effective for the control of acute preoperative pain in senile patients with femoral neck fracture. Both methods have good analgesic effects, which can improve nursing and sleep quality, and reduce the incidence of delirium. As a traditional Chinese medicine method, acupuncture analgesia can effectively manage the acute preoperative pain in senile femoral neck fracture patients.

**Keywords:** Acupuncture, femoral nerve block, femoral neck fracture, preoperative pain, traditional Chinese medicine

## Introduction

Femoral neck fracture (FNF) is a common type of fracture. With the population aging, FNF has become a major public health concern [1, 2]. Regardless of the treatment method, managing the acute preoperative pain of these patients could improve quality of life and reduce perioperative complications [3, 4].

In our hospital, pain assessment is performed for senile patients with FNF as soon as they are hospitalized, and the appropriate analgesic therapy is applied to relieve pain. However, the conventional analgesic therapy has its shortcomings: the analgesic effect is often unsatisfactory and may cause side effects such as peptic ulcer, nausea, vomiting, liver or kidney function damage [5, 6]. Especially for senile patients, these side effects may lead to serious perioperative complications [7]. Femoral nerve block (FNB) is also used to manage the acute preoperative pain of senile patients with FNF [4, 8-10]. However, in practice, we found its blocking effect varies among individuals.

Based on the theory of traditional Chinese medicine (TCM), pain results from blocked meridians, and dredging the meridians is the key to relieve pain [11-13]. Acupuncture analgesia is based on the "meridian theory" and has been used to lessen pain for more than two thousand years in China [14]. Acupuncture refers to piercing a filiform needle into the patient's body at a certain angle under the guidance of the theory of Chinese medicine, and using acupuncture

techniques such as twisting and lifting to stimulate specific parts of the human body to achieve the purpose of curing diseases. Studies have shown that acupuncture can activate opioid peptide neurons in the spinal cord to release opioids, which can bind to the opioid receptors at the primary sensory afferent terminals and inhibit the pain response of spinal cord nociceptive neurons. It can also promote the excitability of opioid peptidergic neurons in the nucleus of the brain, release transmitters, participate in the downward inhibitory system, and inhibit the transmission of pain. Acupuncture can also promote the release of serotonin in the central nervous system and inhibit the secretion of serotonin in the peripheral nervous system, thereby acting as an analgesic [15-17]. Compared to conventional analgesic therapy such as drugs, acupuncture analgesia can avoid side effects as well as drug addiction [12, 17].

In the current study, we hypothesized that acupuncture analgesia could be used to control acute preoperative pain in senile patients with FNF. This study compared FNB with acupuncture analgesia in managing acute pain in senile patients with FNF before surgery.

## Materials and methods

### *Patients*

This study was reviewed and approved by the institutional review board of Changhai Hospital Affiliated to the Navy Military Medical University (Approval Number: CHEC2017-116). From June 2017 to June 2019, all case data of FNF patients were reviewed. The inclusion criteria were: (1) Patients with age ≥65 years old; (2) Patients with VAS score at admission ≥40; (3) Patients with FNFs (Garden type III or IV); (4) Patients who underwent surgery the next day after admission; (5) Patients with complete information, including clinical information, VAS scores, nursing quality scores, sleep quality scores, delirium numbers, and perioperative complications. Exclusion criteria were: (1) Patients with contraindications to FNB or acupuncture; (2) Patients with American Society of Anesthesiologists (ASA) score of grade V; (3) Patients with analgesic medication within 24 hours; (4) Patients with presence of pain caused by other disease; (5) Patients with pathological fracture. The follow-up was conducted at the same rehabilitation unit in our hospital for at least one year, and all complications after the surgery were recorded. 130 patients were included, 66 of them received ultrasound-guided femoral nerve block (FNB group), and 64 of them received acupuncture analgesia (Acupuncture group). All patients were informed of the study and signed consent forms.

### *Preoperative analgesia procedures*

*FNB group:* First, the femoral nerve was positioned and the high-frequency linear array ultrasound probe (13-6 MHz) was used to obtain ultrasound imaging of the femoral nerve. The patient was placed in the supine position, and the lower limbs were abducted and externally rotated to fully expose the thigh and groin area. The pubic tubercle and anterior superior iliac spine were marked and connected by the inguinal ligament. The ultrasound probe was placed 1 cm distal to the inguinal ligament, transverse to the neurovascular structures. The fascia lata and iliac fascia were identified respectively, and the femoral vein and femoral artery were visualized on the same view (**Figure 1A**). The femoral nerve (hyperechoic triangular or oval structure) could be found about 1 cm outside the femoral artery. After the positioning was clear, the skin was disinfected and the local anesthesia was given at the puncture point. The out-of-plane technique was used, a 22G nerve block needle was inserted into the skin from the lateral end of the probe, and the puncture needle was slowly pushed to the inside until the needle tip passed through the fascia lata and the iliac fascia, approaching the femoral nerve meridian (**Figure 1B**). Then, local anesthetics could be injected after no blood was extracted, and the femoral nerve wrapped in the drug solution was the best result of ultrasound imaging after injection (**Figure 1C**). The local anesthetic was 20 ml of 0.375% ropivacaine in diluted concentration. The injection site was pressed for 1 minute immediately after FNB treatment to ensure drug diffusion. Anesthesia in FNB group was performed by the same anesthesiologist. After the operation, the patient was observed for 20 minutes and then returned to the ward.

*Acupuncture group:* First, the individualized "inch" was determined. The width of four fingers (four fingers except the thumb) was used as individualized three inches to locate acu-

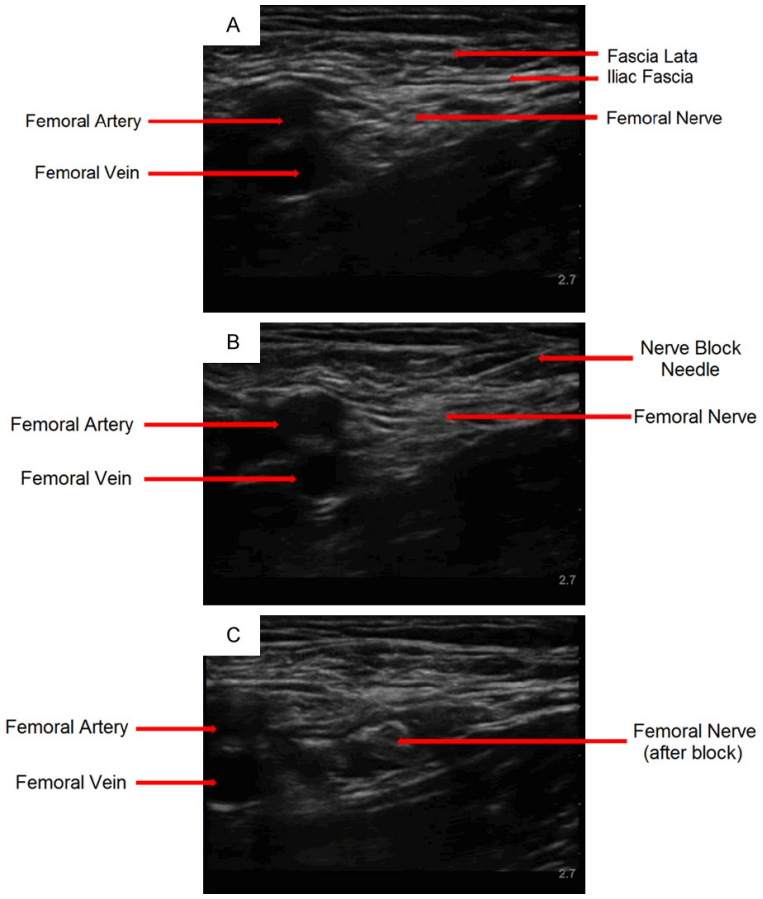


**Figure 1.** Procedure of femoral nerve block. A: The fascia lata and iliac fascia were identified respectively, and the femoral vein and femoral artery were visualized on the same view; B: The nerve block needle was pushed through the fascia lata and the iliac fascia, and approached the femoral nerve meridian; C: The femoral nerve was wrapped in the drug solution.

points. The point of Hegu (LI4), Waiguan (TE5), Taichong (LR3), and Yanglingquan (GB34) were identified (**Figure 2**). Hegu (LI4) point is located on the back of the hand, between the first and second metacarpal bones and at the midpoint of the radial side of the second metacarpal bone. Waiguan (TE5) point is on the back of lower arm, about 3 cm distal to the transverse crease of the wrist, and the midpoint of the interspace between ulna and radius. Taichong (LR3) point is on the back of the foot, in front of the first and second metatarsal bone joint. Yanglingquan (GB34) point is located on the lateral side of the crus, in the pit under the fibular head. Acupuncture needles (0.30 mm×25 mm, Wuxi Jiajian Acupuncture Medical Appliance, Wuxi, China) were used to puncture the bilateral acupoints with 0.5-0.8 inches perpendicular to the skin. During the acupuncture, sterility was maintained. When achieving "DeQi" (Pain, numbness, swelling, or a radiating sensation, which is considered effective with acupuncture) at the acupoints, acupuncture manipulation techniques were performed for 30 minutes.

*Data collection*

The data of the patients, including age, gender, height, weight, and BMI were collected. The VAS scores (0-100) for pain were measured for each patient in a supine position directly (Resting VAS score), and then elevated the legs to 15° (Exercise VAS score) [18]. VAS scores for pain were recorded before, 30 min after FNB or acupuncture analgesia, and on the first and second morning after admission. According to the nursing quality scores introduced by MacDonald et al. [19], patients ranged from 0 to 10. Sleep rhythm and sleep quality scores were assessed and recorded on the first and second night after admission. The sleep quality scores ranged from 0 to 10 [20]. Delirium was diagnosed according to the "Diagnostic and Statistical Manual of Mental Disorders, 5th Ed (DSM-5)". All perioperative complications, such as infection, wound complications, deep venous thrombosis, bedsore, pneumonia, and urine storage were recorded.

*Statistical analysis*

SPSS 22.0 was used to analyze the data. Continuous variables were presented as mean ± SD, and categorical variables were shown as number of cases and percentages. Chi-square test was used to compare the gender, sleep rhythm disorder, and delirium of patients between the two groups. t-test was used to compare the age, weight, height, BMI, VAS score, nursing quality and sleep quality between the two groups. $P<0.05$ was considered significant.

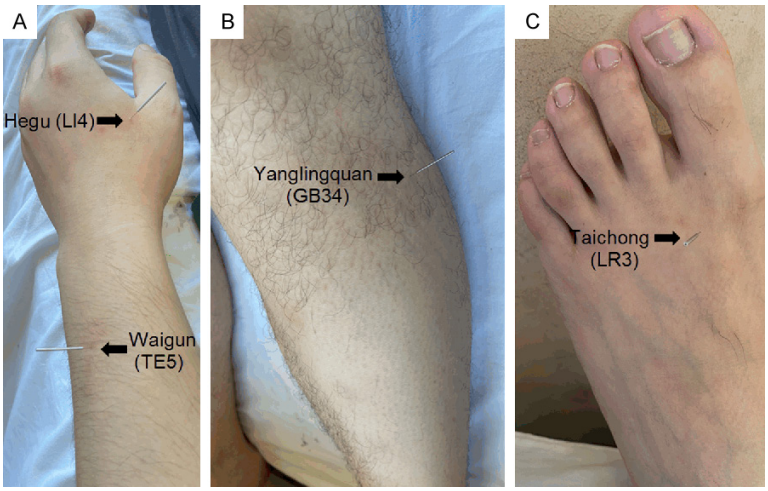


**Figure 2.** Acupoint Hegu (LI4), Waiguan (TE5), Taichong (LR3), and Yanglingquan (GB34) were showed. A: Hegu (LI4) and Waiguan (TE5); B: Yanglingquan (GB34); C: Taichong (LR3).

**Table 1.** Characteristics of patients

| Characteristic | FNB | Acupuncture | *P* value |
|---|---|---|---|
| Number of patients | 66 | 64 | |
| Age (years old) | 81.4.1±5.3 | 80.0±6.6 | 0.21 |
| Male/Female | 25/41 | 19/45 | 0.32 |
| Weight (kg) | 59.5±9.7 | 58.4±11.5 | 0.55 |
| Height (cm) | 162.7±8.4 | 161.6±8.5 | 0.50 |
| BMI (kg/m$^2$) | 36.5±5.0 | 36.0±6.3 | 0.64 |

Note: Data are presented as mean ± SD. *P* values indicate no significant difference among two groups. Abbreviations: FNB, femoral nerve block; BMI, Body Mass Index.

**Table 2.** Comparison of VAS between two groups

| | FNB | Acupuncture | *P* value |
|---|---|---|---|
| Resting VAS score | | | |
| Before block | 83.1±6.0 | 82.7±5.8 | 0.70 |
| 30 min after block | 27.3±8.0[a] | 27.9±7.8[a] | 0.67 |
| Day 1 after admission | 28.7±8.0[a] | 29.7±7.9[a] | 0.46 |
| Day 2 after admission | 35.8±8.4[a,b,c] | 36.6±9.0[a,b,c] | 0.59 |
| Exercise VAS score | | | |
| Before block | 95.0±3.2 | 95.3±2.9 | 0.62 |
| 30 min after block | 60.2±10.4[a] | 59.5±9.8[a] | 0.73 |
| Day 1 after admission | 45.7±8.6[a,b] | 46.6±8.5[a,b] | 0.57 |
| Day 2 after admission | 54.4±9.5[a,b,c] | 55.7±10.3[a,b,c] | 0.47 |

Note: Continuous variables are presented as mean ± SD. a, P<0.01 when compared with that before block; b, P<0.01 when compared with 30 min after block; c, P<0.01 when compared with first day after admission.

## Results

The basic information of the 130 patients is presented in **Table 1**. The efficacy of analgesia of FNB and acupuncture are compared in **Table 2**. The resting VAS score and the exercise VAS score were decreased in both groups. 30 min after blocking, the resting VAS scores in the FNB group and the acupuncture group were 27.3±8.0 and 27.9±7.8, respectively (P=0.67); while the exercise VAS scores in the FNB group and the acupuncture group were 60.2±10.4 and 59.5±9.8, respectively (P=0.73).

Also, there were no statistical differences in VAS score between two groups on day 1 and day 2 after admission.

The resting VAS scores of the FNB group on day 2 were higher than those at 30 min and day 1 after nerve blocking (P<0.01). When compared at 30 min after nerve blocking, the exercise VAS scores were lower on day 1 and day 2 after admission (P<0.01). The exercise VAS scores of day 2 after admission were higher that of day 1 after admission (P< 0.01). The same result was observed in the acupuncture group.

In terms of nursing quality, sleep rhythm disorder, sleep quality and the number of deliriums, no significant differences were detected between these two groups (**Table 3**). Perioperative complications are recorded in **Table 4**.

## Discussion

The preoperative management of FNF in the senile patients has long been challenging for orthopedic surgeons [21, 22]. In the past, more emphasis has been on surgical techniques and methods, while preoperative pain management has relatively been neglected [8, 9, 23]. Pain increases

**Table 3.** Comparison of general conditions between two groups

| | FNB (n=66) | Acupuncture (n=64) | *P* value |
|---|---|---|---|
| Nursing quality | | | |
| Before block | 3.5±1.2 | 3.3±1.4 | 0.50 |
| After block | 7.6±1.2 | 7.4±1.2 | 0.28 |
| Sleep quality | | | |
| The first night | 4.7±1.7 | 4.5±1.8 | 0.39 |
| The second night | 5.6±1.8 | 5.1±1.7 | 0.10 |
| Sleep rhythm disorder (number/%) | 9/13.6 | 10/15.6 | 0.75 |
| Delirium (number/%) | 5/7.6 | 4/6.3 | 0.77 |

Note: Data are presented as mean ± SD.

**Table 4.** Postoperative complications in the two groups

| | FNB | Acupuncture |
|---|---|---|
| Infection (number/%) | 0/0 | 0/0 |
| Wound complications (number/%) | 1/1.5 | 2/3.1 |
| Deep venous thrombosis (number/%) | 1/1.5 | 2/3.1 |
| Bedsore (number/%) | 1/1.5 | 2/3.1 |
| Pneumonia (number/%) | 3/4.5 | 2/3.1 |
| Urine storage (number/%) | 1/1.5 | 1/1.6 |

the possibility of perioperative complications, especially the incidence of delirium. This can lead to prolonged waiting time before surgery, and might even be fatal to senile patients [24, 25]. At present, preoperative pain management mainly includes oral drug analgesia and nerve block. Drug analgesia mainly uses non-steroidal anti-inflammatory drugs (NSAIDs) and opioids. Although oral drugs are convenient to administer, the side effects of drugs should be considered. NSAIDs increase risk of adverse cardiovascular events, clotting disorders, and other side effects [5, 23]. Opioids can cause nausea, vomiting, dizziness, respiratory depression and hypotension [6, 7]. In addition, the use of opioids may lead to fatal delirium [26, 27]. In senile patients with FNF, nerve block is the preferred method of analgesia, especially when oral analgesics are prohibited or are expected to be ineffective [28]. Techniques of nerve blocking for preoperative analgesia include femoral nerve block, obturator nerve block, and iliac fascial compartment block [8, 10]. Nerve blocking can reduce the side effects of analgesic drugs and is not addictive. FNB has been shown to have better analgesic effects compared with iliac fascial compartment block [4]. However, during the practice, we found FNB is more complex and the learning curve is steep. At the same time, due to the variability of the femoral nerve, the anesthetic effect varies significantly among individuals and requires an experienced anesthesiologist to perform the operation.

Acupuncture has been practiced in China for more than 2,000 years. It mainly uses acupuncture to penetrate specific acupoints in the human body and then play the role of dredging Blood and promoting Qi to relieve pain [29, 30]. Acupuncture can be used to treat acute and chronic pain in recent years [31-33]. Compared to medications, acupuncture has the advantages of not being addictive, with no adverse reactions to the liver, kidney or gastrointestinal system [12, 17]. Traditional Chinese Medicine holds the notion that pain is largely caused by obstruction or weakening of Qi and Blood. In senile patients with FNF, blood stasis after fracture causes local meridian obstruction, slow movement of Qi and Blood, and then causes pain. We selected acupuncture at Siguan points (Hegu point, Taichong point), Yanglingquan (GB34) point and Waiguan (TE5) point to relieve pain. “Biao You Fu” (Song to Elucidate Mysteries in Acupuncture Moxibustion) recorded that arthralgia caused by Qi and Blood block can be treated by “acupuncture at Siguan”. Through the stimulation of Hegu (LI4) and Taichong (LR3) points, the purpose of regulating the Qi and Blood throughout the body, promoting blood circulation and relieving pain was achieved. The main clinical manifestations of hip fracture patients are hip pain and restricted movement, and the range of pain belongs to the path of Yangming Gallbladder Meridian of foot and the Yangwei Meridian [34, 35]. Yanglingquan (GB34) point is the Gallbladder Meridian combined point, which can dredge the Qi and Blood of Gallbladder Meridian [36]. In addition, the Gallbladder Meridian is also the “influential point of tendons” in the “Eight influential points”, and has a therapeutic effect on the

pain of the muscles and bones of the lower limbs. Shaoyang Gallbladder Meridian of foot and Jueyin Liver Meridian of foot are respectively stands for exterior and interior, and Yanglingquan (GB34) and Taichong (LR3) are the key points of the two meridians respectively, which complement each other. Waiguan (TE5) point is the original point of Sanjiao Meridian of Hand-Shaoyang. Meanwhile Waiguan (TE5) point and Yanglingquan (GB34) are Shaoyang Meridian acupoints [37]. They promote each other, and strengthen the effect of promoting Qi, activating Blood and relieving pain. Waiguan (TE5) point is also one of the eight confluence points, which connected with the Yangwei Meridian. Acupuncture at Waiguan (TE5) point can stimulate the channel Qi of Yangwei Meridian, and regulate the local ups and downs of Qi and Blood of the hip joint.

130 senile patients were investigated in our hospital from June 2017 to June 2019. Sixty-six received the ultrasound-guided femoral nerve block (FNB group), and the rest received the acupuncture analgesia (Acupuncture group). As shown in **Table 2**, we found that the VAS scores of both groups were significantly decreased at all time points as compared with before block (all $P<0.01$). At the same time, we also found that VAS scores of FNB group and Acupuncture group were not significantly different at each time point. These results indicated that both analgesic methods can effectively relieve preoperative pain. No difference was observed in resting VAS score at 30 min and day 1 after nerve blocking. However, we found that the resting VAS scores on day 2 were significantly elevated. This suggested that the analgesic effects of both types of anesthesia were gradually weakening. However, by comparing the VAS scores at 30 minutes after block, exercise VAS score were lower on day 1 and day 2 after nerve blocking ($P<0.01$), and the exercise VAS score of day 2 after admission was above that of day 1 after admission ($P<0.01$). This suggested that when passively moving the affected hip joint, the analgesia effect was most significant on day 1 after admission, and the analgesic effect of day 2 was similar to that of 30 min after blocking. Moreover, we observed this phenomenon in both groups, and we speculated that it may be related to the process of analgesia, and the specific reasons will be explored in the future study.

The quality of care is an important part of rehabilitation. If patients can turn over, stay in bed, or actively ask for food, then this can effectively prevent the complications of bed rest [4, 19, 26]. Combined with the nursing quality scores mentioned by MacDonald et al. [19], we found that before analgesia, the nursing quality scores of the two groups were 3.5±1.2 and 3.3±1.4, respectively. After analgesia, the nursing quality scores of the two groups were obviously improved, at 7.6±1.2 and 7.4±1.2, respectively. At the same time, as shown in **Table 3**, we found that the difference between the two groups was not significant. Both methods can manage preoperative pain, make it easier for patients to turn over and sit, and actively ask for food, which can reduce perioperative complications before surgery.

Sleep quality and sleep rhythm is another key issue that needs to be considered. Effective sleep can significantly improve patients' quality of life and reduce nursing costs [20]. No difference was shown in sleep quality or sleep rhythm between these two groups (**Table 3**). Compared to previous studies, both can improve sleep in senile patients with preoperative FNF by effective analgesia [20, 38, 39]. Delirium is an important cause of prolonged hospital stay, poor functional prognosis, nursing home placement, and increased one-year mortality in senile patients with FNF [7]. Studies have shown that preoperative pain significantly increased the incidence of delirium [7, 25, 26]. FNB can reduce the incidence of delirium in senile patients with FNF, reduce the incidence of perioperative complications, and improve prognosis. This study found that compared with FNB, there was no difference in the incidence of delirium in the acupuncture group. This indicated that acupuncture analgesia can also reduce the incidence of preoperative delirium through effective analgesia.

Limitations exist in our study. First, as a single-center, non-randomized, retrospective study, it might be hampered by selection bias. Second, the analysis of a small number of patients might affect the statistical power. Third, both FNB and acupuncture analgesia were completed by one doctor, but the skills of different doctors in different hospitals may introduce variations in analgesic effect.

In conclusion, both FNB and acupuncture analgesia are safe and effective in the treatment of

acute preoperative pain in senile patients with FNF. Both methods are effective, and can improve nursing quality, improve patients' sleep, as well as reduce the incidence of delirium. As a traditional analgesic method, the effectiveness of acupuncture analgesia is supported in this study, and we need a well-conducted randomized controlled trial to further evaluate its efficacy.

## Disclosure of conflict of interest

None.

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