Original Article

Impact of wrist-ankle acupuncture on propofol dosage under the dual monitoring of density spectrum array and anesthesia consciousness index in elderly patients undergoing urologic surgery: a sham-controlled randomized clinical trial

Lili Kong[1#]^, Yuexia Ma[1#], Qinxian Wang[1], Tao He[1], Zhe Xu[1], Zhixia Lu[1], Na Zhou[1], Wei Hao[1], Yanhong Li[2]

[1]Department of Anesthesiology and Perioperative Medicine, Hebei Provincial Hospital of Traditional Chinese Medicine, Shijiazhuang, China; [2]Rehabilitation Department, Hebei Provincial Hospital of Traditional Chinese Medicine, Shijiazhuang, China

Contributions: (I) Conception and design: W Hao, L Kong; (II) Administrative support: W Hao, Y Li; (III) Provision of study materials or patients: L Kong, Q Wang, T He; (IV) Collection and assembly of data: Y Ma, Z Lu, N Zhou; (V) Data analysis and interpretation: L Kong, W Hao; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

[#]These authors contributed equally to this work.

Correspondence to: Wei Hao, MD. Department of Anesthesiology and Perioperative Medicine, Hebei Provincial Hospital of Traditional Chinese Medicine, No. 389 Zhongshan East Road, Chang'an District, Shijiazhuang 050013, China. Email: keyan_66666@126.com; Yanhong Li, MD. Rehabilitation Department, Hebei Provincial Hospital of Traditional Chinese Medicine, No. 389 Zhongshan East Road, Chang'an District, Shijiazhuang 050000, China. Email: lyhputaoshula@163.com.

Background: Propofol is a widely used intravenous anesthetic in clinic. However, it is easy to cause serious circulatory fluctuation in elderly patients, so the dose should be reduced as appropriate. Studies have shown that wrist-ankle acupuncture (WAA) can reduce the dosage of propofol in patients undergoing painless endoscopy. Unfortunately, there is no report on whether WAA will reduce the dosage of propofol when used for anesthesia in elderly patients. The purpose of this study is to observe the effect of WAA on propofol dosage in elderly patients, and to provide a new method for maintaining circulatory stability in elderly patients under general anesthesia.

Methods: From October 2022 to December 2022, Hebei Provincial Hospital of Traditional Chinese Medicine was selected. Forty-four elderly patients undergoing general anesthesia in urology department were randomly divided into two groups according to the complete random method with WAA group, consisting of 22 individuals, and non-WAA (NWAA) group, also consisting of 22 individuals. Both groups were treated with WAA or false needle acupuncture at the same site before anesthesia, respectively, and the needle was kept until the operation was finished. During the operation, the dosage of propofol was adjusted according to the depth of field monitoring density spectrum array (DSA) and anesthesia consciousness index (Ai) with anesthesia monitor.

Results: A total of 44 patients participated in this study, and all of them completed the experiment. There were no significant difference in sex, age, height, weight, duration of anesthesia, liver and kidney function, score of Fried frailty scale, activity of daily living (ADL), age-adjusted Charlson comorbidity index (aCCI) and mini-cognitive test (Mini-Cog) between the two groups (P>0.05), but the total dose of propofol (WAA =121.5, NWAA =170.5) mg and maintenance dose (WAA =1.02±0.55, NWAA =1.76±0.67) mg/kg/h, utilization rate of vasoactive drugs during operation, recovery time after anesthesia (WAA =2, NWAA =3) min and surgeon satisfaction (WAA =9, NWAA =8.5) had significant differences (P<0.05).

^ ORCID: 0000-0003-3746-4477.

Conclusions: Compared with NWAA group, WAA group could reduce the dosage of propofol in anesthesia for elderly patients with exocrine secretion and was beneficial to circulatory stability.
Trial Registration: Chinese Clinical Trial Registry (ID: ChiCTR2100054132).

Keywords: Wrist-ankle acupuncture (WAA); elderly patients; propofol; density spectral array (DSA); anesthesia consciousness index (Ai)

Submitted May 23, 2023. Accepted for publication Nov 10, 2023. Published online Nov 23, 2023.
doi: 10.21037/tau-23-301
View this article at: https://dx.doi.org/10.21037/tau-23-301

Introduction

With rapid economic growth and continuous improvements in science, medical and health conditions and living standards have correspondingly improved, making the death rate drop, and extending the average life span of population. However, the extension of average life span also aggravates the problems of our aging population (1). The elderly patients have poor tolerance to general anesthesia due to the decline of organ function and the weakened compensability and thus face higher anesthesia risk (2). Propofol is the most widely used intravenous anesthetic in clinical practice and is characterized by fast induction and rapid recovery, However, the disadvantage of propofol anesthesia is that it has a great influence on circulatory dynamics, especially on elderly patients with poor compensatory ability. Severe cases can lead to perioperative cardiovascular and cerebrovascular accidents and even death. Although the package insert of propofol indicates that its dosage must be reduced appropriately in elderly patients, there is no specific reference dose. In clinical settings, the administration rate is mostly adjusted based on the hemodynamic changes, but this practice lacks a scientific basis. With the adoption of the concept of enhanced recovery after surgery (ERAS), the dose of anesthetic drugs needs to be reduced to achieve a more precise dose of anesthetics; moreover, the time to postoperative recovery of spontaneous breathing and the awakening time need to be shortened to promote postoperative recovery.

Wrist-ankle acupuncture (WAA) was a therapy researched by Professor Xinshu Zhang that involved using specific needle entry points at the wrist and ankle to treated diseases. It was a form of acupuncture anesthesia that was known for its simple operation, safety and effectiveness, and no serious adverse side effects. WAA only requires regional acupuncture on the wrist and ankle to treat systemic diseases (3). It involves subcutaneous shallow needling and linear stimulation of nerve endings to stimulate twelve skin meridian qi and defensive qi function, promoting the operation of qi and blood and treating diseases, to achieve the purpose of 'Tong Ze Bu Tong' treatment of disease (4,5). For the urethra, prostate, and bladder, acupuncture should be done in the lower 1, lower 2, and lower 3 areas, following the direction of the three yin meridians of the foot (6). WAA treatment is mainly used in clinical practice to alleviate patients' pain, discomfort, anxiety, and depression, and it is a fairly safe treatment method (7-9). It was easier to apply compared to other acupuncture therapies as it did not require additional equipment (10). Research has shown that WAA can reduce propofol dosage in patients undergoing painless endoscopy (11-13); unfortunately, no literature has reported whether WAA reduces propofol dosage when used

Highlight box

Key findings
- Wrist-ankle acupuncture can decrease the amount of propofol required in elderly urological patients, maintain stable circulation, and improve the quality of patients' awakening and the satisfaction of operators.

What is known and what is new?
- Wrist-ankle acupuncture can reduce propofol dosage in patients undergoing painless endoscopy.
- Under the dual monitoring of density spectrum array and anesthesia consciousness index, it is found that wrist-ankle acupuncture has the potential to decrease the speed and overall amount of propofol administered in elderly patients undergoing general anesthesia in urology

What is the implication, and what should change now?
- Wrist-ankle acupuncture can effectively decrease the amount and speed of propofol administration in elderly patients undergoing urologic surgery, accelerate postoperative recovery, reduce the intraoperative use of noradrenaline, and increase surgeon satisfaction. Thus, it is a safe and reliable anesthetic technique that warrants further application in clinical settings.

for anesthesia in elderly patients.

In this study, we conducted a randomized controlled trial, based on the dual monitoring of density spectrum array (DSA) and anesthesia consciousness index (Ai), to observe the influence of wrist and ankle acupuncture on propofol dosage in elderly patients in urology department, and to find the best anesthesia method for elderly patients. We present this article in accordance with the CONSORT reporting checklist (available at https://tau.amegroups.com/article/view/10.21037/tau-23-301/rc).

Methods

Study design

This is a prospective, double-blinded, single-center, randomized controlled study. The study was approved by the Ethics Committee of Hebei Provincial Hospital of Traditional Chinese Medicine (approval No. HBZY2021-KY-139-01). Each participant or legal guardian provided written informed consent. This study was conducted in accordance with the Helsinki Declaration (revised in 2013).

Forty-four elderly patients undergoing elective general anesthesia in Urology Department of Hebei Provincial Hospital of Traditional Chinese Medicine were enrolled and randomly divided into WAA group (n=22) and non-WAA (NWAA) group (n=22) according to 1:1, and the details of the randomization were sealed inside a non-transparent envelope. The anesthesiologist with training in WAA was assigned to open the envelope prior to the acupuncture session and then proceeding accordingly. However, they did not have responsibility for patient care or data collection related to the research. The other anesthesiologist solely focused on managing all patients during the surgery and had no knowledge of the patient grouping. Surgeons were only responsible for the operation process, also blinded to the grouping of patients, and were not involved in subsequent studies. Although not completely blinded, anesthesiologist who provided WAA or NWAA interventions were required to keep the participants and evaluators uninformed about the treatment and results. Therefore, neither participants nor evaluators could clearly distinguish between the interventions given.

The inclusion criteria were as follows: (I) categorized as American Society of Anesthesiologists (ASA) grade I–III; (II) men and women aged ≥65 years; and (III) a weight of 40–90 kg. The exclusion criteria were the following: (I) abnormal thyroid function before surgery; (II) a previous history of WAA or needle fainting; (III) a history of long-term sedative use or alcohol dependence; (IV) requiring blood transfusion for massive intraoperative hemorrhage; and (V) communication disorders or mental disorders potentially impeding cooperation during procedures.

Interventions

Monitoring

The anesthesia machine, monitoring devices, and other equipment were maintained at normal status. Patients were consistently required to abstain from solid food for 8 hours and clear fluids for 4 hours prior to the procedure. The patients were brought into the anesthesia recovery room 30 min after the acupuncture, in which electrocardiogram (ECG), heart rate (HR), noninvasive blood pressure (NIBP), axillary temperature, blood oxygen saturation (SpO_2), and end-tidal carbon dioxide partial pressure ($P_{ET}CO_2$) were routinely monitored using the Mindray patient monitor (Mindray Medical International Ltd., Shenzhen, China). DSA and Ai were monitored with an anesthesia depth detector (ConView; PearlCare, Zhejiang Province, China), the measurement method: Before sticking the sensor, the skin surface was gently polished with matching sandpaper, and the skin was cleaned with alcohol cotton; The sensor was attached to the forehead near the hair mark, the No. 1 electrode was attached to the center of the forehead, the No. 2 and No. 3 electrodes were attached to the left, and the No. 4 electrode was attached to the temple [the attachment position and method are the same as bispectral index (BIS) monitoring], and then the sensor electrode was attached to ConView PearlCare. Ringer's acetic acid solution was infused through an open venous channel. Ringer's acetate solution was infused via open venous channels. Patients with a negative Allen test were subjected to invasive arterial puncture and catheterization under local anesthesia, along with real-time monitoring of arterial blood pressure and pulse pressure variation (PPV).

WAA and NWAA interventions

Patients were asked to take a supine position. According to the surgical zones, needles were inserted in zones 1, 2, and 3 at both ankles (*Figure 1*). In the WAA group, 25 mm × 25 mm filiform needles (cat. No. 190563, Huatuo; Suzhou Medical Supplies Factory Co., Ltd., Jiangsu Province, China) were inserted subcutaneously at an angle of approximately 15° to 30°. Then, the needle body was attached closely to the skin surface and pushed

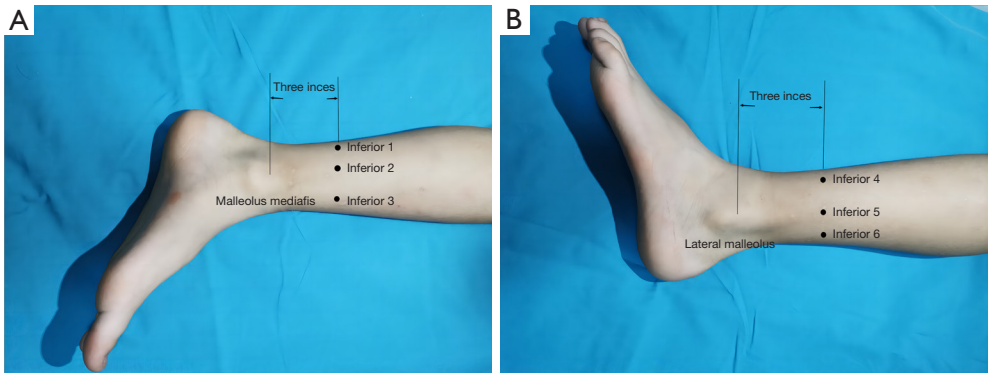

Figure 1 Sites of wrist-ankle acupuncture in the lower limbs.

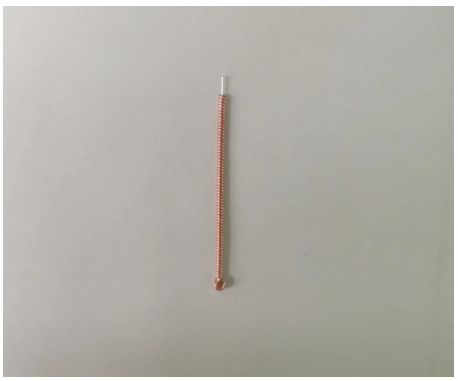

Figure 2 Sham needle.

Figure 3 Acupuncture needle covering mode.

slowly inward along the longitudinal axis of the upper limbs. The needle body entered 1.2–1.4 inches along the dermis, with care taken to ensure the needling was soft and gentle and to avoid aches, numbness, swelling, or pain. If patients experienced any of these sensations, the needling angles and depth were adjusted. Finally, the needles were securely fixed with an opaque medical adhesive plaster. The NWAA group used a modified needle for sham acupuncture (14), the tip of the acupuncture needle was cut off by 23 mm, the needle was blunted, leaving 2 mm (*Figure 2*), and after gently pricking the skin but not penetrating it, it was placed flat on the skin and fixed. Sham acupuncture, also referred to as placebo acupuncture control, applied pressure on the corresponding areas using a specialized placebo acupuncture device without actually penetrating the skin. This method had been used to form control groups in other studies (15). After skin disinfection, the anesthesiologist used his or her right hand to hold the needle; after the skin was gently pricked (without piercing the skin), the needle handle was attached to the skin at zones 1, 2, and 3 of both ankles and securely fixed with a sterile adhesive bandage. All the leaked parts needed to be covered (*Figure 3*). The whole process was not visible to the patients. If the patient experienced dizziness, nausea, or other discomfort, the needles were quickly removed and patients were offered oxygen inhalation placement in a supine position.

Anesthesia process

After denitrogenation, oxygen was given via face mask for 3 min (oxygen flow: 6 L/min) before anesthesia induction. For anesthesia induction, sufentanil (0.1 μg/kg), cis-atracurium (0.15 mg/kg), and etomidate (0.15–0.2 mg/kg) were intravenously injected one after another; meanwhile, remifentanil (1 μg/kg) was intravenously infused. After the muscle relaxation was achieved, the Ai dropped to 45–55, and the DSA showed weak α, β, and γ waves and strong δ wave, endotracheal intubation and mechanical ventilation were performed by the same senior anesthesiologist, the tidal volume was set to 6–8 mL/kg, a ventilation frequency

was set to 12 times/min, an oxygen flow of 2 L/min, and an inspiratory to expiratory ratio of 1:2. The ventilator parameters were adjusted according to SpO_2 and $P_{ET}CO_2$ measurements.

For anesthesia maintenance, continuous remifentanil was infused in both groups at a rate of 0.5 μg/kg/min, along with an intermittent injection of cis-atracurium. The infusion rate of propofol was adjusted according to Ai value and DSA. Ai was maintained at 45–55; for DSA, weak α, β, and γ waves and strong δ wave were maintained. During the surgery, SpO_2 was maintained at 98–100%, $P_{ET}CO_2$ at 35–45 mmHg, and axillary temperature at 36–37 ℃ (through use of an infusion heating system). According to the changes in the circulation system during the surgery, target-directed fluid therapy was performed according to PPV during anesthesia. vasoactive drugs were used, when appropriate, to control the hemodynamic fluctuations within ±20% of the basal value in both groups. The procedure was performed by the same senior chief physician, and the anesthetic infusion was stopped upon the completion of the operation. After the patients regained consciousness and resumed spontaneous breathing, the endotracheal tube was withdrawn, and the patient was sent to the anesthesia recovery room.

Recording indicators

The data were recorded by an anesthesiologist who was blinded to the study protocol. the primary endpoints were the total propofol dosage and infusion rate, and the secondary endpoints were the utilization rate of norepinephrine, the awakening time of patients after operation and the satisfaction of doctors. In addition, the following data were recorded: gender, age, height, body weight, preoperative liver and kidney function; the Fried frailty scale score, activity of daily living (ADL) scale score, age-adjusted Charlson comorbidity index (aCCI) score and mini-cognitive test (Mini-Cog) scale; Duration of anesthesia and type of operation. When HR <45 bpm is defined as bradycardia, atropine was given intravenously until HR >45 bpm; when the patient had hypotension (rose more than 20% of the baseline value), norepinephrine was given intravenously. The doctors' satisfaction was measured by Visual Simulation Scale (VAS) [the scale consists of a horizontal line with a length of 10 cm, the centimetre measurement was converted to points on a scale of 0 (complete dissatisfaction) to 10 cm (complete satisfaction)].

Statistical analysis

In this study, a completely randomized method was used, and the SAS software PROC PLAN was used to create a random allocation table. Patients who met the criteria were randomly assigned to either WAA or sham acupuncture based on the allocation table.

According to the results of the pretest, it was determined that the probability of type I error (α) was 0.05, and probability of the type II error (β) was 0.1, and the power was 0.9. The average propofol dosage in the WAA group was 132.15 mg [standard deviation (SD) 107.26 mg], and the average propofol dosage in the NWAA group was 228.23 mg (SD 98.69 mg). Based on the results of a 2-tailed test, the calculated sample size was 21 cases in each group. Considering the withdrawal rate of 5%, we plan to randomly include 22 cases in each group. In this study, there are 44 cases in intention-to-treat (ITT) analysis set and per-protocol (PP) analysis set, the analyses were performed for the PP set. Statistical analysis and plotting were conducted using the SPSS v. 26.0 (IBM Corp., Armonk, NY, USA) and GraphPad Prism version 9.0 (GraphPad Software). Count data are presented as numerical values and proportions and were analyzed using the chi-square test. The normally distributed measurement data are presented as x ± SD and were compared using a 2-sample *t*-test. Nonparametric tests were used to compare measurement data that did not follow a normal distribution, and the data were reported as medians with interquartile ranges. A P value <0.05 was considered statistically significant.

Results

General information of participants

Subjects were recruited in 2022, and those who met the inclusion criteria were randomly divided into WAA group and NWAA group. Follow-up on the first, third and seventh day after operation until the patient was discharged. The patients were followed up by telephone at the first week, the second week, the third week and the fourth week after discharge. Forty-four patients were assessed for eligibility, and no cases were lost. The 44 patients were randomized in a 1:1 ratio: 22 to the WAA group and 22 to the NWAA group. The CONSORT diagram was displayed (*Figure 4*). Differences between the two groups in general information including: gender, age, height, duration of anesthesia, preoperative liver and kidney function, the Fried frailty

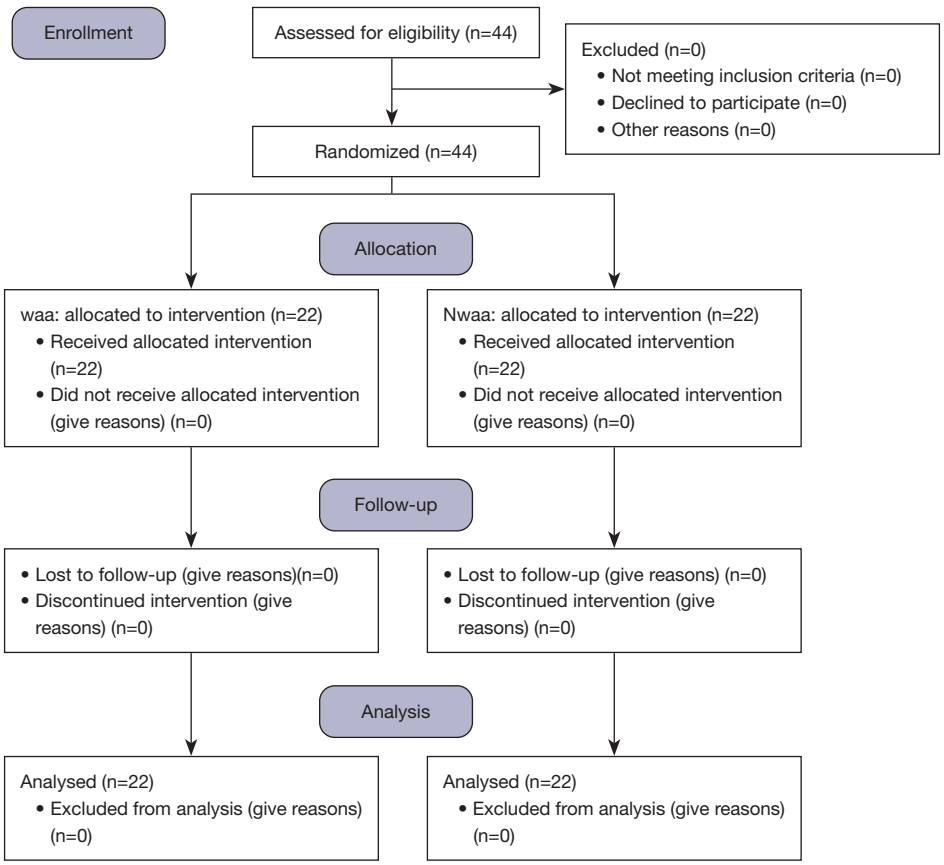

Figure 4 Flowchart of patient enrollment. WAA, wrist-ankle acupuncture; NWAA, non-WAA.

scale score, ADL scale score, aCCI score and Mini-Cog scale, surgical site were not statistically significant (P>0.05, *Table 1*).

Anesthesia-related indicators

There were significant differences in total propofol dosage, infusion rate, noradrenaline utilization rate, and time to awakening between these two groups (all P values <0.05). Atropine dosage showed no statistical significance (P>0.05; *Table 2*). The doctors' satisfaction was statistically significant between the two groups (P<0.05), the median VAS in the WAA and NWAA groups was 9 (interquartile range 1) and 8.5 (interquartile range 1.5) (*Figure 5*).

Discussion

As the era of an aged population approaches, a greater number of elderly patients will be requiring surgical treatment. The elderly patients often have a variety of organ dysfunctions, which result in altered pharmacodynamics and pharmacokinetics of anesthetic drugs. The elderly patients typically have increased sensitivity to central nervous system-inhibiting drugs (16). In addition, preoperative fasting is known to cause a deficit in intravascular blood volume (17). Therefore, small doses of anesthetic drugs can cause obvious circulatory inhibition in elderly patients, which manifests as a decreased HR and blood pressure (18). Propofol has the advantages of short action time, rapid recovery, and lower incidence of postoperative nausea and vomiting and therefore is the intravenous anesthetics most used for the maintenance of anesthesia. The superficial and peripheral distribution volume and clearance of propofol are decreased in elderly patients, and therefore the concentration for 50% of maximal effect (EC_{50}) declines in these patients. Thus, the dosage of propofol should be lowered (19).

The monitoring of the depth of general anesthesia during surgery can prevent intraoperative awareness to the greatest extent, avoid excessive anesthesia, and promote

Table 1 General information of participants

General information	WAA group	NWAA group	t/χ^2	P value
Gender (males/females)	19/3	18/4	0.17	0.68
Age (years), mean ± SD	72±5.61	73±6.13	–0.565	0.575
Duration of anesthesia (min), mean ± SD	109.05±48.01	121.05±75.11	–0.631	0.531
Height (cm), mean ± SD	165.95±6.8	166.14±6.13	–0.093	0.926
Body weight (kg), mean ± SD	69.77±11.95	64.92±9.5	1.489	0.144
Hemoglobin (g/L), mean ± SD	132±18.74	124.82±17.91	1.299	0.201
Urea (mmol/L), mean ± SD	6.9±4.59	6.09±2.64	0.726	0.472
Serum creatinine (μmol/L), mean ± SD	101.08±71.3	82.94±29.06	1.105	0.275
Alanine aminotransferase (U/L), mean ± SD	17.2±8.37	13.78±4.76	1.668	0.103
Aspartate transaminase (U/L), mean ± SD	20.43±6.24	19.77±5.23	0.38	0.706
ADL score (points), mean ± SD	97.73±7.52	99.32±3.2	0.914	0.366
aCCI, mean ± SD	3.59±1.47	4.18±2.46	–0.967	0.339
Mini-Cog, mean ± SD	0.32±0.48	0.23±0.43	0.665	0.51
Hypoalbuminemia (Y/N)	7/15	9/13	0.393	0.53
Fried (Y/N)	19/3	21/1	1.1	0.29
Surgical site				
Prostate gland	12	12	0	>0.99
Kidneys	3	3		
Bladder	2	2		
Ureters	5	5		

WAA, wrist-ankle acupuncture; NWAA, non-WAA; SD, standard deviation; ADL, activities of daily living; aCCI, age-adjusted Charlson comorbidity index; Y, yes; N, no.

Table 2 Anesthesia-related indicators

Anesthesia-related indicators	WAA group	NWAA group	$z/t/\chi^2$	P value
Total propofol dosage (mg), median (interquartile range)	121.5 (111.75)	170.5 (125.0)	–2.489	0.013
Propofol infusion rate (mg/kg/h), mean ± SD	1.02±0.55	1.76±0.67	–4.009	<0.001
Atropine dosage (mg), mean ± SD	0.12±0.35	0.15±0.36	–0.215	0.831
Noradrenaline utilization (Y/N)*	6/16	16/6	9.091	0.003
Time to awaking (min), median (interquartile range)	2 (1.0)	3 (3.0)	–3.88	<0.001
Surgeon satisfaction (VAS points), median (interquartile range)	9 (1.0)	8.5 (1.5)	–2.4	0.017

*, proportion of noradrenaline used in different groups. WAA, wrist-ankle acupuncture; NWAA, non-WAA; SD, standard deviation; Y, yes; N, no; VAS, visual analogue scale.

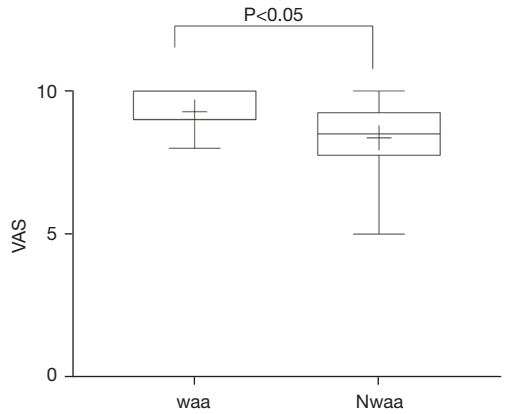

Figure 5 Surgeon satisfaction (measured by VAS). VAS, visual analogue scale; WAA, wrist-ankle acupuncture; NWAA, non-WAA.

the recovery from general anesthesia (20). Based on the electroencephalogram (EEG) frequency data in Asian populations, the Ai was developed by PearlCare. It has been discovered that Ai could effectively track the level of sedation caused by propofol in adult patients without painful stimuli, with no notable difference in accuracy compared to the BIS (21). In a study comparing these indices, Ai and BIS values showed few differences at loss of consciousness or recovery of consciousness and had high consistency in judging the depth of anesthesia; when consciousness states were altered, however, changes of Ai were significantly greater than those of BIS. Thus, Ai is a better parameter to estimate alterations in consciousness (22). Therefore, in our present study, Ai (with values similar to BIS) and DSA were jointly used to guide the maintenance dosage of propofol in older adult patients. DSA is decomposed and converted from the original EEG findings, and the color of EEG activity depends on the power of a specific frequency band. DSA can reflect the activities brain frequency bands in real-time, without any response lag. In a study of adult patients over 65 years of age, the α-oscillation disappeared in the DSA spectrogram, the overall power decreased (23), and the sensitivity to the same dose of sedative drugs increased significantly. Dual guidance with Ai and DSA can provide anesthesiologists with more timely and accurate information, so as to ensure a more objective and accurate propofol dosage and the reduction of errors caused by empirical medicine.

Research (24) has proposed to integrate traditional Chinese medicine (TCM) methods into ERAS procedures. ERAS programs integrating TCM and Western medicine (e.g., acupuncture-assisted anesthesia to optimize traditional anesthesia methods) may reduce the dosage of anesthetics, alleviate their impact on physiological functions, and reduce stress. These programs comply with the core components of ERAS and are conducive to postoperative recovery.

WAA is an acupuncture anesthesia technique that is applied in the shallow parts of the subcutaneous tissue, with the acupuncture sites located in the wrists and ankles. The anterior and posterior sections of the human body are divided into 6 longitudinal zones, arranged from front to back and numbered with numerals 1–6. Furthermore, these 6 zones are bound by the diaphragm and are used for symptom localization. According to the WAA positioning criteria, all the surgeries performed in our current study were urological procedures. Therefore, the ankle zones 1, 2, and 3 were selected (*Figure 1*). WAA has the advantages of easy positioning and convenient needle retention compared to other acupuncture techniques; rapid therapeutic response; a lack of soreness, numbness, swelling, and pain after needling; and high safety and reliability. In addition, it does not require other additional instruments or equipment. Thus, it is more suitable for clinical anesthesia (10). WAA has been widely used in clinic as an auxiliary means to treat various patients' pain, anxiety, depression and other discomfort because of its few adverse reactions (mostly subcutaneous bleeding and needle fainting during operation).

To our knowledge, acupuncture interventions using conventional filiform needles are difficult to include in blinded trials due to the special nature of the interventions. According to the traditional acupuncture theory, acupuncture using filiform needles induces in participants a sensation of *deqi* (i.e., soreness, numbness, dullness, and pain). An acupuncture trial that does not ask participants whether they have the sensation of *deqi* will not be able to reflect the correct and real effectiveness of acupuncture treatment (25). However, acupuncture sensation is not required for WAA. Randomized controlled single-blind trials using nonpenetrating sham needles in which participants are asked to wear eye patches are quite innovative. Under such conditions, the participants were unaware of the intervention they received, and they cannot distinguish between the therapeutic interventions and sham interventions in subsequent treatments. Therefore, we believe that this approach can be served as a viable placebo intervention. Our current study may thus provide high-quality evidence for the impact of WAA on propofol dosage in older adult patients undergoing urologic surgery under DSA and Ai monitoring.

In our present study, the total dose and infusion rate of propofol in the WAA group were significantly lower than those in the NWAA group. Compared with the propofol maintenance dose recommended in previous studies for the elderly during general anesthesia surgery of 3.372±0.774 mg/kg/h, the propofol maintenance dose recommended in this study for the elderly in the WAA group was 1.02±0.55 mg/kg/h (26). Similarly, a different study (24) also revealed that acupuncture anesthesia could reduce the dosage of anesthetic drugs, this could be attributed to the potential effect of acupuncture on enhancing cerebral blood flow (27) and altering the permeability of the blood-brain barrier (28,29), thereby facilitating the entry of propofol into the brain and promoting the rapid onset of anesthesia. By reducing the amount of propofol used, WAA can increase perioperative safety and reduce anesthesia-related complications in elderly patients.

Hypotension during anesthesia surgery, even if it is of very short duration, may affect tissue perfusion and functions of vital organs and may be tightly linked to poor prognosis and outcomes. Therefore, preventing hypotension is more important than treating it after the fact. There was a lower rate of noradrenaline use in the WAA group, indicating that WAA has very good effectiveness in preventing hypotension during anesthesia and surgery. Thus, intraoperative WAA may be an effective technique to lower the incidence of perioperative hypotension-related complications. In addition, the lower rate of intraoperative noradrenaline use in the WAA group might be related to the autonomic modulation effect of WAA. WAA is performed subcutaneously, and the cutaneous innervation consists of both autonomic (sympathetic and parasympathetic) and sensory nerve fibers (30). Therefore, when the needles stimulate the subcutaneous superficial layer, they may stabilize the circulation by modulating the sympathetic vagus nerves (31), as demonstrated in a previous study (32).

Monitoring of both Ai and DSA can accurately reflect the whole-body anesthetic depth in real time, thus avoiding excessively deep anesthesia incurred through empirical practice and achieving the individualized use of anesthetics. Moreover, the low propofol dosage in the WAA group might also explain the quicker recovery of the patients in this group. Additionally, in the WAA group, the stable circulation during the operation and the rapid recovery of spontaneous breathing and rapid awakening after the operation was reflected in improved the surgeon satisfaction.

However, our current study had certain limitations. Firstly, only the elderly patients undergoing urologic surgery were included, and other fragile patients (decompensation of important organs such as heart, liver, kidney, etc.) and patients receiving other types of surgery were not investigated. Secondly, we only explored the effect of WAA on propofol dosage and did not study its effect on other intravenous anesthetics. Thirdly, we did not study the influence of other acupuncture treatments on propofol dosage.

Conclusions

In summary, WAA can effectively reduce the dosage and infusion rate of propofol in elderly patients undergoing urologic surgery, accelerate postoperative recovery, reduce the intraoperative use of noradrenaline, and increase surgeon satisfaction. Thus, it is a safe and reliable anesthetic technique that warrants further application in clinical settings.

Acknowledgments

We thank Professor Kathleen Lumiere (Bastyr University/Bastyr Center for Natural Health, Seattle, USA) and Dr. Marlene Zuccolotto Moro (Universidade Estadual Paulista, São Paulo, Brazil) for their critical comments and valuable advice on this study.
Funding: None.

Footnote

Reporting Checklist: The authors have completed the CONSORT reporting checklist. Available at https://tau.amegroups.com/article/view/10.21037/tau-23-301/rc

Trial Protocol: Available at https://tau.amegroups.com/article/view/10.21037/tau-23-301/tp

Data Sharing Statement: Available at https://tau.amegroups.com/article/view/10.21037/tau-23-301/dss

Peer Review File: Available at https://tau.amegroups.com/article/view/10.21037/tau-23-301/prf

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://tau.amegroups.com/article/view/10.21037/tau-23-301/coif). The authors

have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. This study was approved by the Ethics Committee of Hebei Provincial Hospital of Traditional Chinese Medicine (approval No. HBZY2021-KY-139-01). Written informed consent was provided by each participant or legal guardian. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013).

References

1. Xiang X, Wang Y. The present situation, characteristic, reason and countermeasure of population ageing in China. Chinese Journal of Gerontology 2021;41:4149-52.
2. Lu CX, Yang SJ, Tao HZ, et al. Research progress on aging mechanism. Chinese Journal of Gerontology 2018;38:248-50.
3. Zhou QH, Gu W, Lin CQ. Wrist-ankle acupuncture. Shanghai: Shanghai Science and Technology Press, 2017.
4. Liu LC, Chen H, Xiong CY. Research progress of wrist-ankle acupuncture for postoperative analgesia. Shanghai Journal of Traditional Chinese Medicine 2016;50:94-6.
5. Zhuo SL. Acupuncture 'Examining Weiqi'. Chinese Acupuncture 2010;30:763-7.
6. Hou J, Li Y, Wu Y, et al. Safety and efficacy of wrist-ankle acupuncture in treating catheter-related bladder discomfort after transurethral resection of the prostate: a double-blind randomized clinical trial. Gland Surg 2022;11:1464-71.
7. Zhu LB, Chan WC, Lo KC, et al. Wrist-ankle acupuncture for the treatment of pain symptoms: a systematic review and meta-analysis. Evid Based Complement Alternat Med 2014;2014:261709.
8. Shu S, Li TM, Fang FF, et al. Relieving pre-exam anxiety syndrome with wrist-ankle acupuncture: a randomized controlled trial. Journal of Chinese Integrative Medicine 2011;9:605-10.
9. You Y, Zhang T, Shu S, et al. Wrist-ankle acupuncture and Fluoxetine in the treatment of post-stroke depression: a randomized controlled clinical trial. J Tradit Chin Med 2020;40:455-60.
10. Zeng K, Zhou QH. Clinical application and research progress of wrist and ankle acupuncture in the treatment of pain. Zhenjiu Linchuang Zazhi 2012;9:69-72.
11. He T, Liu C, Lu ZX, et al. Effect of wrist-ankle acupuncture on propofol dosage during painless colonoscopy: A randomized controlled prospective study. World J Clin Cases 2022;10:3764-72.
12. Zheng LY, Mi SC, Wu LY, et al. Study of wrist-ankle acupuncture therapy for optimizing anaesthesia scheme of painless gastroscopy and improving painless gastroscopy related complications. World J Gastrointest Endosc 2023;15:56-63.
13. Lu ZX, Yang L, Liu MX, et al. Reducing dosage of propofol in painless undergoing bronchoscopy of older adult patients by wrist-ankle acupuncture: A randomised controlled trial. Chinese Journal of Integrated Traditional and Western Medicine 2022;42:317-21.
14. Chen Y, Tian S, Tian J, et al. Wrist-ankle acupuncture (WAA) for primary dysmenorrhea (PD) of young females: study protocol for a randomized controlled trial. BMC Complement Altern Med 2017;17:421.
15. Zheng H, Li J, Li Y, et al. Acupuncture for patients with mild hypertension: A randomized controlled trial. J Clin Hypertens (Greenwich) 2019;21:412-20.
16. JandaM, Simanski O, Bajorat J, et al. Clinical evaluation of a simultaneous closed-loop anaesthesia control system for depth of anaesthesia and neuromuscular blockade. Anaesthesia 2011;66:1112-20.
17. Zhang Y, Pan Q, Tian HH, et al. Application of fluid pre-infusion in the protection of circulatory function in older adult patients during general anesthesia induction. Journal of Xuzhou Medical University 2017;37:241-4.
18. Zhang Y, Zhuang XL. Myocardial inhibition by intravenous general anesthetics and its mechanism. International Journal of Anesthesiology and Resuscitation 2002;23:45-8.
19. Zhao LY, Xie H, Wang C, et al. Half-effective target plasma concentration during target-controlled infusion of remifentanil in awake older adult patients. Suzhou University Journal of Medical Science (Medical Edition) 2007;(03):470-2.
20. Shi XY, Yu WF. Expert consensus on anesthesia

management to promote postoperative rehabilitation. Chinese Journal of Anesthesiology 2015;35:141-8.
21. Jiang Y, Yu LZ, Liu Y. Accuracy of anesthesia index for monitoring depth of sedation induced by propofol: a comparison with bispectral index. Chinese Journal of Anesthesiology 2017;37:1516-9.
22. Fu Y, Xu T, Xie KL, et al. Identifying consciousness alterations during intravenous anesthesia with the depth of anesthesia index and bispectral index: a randomized multicenter study. International Journal of Anesthesiology and Resuscitation 2018;39:1005-9.
23. Purdon PL, Pavone KJ, Akeju O, et al. The Ageing Brain: Age-dependent changes in the electroencephalogram during propofol and sevoflurane general anaesthesia. Br J Anaesth 2015;115 Suppl 1:i46-57.
24. Cheng LY, Xie ZY, Chen JY, et al. Research status and thinking of enhanced recovery after surgery with integrated traditional Chinese medicine and western medicine. The Journal of Practical Medicine 2015;31:2771-4.
25. To M, Alexander C. The effects of Park sham needles: a pilot study. J Integr Med 2015;13:20-4.
26. Jia L, Hou J, Zheng H, et al. Study of the rational dose of propofol in elderly patients under bispectral index monitoring during total intravenous anesthesia: A PRISMA-compliant systematic review. Medicine (Baltimore) 2020;99:e19043.
27. Zhang LL, Wang YH, Song XL, et al. Effects of acupuncture on carotid intima-media thickness and cerebral blood flow velocity in patients with mild-to-moderate hypertension. Zhongguo Zhen Jiu 2019;39:703-7.
28. Zhang M, Zhang JY, Zhong W. Advances in strategies to overcome the blood-brain barrier. Journal of International Pharmaceutical Research 2016;43:126-33.
29. Lin XM, Tan KP, Zhang AJ, et al. Effect of electroacupuncture on the permeability of blood-brain barrier for nerve growth factor and its relevance to PKC pathway in cerebral ischemia rats. Zhen Ci Yan Jiu 2009;34:110-3.
30. Nolano M, Provitera V, Caporaso G, et al. Cutaneous innervation of the human face as assessed by skin biopsy. J Anat 2013;222:161-9.
31. Huang ST, Chen GY, Lo HM, et al. Increase in the vagal modulation by acupuncture at neiguan point in the healthy subjects. Am J Chin Med 2005;33:157-64.
32. Qing Y, Zhang ZZ, Yang LY. Effect of additional wrist and ankle acupuncture treatment on blood uric acid and ultrasensitive Creactive protein in patients with essential hypertension. Guangxi Traditional Chinese Medicine 2009;32:7-8.

(English Language Editor: J. Gray)

Cite this article as: Kong L, Ma Y, Wang Q, He T, Xu Z, Lu Z, Zhou N, Hao W, Li Y. Impact of wrist-ankle acupuncture on propofol dosage under the dual monitoring of density spectrum array and anesthesia consciousness index in elderly patients undergoing urologic surgery: a sham-controlled randomized clinical trial. Transl Androl Urol 2023;12(11):1686-1696. doi: 10.21037/tau-23-301

