

ORIGINAL RESEARCH ARTICLE

Effects of rapid rehabilitation nursing on common carotid artery elasticity in patients undergoing transvaginal endoscopic hysterectomy

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Abstract

This was an original article designed to explore the effects of velocity vector imaging (VVI) on common carotid artery elasticity in patients undergoing transvaginal natural cavity endoscopic hysterectomy during perioperative rapid rehabilitation nursing. Eighty patients undergoing transvaginal natural cavity endoscopic hysterectomy in Affiliated Beihua University Hospital from January 2021 to December 2022 were selected and divided into a control group (CG) and an intervention group (IG). The CG adopted perioperative routine nursing, while the IG adopted perioperative rapid rehabilitation nursing. Relative to the CG, the IG presented higher serum level of estradiol, higher change rate of transverse carotid artery area, higher mean systolic velocity peak time (VTTP) and mean systolic maximum strain (Smax) in the six wall segments. We conclude that rapid rehabilitation nursing in patients with transvaginal natural cavity endoscopic hysterectomy, can improve the common carotid artery elasticity and promote the rehabilitation of the patients. Velocity vector imaging technology can reflect the coordination of the overall movement of the tube wall, which is of great clinical value to prevent and delay the development of cardiovascular complications in patients. (*Afr J Reprod Health* 2025; 29 [2]: 133-139).

Keywords: rapid rehabilitation nursing; transvaginal natural cavity endoscopic hysterectomy; velocity vector imaging; carotid artery elasticity

Résumé

Il s'agissait d'un article original conçu pour explorer les effets de l'imagerie vectorielle de vitesse (VVI) sur l'élasticité de l'artère carotide commune chez les patientes subissant une hystérectomie endoscopique transvaginale à cavité naturelle au cours de soins infirmiers périopératoires de rééducation rapide. Quarante-vingts patientes subissant une hystérectomie endoscopique transvaginale à cavité naturelle à l'hôpital universitaire affilié de Beihua de janvier 2021 à décembre 2022 ont été sélectionnées et divisées en un groupe témoin (CG) et un groupe d'intervention (IG). Le CG a adopté les soins infirmiers périopératoires de routine, tandis que l'IG a adopté les soins infirmiers périopératoires de réadaptation rapide. Par rapport au CG, l'IG présentait un taux sérique d'estradiol plus élevé, un taux de modification plus élevé de la zone de l'artère carotide transverse, un temps de pic de vitesse systolique moyen (VTTP) plus élevé et une contrainte maximale systolique moyenne (Smax) dans les six segments de paroi. Nous concluons que des soins infirmiers de rééducation rapides chez les patients ayant subi une hystérectomie endoscopique transvaginale à cavité naturelle peuvent améliorer l'élasticité de l'artère carotide commune et favoriser la rééducation des patients. La technologie d'imagerie vectorielle de vitesse peut refléter la coordination du mouvement global de la paroi du tube, ce qui présente une grande valeur clinique pour prévenir et retarder le développement de complications cardiovasculaires chez les patients. (*Afr J Reprod Health* 2025; 29 [2]:133-139).

Mots-clés: soins infirmiers de réadaptation rapide, hystérectomie endoscopique transvaginale dans la cavité naturelle, imagerie vectorielle de vitesse, élasticité de l'artère carotide

Introduction

With recent developments of minimally invasive surgery greater attention is being devoted to the postoperative quality of life and rapid recovery of patients¹. Natural orifice transluminal endoscopic surgery (NOTES) adopts the natural orifice of the

mouth, vagina, urethra along with rectum as a way for surgeons to enter a patient's abdominal cavity for endoscopic surgery. It has been widely used and popularized in the surgical field in recent years². In gynaecology, transvaginal natural orifice transluminal surgery (vNOTES), which combines laparoscopic surgery with traditional transvaginal

surgery, not only reduces postoperative pain, reduce postoperative wound infection and speed up postoperative rehabilitation, it also has the advantages of no incision in the abdominal wall, avoiding surgical scars in the abdominal wall, and bringing better cosmetic effects to patients³.

Rapid rehabilitation nursing is a nursing model that has emerged in recent years⁴. It integrates the knowledge of nutrition, anesthesiology, psychology, and nursing, combined the characteristics and personality of patients to develop nursing programs, which can ultimately comprehensively improve the nursing quality, promote the perioperative quality of life of patients, and comprehensively promote the rehabilitation of patients⁵. As a result of its unique advantages, it has recently been promoted in the nursing of many diseases^{6,7}.

Velocity vector imaging (VVI) is a new ultrasonic technology recently introduced to study the mechanics of cardiovascular structures⁸. It can visually and visually display the longitudinal, radial, and circumferential motion characteristics of vascular walls, and display the movement direction, velocity, distance, and time equality of local tube walls in vector mode⁹. Therefore, it can accurately evaluate the mechanical characteristics of tube wall movement, and sensitively reflect the changes of local vascular wall elasticity and movement characteristics in the early stage of carotid atherosclerosis¹⁰. However, until now, there have been limited studies on the function of arterial elasticity in patients with transvaginal natural cavity endoscopic hysterectomy using VVI technique.

The objective of this study, was to explore the impact of VVI on common carotid artery elasticity in patients with transvaginal natural cavity endoscopic hysterectomy during perioperative rapid rehabilitation nursing. Our study novelty demonstrate that rapid rehabilitation nursing in patients with transvaginal natural cavity endoscopic hysterectomy, can improve the common carotid artery elasticity and promote the rehabilitation of the patients, which provide the reference for clinical nursing of patients. Meanwhile, VVI technology can reflect the coordination of the overall movement of the tube wall, which is of great clinical value to prevent and delay the development of cardiovascular complications in patients.

Methods

Eighty patients undergoing transvaginal natural cavity endoscopic hysterectomy in Affiliated Beihua University Hospital from January 2021 to December 2022 were chosen and randomly divided into a control group (CG) and an intervention group (IG). Each group had 40 patients. As shown in Table 1, there were no significant differences in the sociodemographic characteristics between the two groups ($P>0.05$, Table 1).

The inclusion criteria were: (1) All patients met the disease criteria as published in the Guidelines for Diagnosis and Treatment of Diseases in Obstetrics and Gynecology (2nd Edition)¹¹; 2) transvaginal natural cavity endoscopic hysterectomy was used; 3) no history of abdominal or gynaecological surgery; (4) benign lesions, and 5) provided informed consent. The exclusion criteria were patients with: (1) endometrial and cervical malignancies; (2) patients with severe organ damage; (3) no clear indication of laparoscopic surgery; (4) diseases of the heart, liver, lung, kidney, and brain function and (5) diabetes and lower extremity deep vein thrombosis.

Treatment methods

The patients were placed in the lithotomy position; general anesthesia was given, and an indwelling urethra catheter was placed. The patient's cervix was clamped and gently pulled, and the cervical junction mucosa was incised with an electrotome. The cervico-uterine junction was bluntly separated from the cervical bladder, and the bilateral vesicocervical ligaments were exposed, cut, and sutured. The cervicorectal space was bluntly separated, exposing the patient's bilateral sacral major ligaments. The operation platform of single-hole laparoscope was implanted and artificial pneumoperitoneum was quickly established. The conditions of the uterus were explored under laparoscopy. For those who retained the appendages, bilateral uterine blood vessels and loose tissues of the uterus were cut with coagulation from bottom to top, and then the bilateral uterine ligaments, isthmus of the fallopian tube and round ligaments were separated by coagulation.

The uterine adnexa were removed by coagulation of uterine vessels, followed by the

removal of parametrial tissues, fallopian tubes, the ovaries, ligaments and round ligaments of uterus. Finally, the wound was rinsed and checked for active bleeding. The operating platform was withdrawn, the uterus and other specimens were removed from the vagina, and the vaginal stump was sutured with 1-0 absorbable thread.

Nursing methods

The CG adopted perioperative routine nursing. Preoperative preparation and intraoperative monitoring work were carried out. After the operation, patients were given routine postoperative education and discharge guidance.

In contrast, the IG adopted perioperative rapid rehabilitation nursing using the following specific approaches:

(1) Personalized education was conducted for patients before surgery to reduce their anxiety, improve their initiative and compliance, and achieve the best psychological state. On the day before surgery, liquid food was given, polyethylene glycol electrolyte was employed for catharsis, and 200 ml 10% glucose was taken orally 2 hours before surgery.

(2) During the operation, patients were kept warm by increasing the room temperature with heat pump to avoid hypothermia and chills during the operation.

(3) Based on patient's actual situation, the patient's self-care ability along with psychological state were scientifically assessed, the patient was given targeted disease rehabilitation guidance, and the impact of adverse conditions such as anxiety and fear on postoperative recovery was emphasized for the patient, so as to maintain a healthy mental state. Besides, intravenous pump analgesia was used after surgery. Patients were instructed to roll over in bed, stretch their limbs, and exercise their ankle pump 6 h after surgery. Patients were encouraged to get out of bed and move their limbs on the same day to prevent thrombosis. On the second day after the operation, the catheter was removed and the patients moved normally to urinate and defecate when possible. In the early postoperative period, the patients were given small amount of water according to the situation, followed by liquid food, and with gradual migration to semi-liquid food and normal diet.

Detection of estradiol (E2)

Five ml of fasting venous blood was acquired in the morning 3 months after the operation, and the serum level of E2 was measured by electrochemiluminescence immunoassay¹².

VVI examination

The instrument was Siemens S2000 color Doppler ultrasonic diagnostic instrument, equipped with AxisTMVVI on the machine analysis software, select L9-4 probe, frequency 8 ~ 14 MHz. The patient was placed in a supine position with a pillow behind the neck, the neck was fully exposed, and the head was tilted to the opposite side for examination. Calm breathing was performed. The common carotid artery was scanned from top to bottom on the long axis and short axis, and the short axis section was taken 4 cm below the level of the common carotid artery bifurcation. Carotid intima-media thickness (IMT) > 1.2 mm was defined as plaque. The probe measured IMT perpendicular to the skin. The patients were asked to hold their breath, and two-dimensional dynamic images of three cardiac cycles were collected and stored for offline analysis by the supporting VVI workstation. The left ventricular ejection fraction (EF) and stroke output (SV) were measured by echocardiography to determine ventricular systolic function.

After replaying the collected two-dimensional dynamic images, VVI automatic analysis software was employed to fix the images of the short axis of the common carotid artery in the diastole period. The carotid artery wall was traced point by point along the intima of the blood vessel. The system automatically divided the carotid artery into six segments, and gave the time-to-peak (TTP) of each segment, and extracted the maximum systolic period of the movement velocity, strain and strain rate curves of each tracing point in 3 cardiac cycles.

Statistical analysis

SPSS 20.0 statistical software was utilized for data analysis. The measurement data were exhibited by ($\bar{x} \pm s$), and analyzed by t test. The count data was expressed as rate (%), and χ^2 test was implemented for comparison. $P < 0.05$ meant the difference was statistically significant.

Ethical considerations

All patients included in this study signed the informed consent. This study was approved by the Ethics Committee of Affiliated Beihua University Hospital in December 2020.

Results

Blood pressure, heart rate, EF, SV and IMT in both groups

There were no significant differences in blood pressure, heart rate, EF, SV and IMT between both groups ($P > 0.05$, Figure 1).

Serum level of E2 in both groups

Before nursing, no significant difference was discovered in serum level of E2 in both groups ($P > 0.05$). After nursing, the serum level of E2 decreased in both groups, but relative to the CG, the IG had higher serum levels of E2 ($P < 0.05$, Figure 2).

VVI analysis results

As shown in Figure 3, the results indicate that relative to the CG, the IG had higher change rate of transverse carotid artery area ΔS ($P < 0.05$), higher mean systolic velocity peak time (VTTP), and mean systolic maximum strain (Smax) in the six wall segments ($P < 0.05$). The average maximum systolic velocity (Vmax) and average maximum systolic strain rate (SRmax) of the six wall segments were not significantly different between 2 groups ($P > 0.05$).

Discussion

Rapid rehabilitation nursing is a new nursing concept, which applies various means in perioperative period to reduce the stress response of patients, ensure the smooth operation of patients, and promote postoperative rehabilitation of patients¹³.

Estrogen can significantly improve vascular endothelial function¹⁴, and the change of arterial elastic function may be the earlier change of arteriosclerosis, which is the basis for the development of cardiovascular and cerebrovascular diseases¹⁵. Numerous reports have shown that estrogen has a vital role to play in cardiovascular and cerebrovascular diseases^{16,17}. In our study, the serum

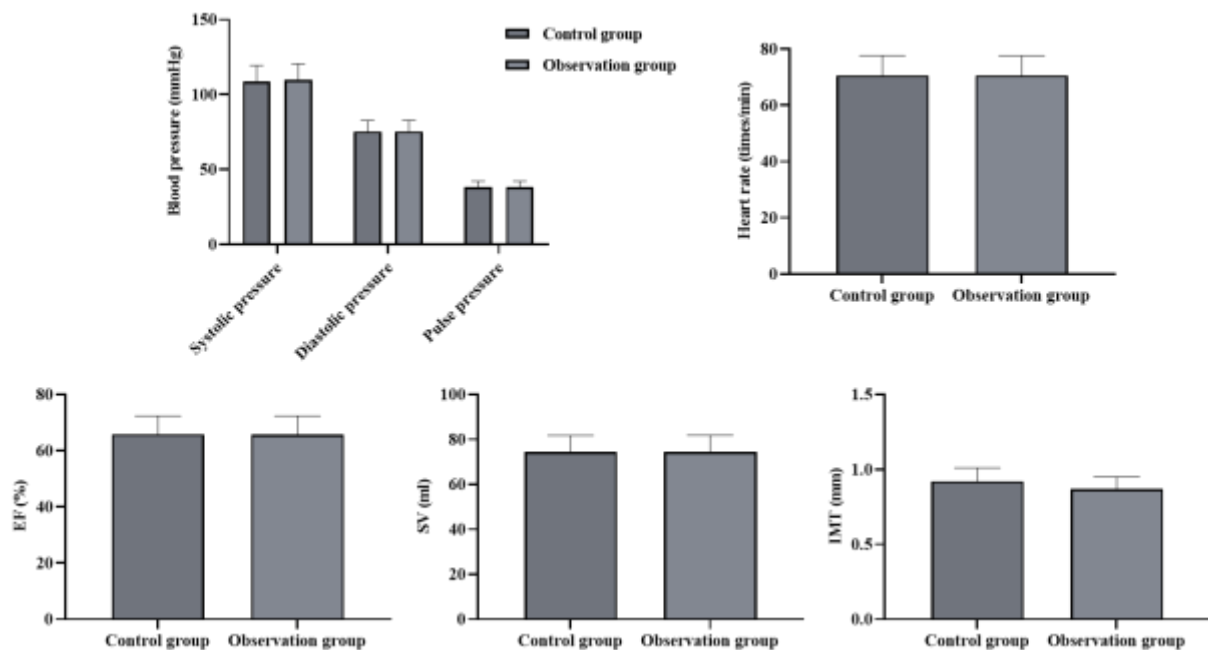
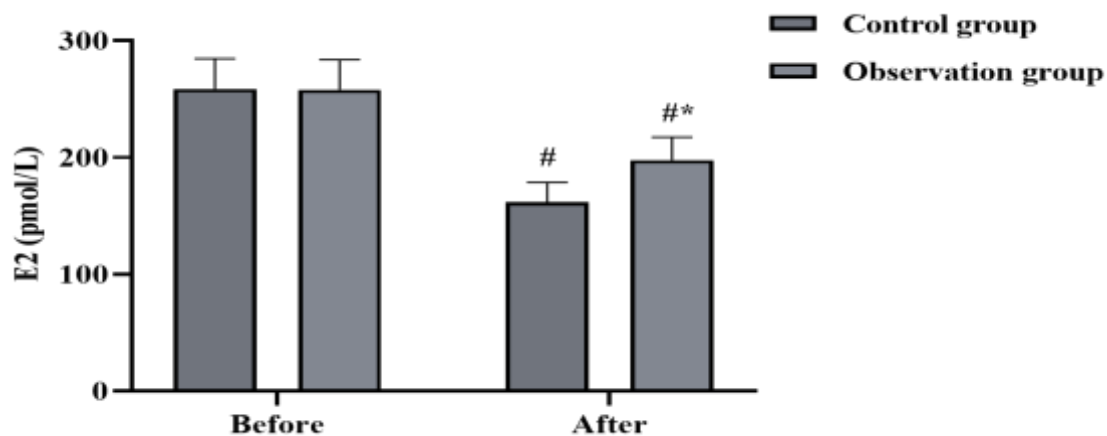
level of E2 in both groups declined after transvaginal natural cavity endoscopic hysterectomy, with that in the IG more elevated as compared to the CG, which suggest that rapid rehabilitation nursing could improve the estrogen level of patients undergoing transvaginal natural cavity endoscopic hysterectomy, and the common carotid artery elasticity of patients in the IG may better as comparing with the CG.

There are many markers applied to reflect arterial stiffness, and the measurement techniques and methods are varied¹⁸. VVI technology is developed for the study of myocardial movement. It uses the spatial phase, point tracking and boundary tracking of ultrasonic pixels, independent of angle, and can reflect myocardial movement more accurately and comprehensively¹⁹. It can also be applied to evaluate the stiffness of the great arteries because it has high temporal and spatial resolution and is suitable for the detection of common carotid artery velocity at any time during the cardiac cycle²⁰. Any object will be deformed under the action of external forces, if the deformation energy of the object fully disappears after removing external forces, and then this object is an elastic body, elastomechanics studies the law of force and deformation²¹. In addition, when the object is deformed by force, the degree of deformation at each point in the body is generally not the same. S is a mechanical quantity that describes the degree of deformation at a point²². The rate of alteration of S over time is called SR , which is a measure of the rapid deformation of an object²³. Carotid artery wall is rich in elastic membrane and elastic fiber, which is a typical elastic artery. The S and SR of the carotid artery wall reflect the biomechanical properties of the elastic artery and are directly related to its wall elasticity, that is, the ability of the artery wall to deform after the heart pumps blood²⁴.

The results of our VVI analysis indicate that relative to the CG, the IG presented higher change rate of transverse carotid artery area ΔS , and higher mean VTTP and mean Smax in the six wall segments. Several studies have pointed out that with decreases in hormone levels, the composition of blood vessels begins to change, the elastic components of blood vessel walls decrease, the flexibility of blood vessels decreases, the internal stress of blood vessel walls increases under the action of blood pressure, and the arterial diastolic function decreases²⁵.

Table 1: General data of patients in both groups

Items	Control group (n=40)	Intervention group (n=40)	P value
Average age (years)	53.6±5.4	53.7±5.5	0.9
Average BMI (kg/m ²)	23.3±2.5	23.2±2.6	0.9
Uterine fibroids	14	15	
Adenomyopathy	20	18	
Endometrial atypical hyperplasia	3	4	
Types of disease	Cervical intraepithelial neoplasia grade III	3	0.9

**Figure 1:** Blood pressure, heart rate, EF, SV and IMT in both groups.**Figure 2:** Serum level of E2 in both groups. #P<0.05, compared with before nursing, *P<0.05, compared with the control group.

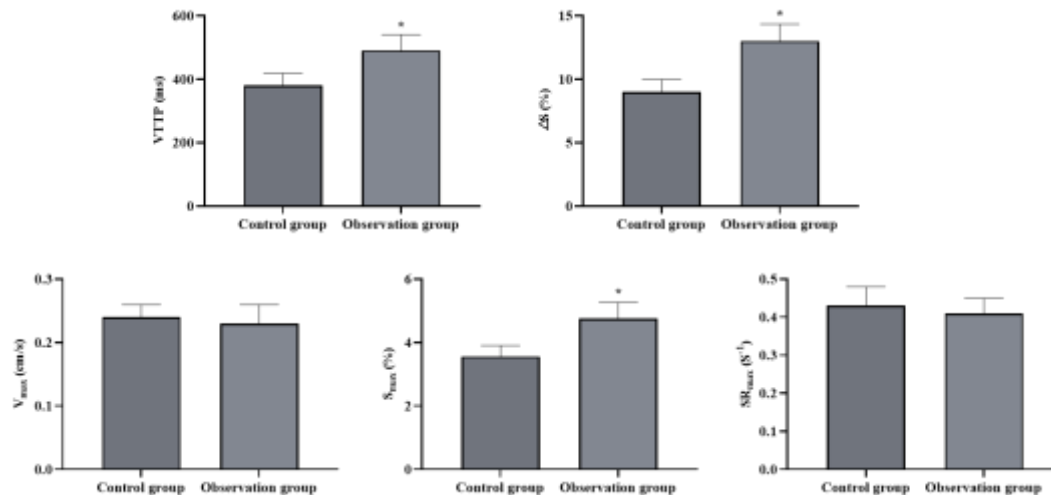


Figure 3: Carotid artery biomechanical index in both groups. *P<0.05.

Study strengths and limitations

Strengths include the application of VVI technology, the randomized grouping and the assessment of common carotid artery elasticity, which may provide valuable reference for clinical nursing of patients with transvaginal natural cavity endoscopic hysterectomy and prevention of cardiovascular complications. This study was conducted with a small sample size and short follow-up time; therefore, interpretation of the results requires great caution.

Conclusion

Rapid rehabilitation nursing has a definite effect in patients with transvaginal natural cavity endoscopic hysterectomy, which can improve the common carotid artery elasticity and promote the rehabilitation of the patients. Moreover, VVI technology can intuitively and sensitively reflect the coordination of the overall movement of the tube wall, so that further research can be conducted on the damage of the artery wall caused by various reasons, so as to guide the clinical early evaluation of arteriosclerosis in cardiovascular and cerebrovascular sub-healthy people, delay aging, improve arterial elasticity, and prevent the development of complications of cardiovascular and cerebrovascular diseases.

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Contribution of authors

Yuan J and Wu YF: conceived and designed the study. Qiao YQ and Lin YR: collected and analysed the data. Yuan J and Wu YF: prepared the manuscript. All authors mentioned in the article approved the manuscript.

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