

An observation of a hysteroscopy teaching program for standardized training of obstetrics and gynecology residents

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Abstract

Background: Standardized training for resident (STR) program in China is an important link for continuing education and clinical work training for students who graduated from medical college. Bedside teaching rounds (TR) has a valuable educational merit for residents. Hysteroscopic surgery (HS) is a single-person operation which is difficult for beginners. The purpose of our study was to enable educators to maintain effectiveness of hysteroscopy surgery teaching techniques through teaching rounds for practical training in hysteroscopy surgery in order to train the residents to acquire the theoretical and surgical operations skills. **Methods:** From August 2017 to August 2018, a total of four attending gynecologic surgeons, seven junior residents, and five senior residents of the Department of Obstetrics and gynecology, Shanghai General Hospital were invited to complete an observation of a hysteroscopy teaching program, which included TR and HS, under the guidance of instructors. TR mainly consisted of video-based education and problem-based learning (PBL) discussion. Data of retrospective analysis were collected from 112 patients who participated in the program. We generated evaluation and theoretical tests and open-ended questions based on TR and HS to observe the mastery degree of students. **RESULTS:** Residents learned effectively through the teaching round, which met the demands of different developmental strategies for trainees. There were statistically significant differences in the whole operation time (21.00 ± 0.92 min vs. 30.56 ± 1.08 min, respectively, $P < 0.05$) and the volume of distension fluid used (480.00 ± 14.76 ml vs. 642.74 ± 14.82 ml, respectively, $P < 0.05$) between junior and senior residents. We observed residents participated more TR before they finished their HS program conducted more skilled hysteroscopic operation. All the residents believed TR could help improve their surgical skills in HS through open-ended questions survey. **CONCLUSIONS:** It is important to improve the theoretical knowledge of resident physicians in the surgical department before the actual operation. The purpose of this retrospective study is to assess the teaching role in TR and practical hysteroscopic training program to help trainees gain professional and clinical skills, as well as enable teachers to formulate educational techniques.

Background

Medical graduates are not fully trained physicians when they leave medical school, so it is very important to build a connection between theoretical learning in college and practical training in hospital. Standardized training for resident (STR) program in China is an important link for continuing education and receiving system-based clinical work training for students who have completed basic theoretical courses in a medical college. It is defined as residents who participate in different departments according to the schedule, and carry out systematic clinical basic training for three years. Residents are divided to grade 1, grade 2 and grade 3 by the years they trained. Junior residents were defined as those in the Grade 1 to 2 resident standardized training stage which correspond to the first to second year of postgraduate training, while senior residents were defined as those in Grade 3 resident standardized training stages in the third year of postgraduate training. Taking example for residents in obstetrics and gynecology department, they need to do clinical rotation in the gynecological ward, obstetrics ward and outpatient department each for 4 month in Grade 1, in gynecological ward and obstetrics ward each for 6 month in Grade 2, while in gynecological ward and obstetrics ward each for 3 month in Grade 3, and in general surgery ward and pediatrics ward as well as medical imagery department each for 2 month.

The training process comprise standardized courses to facilitate acquisition of the required skills; In Grade 1, the basic skills will be trained and in Grade 2 to 3, the clinical skills and theoretical knowledge will be thoroughly studied and mastered. The residents should pass the theoretical and operating comprehensive examination before they graduate from the standardized training for resident (STR) program, then they could become a specialist doctor. Currently, STR is conducted in progress in most hospitals according to the Ministry of Health guidelines, while educators have long struggled with how best to act in teaching and fulfill the professionalism[1]. In China patients have always been prejudiced against young doctors as residents lacked adequate experience. Once a surgical complication develops, it causes disputes with patients. Therefore, senior doctors do not dare to allow residents performing an operation, making surgical training even more difficult. Thus, a more effective and faster independent operation education is required for training of residents. In order to make these residents well trained, the clinicians should be professionalism not only in clinical treatment but also in teaching, which request them to master well method in education.

Hysteroscopic surgery (HS) is an important subject taught in the STR program during residents doing clinical rotation in gynecological ward. It is a vital technique for identifying many typical manifestations of gynecological diseases, such as uterine anatomy, normal and abnormal uterine morphologies, dysfunctional uterine bleeding, endometrial polyps, endometrial hyperplasia, submucosal uterine fibroids, endometrial cancer, mediastinal uterus, intrauterine adhesions, and foreign bodies in the uterine cavity. However, compared with traditional open and laparoscopic surgeries, HS is a single-person operation that has a certain degree of surgical difficulty for beginners and requires a relatively long learning process; therefore, it is a great challenge for teachers to physically show a trainee how to accomplish a hysteroscopic motion rather than describe how to do it.

Generally, gynecologic STR units in teaching hospitals use traditional teaching methods and encourage young doctors to develop intraoperative skills that are classified into the following three categories: (1) teaching: the verbal explanatory stage like teaching rounds(TR); (2) directing: the verbal commanding stage, and (3) assisting: encompassing the physical guidance stage[2]. Different from the theoretical knowledge taught in medical school, TR was conducted in hospital so that residents could learn through real clinical cases, there are two stages of teaching rounds(TR) instructions: taught at the bedside and taught in the classroom. The first stage is bedside teaching, in which the trainees can observe behaviors of all teachers with respect to how they handle introductions, address patients' concerns, elicit key details, and ask permission to examine and explain symptoms[3]. The second stage includes complex discussions on the purpose and management, where the trainees can sit down and teachers can take advantage of the Microsoft Office PowerPoint (PPT) slide or multimedia video to explain the procedure or problem-based learning (PBL) discussion about their own concerns[4]. After theoretical teaching, the residents perform practical training for hysteroscopy surgery. Teaching quality assurance during

hysteroscopic endoscopy often necessitates guidance from expert instructors side by side to accompany with the residents, and explain the surgical procedure and considerations[5].

Although the importance of resident physician training has been well-demonstrated, only a few formal hysteroscopic training opportunities exist for residents to learn effectively. On the other hand, residents did clinical rotation one after another in different wards during different periods, they might not have attended all the topic of hysteroscopy teaching rounds before they actually operate. In this project, we talk about theoretical knowledge of the HS which was taught not only before the surgery by TR, but also during the produce of operation. We planned to arrange a HS training project for residents including TR with different pattern and surgery direction, and discuss which pattern of TR is more important for practical training in hysteroscopy surgery for obstetrics and gynecology resident physicians. Our aim was to both assess the effectiveness of teaching techniques for educators in a hysteroscopy teaching program and to train the residents for acquiring the theoretical and surgical operations skills. Therefore it is more important for teachers not only to teach surgical residents how to accomplish an operation but also to ensure that they acquire theoretical and basic clinical knowledge.

Methods

Residents and Teachers attending the program

We invited 4 attending gynecologic surgeons as directors and 12 residents, including 7 junior residents(J1,J2,J3,J4,J5,J6,J7) and 5 senior residents(S1,S2,S3,S4,S5), to participate in this study. J1-4 were in Grade 1, and J5-7 were in Grade 2, while all the senior residents S1-5 were in Grade 3. The residents did hysteroscopic operation during their clinical rotation in the gynecological ward and had attended all of the TR courses even if they were in other wards. The gynecologic surgeons who attended the STR program was participated as educators, among whom 2 were males and 2 were females.

Teaching Rounds(TR)

All resident physicians had attended TR in which theoretical knowledge, operational procedures, and precautions were taught. Actual typical hysteroscopy cases among hospitalized patients were selected under the guidance of a responsible senior physician, and all the 6 courses of TR were divided into the following three sections within 1 hour: Firstly, the teacher explained the purpose of the rounds and the key knowledge that the students need to gain in the classroom. Then, the residents reported the medical history and performed physical examination at the bedside[6]. Finally, the teacher systematically described the basic knowledge of hysteroscopy either through PPT descriptions, multimedia video or PBL discussion. We conducted theoretical tests within one week after each TR to observe the mastery degree of students. Scores were according to the mastery degree of the knowledge: Very Good:18-20, Good: 15-17, General: 10-15, Bad: <10.

Hysteroscopic Operation

To prepare for a practical hysteroscopic operation, the resident surgeons were instructed to review the patient's history, diagnosis, contraindications and indications. Over a period of 12 months, 112 patients met the inclusion criteria. Sixty-two patients were operated upon by 7 junior residents and fifty patients were operated upon by 5 senior residents. All HS procedures were performed by residents under the supervision of general gynecologists who were arranged to teach on a one-on-one basis.

Survey on the HS teaching program

The teachers gave the evaluation based on the mastery level of the student after the HS teaching program. To develop the question route, we also generated open-ended questions based on TR and HS.

Statistical Methods

Each enrolled attending resident physicians and doctors abstracted the medical records. Comparisons were performed by using the t-test or the Mann-Whitney test, and skewed data were compared by using the Fisher's exact test. All p values less than 0.05 were considered statistically significant, and all p values were two-sided.

Results

Teaching rounds(TR)

Reviews of all details of HS during monthly (2-month) TR managed by four involving teachers were a valuable teaching experience, since surgical director doctors in particular unique challenges in educating trainees to gain specific theoretical knowledge prior to performing a hysteroscopic surgical intervention through TR, and the trainees also needed to follow a clear educational plan in advance. Each teaching round had a focus of meeting the demands of different development strategies for trainees so that they learn effectively. As a result, in all of the TR, teachers analyzed the causes, symptoms, signs, ultrasound reports, lab data, diagnosis, and treatments that require further observation, which could help in hospitalization at the bedside. Since observation of the clinical product could be a powerful tool to develop teaching skills, in the 1st, 2nd, 3rd, 4th and 6th course, the standardization process consisted of a videotaped HS by an experienced teacher so that the trainee could follow the procedure. Video-based education has potential for use in surgical education as trainees face significant barriers in their practice. Use of video settings in surgical education offered sufficient opportunities to integrate theoretical and clinical understanding. Hysteroscopic two-dimensional image display system videos were commonly used for residents who were unfamiliar with hysteroscopy. In the 3rd, 5th and 6th of the TR course, we added PBL discussion which based on specific cases, the students conducted discussion on points such as “Is it suitable for HS?”, “What are the complications of HS?”, and finally, the group leader reviewed the analysis. During PBL class, physicians combined theoretical knowledge with practical operations to stimulate student enthusiasm to improve the residents’ ability to handle practical problems (Table 1).

Within one week after each TR, we arranged a test to observe if residents have grasped the lesson, and teachers explained the answers and reviewed. As to junior residents, they got the mean score 10.7 in the first test, and 14.4 in the second test, we observed the more courses residents attended, the higher scores they achieved among junior residents (Table 2). Senior residents received higher scores (mean, 104) than junior residents (mean, 92) (Figure 1).

Table 1 Focus of the categories of TR

Table 2. Theoretical test scores after each TR

Hysteroscopic surgery (HS)

After the students had mastered theoretical knowledge and basic operational skills related to hysteroscopy through TR, they tried to follow the hysteroscopy practical training stage. We arranged suitable uterus diseases for residents according to the European Gynecologic Endoscopy Association. The training in hysteroscopy surgery is divided into the following three levels: primary level, which is suitable for the junior and senior residents, mainly for the diagnosis and simple operation, such as intrauterine fixed-point biopsy, removal of an intrauterine device, and mild intrauterine adhesions[7]. In order to maintain operational skills, all the residents completed the whole operation with the directing teacher guiding beside and solving problems at any time during the surgery.

Educators were encouraged to teach the principles to trainees[8] and teach hands-on, cultivate good operating habits in the residents, correct the wrong methods in time. For example, the junior learner J1 and J2 in grade 1 was taught to explore the uterine cavity or to dilate the cervix “hand by hand” under the guidance of a directing teacher at the first time. Teachers helped to develop the residents’ control and direction of the hysteroscopic operating device in the uterine cavity. When the residents faced difficult removal of intrauterine device and extraction of endometrial polyps, the teachers would help them to locate with a clamp.

The directors try to avoid the occurrence of intraoperative complications, including control the surgery time to less than 1 h to minimize the occurrence of complications. In clinical observation, fluid overload caused by longer operation time means excessive use of fluid in patients in HS which usually result in symptom of bloating as a result of the fluid in the uterine cavity enters the pelvis through the fallopian tube. In addition, the air in the tube needed to be removed and the pressure of the expansion valve and the flow rate of the perfusate were controlled to avoid serious complications following hysteroscopy such as air embolism, and the cutting depth was controlled to avoid cutting of excessive myometrial tissue.

After the operation was completed, procedure notes were reviewed with respect to trainee participation and postoperative analysis was performed. The mean patient age was 51.78 years (range = 29–71 years), the mean menopause age was 3.8 years (range = 0–26 years), and the mean intrauterine depth was 7.22 cm (range = 5–9.5 cm). In this patient population, 62 procedures (60.6%) were performed by involving junior resident trainees and 50 procedures (39.4%) were performed by involving senior resident trainees. Patient characteristics were summarized in Figure 1. There was no significant difference between junior residents and senior residents in terms of patient age (51.68 ± 1.14 vs 51.92 ± 1.38 , $P=0.90$) (Figure 1A), menopause age (3.48 ± 0.65 vs 4.20 ± 0.80 , $P=0.50$) (Figure 1B). Since the directing teacher guided the residents to conduct the operation on-side, we compared operative time and distension fluid to calculate the time teacher spent to direct them beside. There were statistically significant differences in whole operation time (min) and volume of distension fluid used (ml) between junior residents and senior residents. Whole operation time with involvement of junior resident trainees was more likely to be longer than that with involvement of senior resident trainees (30.56 ± 1.08 min vs 21.00 ± 0.92 min, respectively, $P<0.05$) (Figure 1C). Junior residents involved in the procedures were more likely to use greater volume of distension fluid (ml) than senior residents when conducting HS procedures (642.74 ± 14.82 ml vs 480.00 ± 14.76 ml, respectively, $P<0.05$) (Figure 1D), mainly because teachers spent more time to instruct junior residents than senior residents, who had accepted the guidance when they were in their junior grade. In addition, we did not find any correlation of procedures performed with involvement of junior residents and senior residents with intrauterine depth (7.22 ± 0.13 vs 7.17 ± 0.18 , $P=0.84$) (Figure 1E), uterus position ($P=0.29$) (Figure 1F), post-operative vaginal bleeding ($P=0.49$) (Figure 1G), and pathology ($P=0.86$) (Figure 1H). Only one case of uterine perforation occurred after HS conducted by a senior resident to transit hysteroscopy surgery in all operations (0.89%).

Survey on the HS teaching program

The times of the TR courses when each resident participated in the gynecological ward was shown in Table 3. The teachers gave the evaluation based on the mastery degree of the student, which was divided into unskilled, general and good according to the residents' control and direction of the hysteroscopic operating device in the uterine cavity, the ability do uterine curettage as well as the whole operation time used. We observed residents participated more TR before they finished their HS program conducted more skilled hysteroscopic operation (Table 3). As to the junior residents J1 and J2, they were unskilled at the initial time to do uterine curettage, with the increase times of attending TR, junior residents J3, J4, J5, J6 and J7 became more and more skilled. Senior residents had attended similar TR when they are junior, so most of them were skilled.

Table 3 The times of courses of the TR each resident participated in the gynecological ward;

To develop the question route, we also generated open-ended questions based on TR and HS to both teachers and residents, feedback was received on the structure of the questions. All the residents believed TR could help improve their surgical skills in HS. Junior residents preferred video based TR because they could follow the process, or review the videotapes of complex surgical procedures after completion of surgery offered additional teaching opportunities and creates educational conversations. The senior residents preferred PBL based TR since they could discuss their interesting content. Most junior residents hope to finish all the TR courses before they operate, while senior residents consider it was difficult to finish all the lesson before they operate because of the actual rotation plan. All the residents believed the HS teaching program was focused on their own concerns. Junior residents regarded that one of the most difficult part of hysteroscopy was dilation of cervix. The instructors would help them adjusting the direction when they had difficulty in tracting the cervix and exploring the uterine. Another difficult thing for residents was removal of intrauterine device and extraction of endometrial polyps because they usually felt hard to locate with a clamp (Table 4) .

Table 4 Different attitude towards the senior and junior resident in the interviews;

When the HS program finished, we ranked a list of potential concerns between the teachers and residents concluded challenges to good clinical rounds and HS based on responses from the focus group discussions (Table 5). On completion of the above-mentioned steps, the residents reported learning strategies, and they largely felt more comfortable with their role as a surgeon and were interested in receiving further training in this subject matter. There was also a need to pay attention to teachers' and students' motivation with teaching time. By adopting and promoting this model of interprofessional collaborative practice, the quality and effectiveness of bedside TR and HS guidance could be improved for the benefit of patients, trainees, and the instructor team as a whole.

Table 5 Challenges to good clinical rounds and hysteroscopic surgery based on responses from the focus group discussions;

Discussion

In clinical teaching process, we were usually confused with the situation that although teacher teaches the same contents, different students had different comprehension and master level. Was this just because students had different degrees of ability or it also related to teaching methods? We believed it was related to the teaching methods. Accreditation Council for Graduate Medical Education core competencies expects surgery residents to acquire advanced skills in each of the following six aspects: patient care, medical knowledge, professionalism, evidence-based practice, communication skills, and system-based practice which were available on the ACGME website (www.acgme.org). In addition to these advancing skills, teaching surgeons have to fulfill multiple competing responsibilities to help junior and senior residents developing clinical and technical skills and participate in surgery.

The use of clinical rounds, as an integral part of clinical teaching to help medical students acquire essential skills of practicing medicine, is critically important. The significance of teaching medical students at the bedside was also formerly accentuated by Sir William Osler, the father of modern medicine, his statement on bedside teaching to modern medicine was highly acknowledged: "To study the phenomena of disease without books is to sail an uncharted sea, while to study without patients is not to go to sea at all". It was noted that "Twelve Tips to Improve Bedside Teaching," which included preparation, priming of the patients, assignment of roles, establishment of expectations, roadmap, focus of the encounter, patients' notes, bedside teaching, role-model, summarize, feedback, and reflection, were conducive for residents skilled in basic operations[9].

Learning at the bedside through interactions among the healthcare team with patients not only fosters the medical students' ability to perform physical examination skills, but also helps medical students to gain more experience though history taking and physical examination techniques when it comes to clinical data gathering and clinical decision making. An understanding of medical teachers' perceptions concerning the challenges of different forms of clinical rounds can help identify the key areas of focus to better foster professional development of medical students [10]. Video is one of the most effective tools that provide numerous visual cues for surgical performance. It was reported that video-based education is superior to conventional education since watching an instructional video before surgery may shorten the learning curve of trainees and improve the safety [11, 12]. In our project, medical educators provided basic theoretical and practical teaching methods using multimedia video and PPT descriptions combined with on-site observation mainly included treatment and diagnostic value of hysteroscopy as well as hysteroscopic procedures, and the junior residents considered video descriptions help them a lot in the actual operation.

There are three stages of motor skill acquisition, which include the cognitive, associative, and autonomous stages, which means resident's learning process from accepting basic theoretical courses in a medical college, to problem-based learning. Residents' learning was not only dependent on the

teaching expertise of their attending surgeons, but also more likely to be effectively if the teaching focused on their own concerns[13]. Therefore, teachers need to both teach and interact with students to motivate them explicitly as well as encouraging them to identify their uncertainties and questions that might improve the coaching efficiency. In recent years, PBL discussion method has played specific roles to maintain the interest of each resident, and has ensured adequate rotation between learners. PBL provided a good effect on clinical teaching in our program, which started with clinical practical problems and developed the theme with more detailed practical tips and up-to-date references. In our interviews with the senior residents, they regarded PBL discussion has broken down barriers between educators and learners, thus, ensuring efficient rounds.

After TR, the observers gave the residents an exam to test if the residents had master the knowledge, the exam transcribed the discussion mapped to the following five American College of Physicians test-ordering principles: 1. whether a diagnostic test was previously performed, 2. whether diagnostic test results would affect care, 3. whether a test result represented—or a study under consideration might produce—a false-positive result, 4. whether the patient would experience short-term harm if a test was not ordered, and 5. whether the team considered patient preferences toward a diagnostic study [14]. We observed the more courses residents attended, the higher scores they achieved among junior residents. Senior residents received higher scores than junior residents.

Checking rounds is an assessment tool in surgery[15]. Side by side teaching in the operation room is the time when most of clinical encounters and training between a medical teacher and medical students occur. In the questionnaire, all the residents believed TR could help improve their surgical skills in HS, since during TR, expert surgeons were able to explain actual surgical cases as a deliberate part, thus residents could gain more comprehensive understanding of the indications and contraindications for HS, as well as of prevention and management of complications. When resident-directed learning was more prevalent during surgery, for beginners, there might be a lack of understanding about the strength and depth of the uterus during the operation. In practice, the educators explained the principle and function of hysteroscopy instruments in the operating room. Videotaped, physical “moment-to-moment” teaching exchanges between the surgical attending physicians and their trainees could classify live surgical teaching behaviors[16]. Based on the elicited responses from our participants, teachers thought completing the whole produce of the operation with explain was important to achieve excellent surgical teaching behaviors to make it interesting for the residents. After that, residents are dominant and take the lead most of the time in the surgery, and teachers are observers of practices so that the residents could have good chance and take the responsibility of the patient. With augment of the efficacy of bedside teaching before they actually operate, there must be systematic investigations upon the current practices from the perspective of teachers and students in the clinical setting, longer operation time and higher volume of distension fluid (ml) and were required by junior residents when they conducted hysteroscopic surgeries as teachers spent more time to teach them technique. Senior residents may has implemented the similar TR course when they were in their junior grade. Senior residents only had 3 more months clinical rotation in gynecological ward than the junior residents, since they also need to rotate in general surgery ward and pediatrics ward as well as medical imagery department each for 2 month, moreover, they also need to learn other surgery like laparoscopic, the number of hysteroscopic procedures they perform was not much more than that of the junior students. Therefore, we considered teaching intervention is the reason for the improvement in the mastery level of surgery.

Evidence shows that medical educators cannot ignore the students’ affective domain as attitudes and values are also cornerstones of medical education training[17]. In our HS teaching program, the educators showed increased understanding after TR and operation for the following topics: (1) knowledge gaps related to education; (2) the role of education among academic surgeons; (3) educational tools to improve teaching performance; and (4) perceived knowledge and attitudes towards teaching in the operating room.

The work presented in this study was preliminary, and it aimed at assessing the efficient of hysteroscopy teaching under faculty supervision during the basic surgical procedure. The limitation of our study is a small sample size, which thereby limits the detection of between-group differences. Additional studies are recommended, and the residents should be able to perform HS efficiently when they are operating independently in the future. Larger studies are needed to further explore the potential links among on-round TR, acquisition of high-value care principles by the trainee, and patient outcomes.

Conclusions

Professional development programs for surgeons should consider the teaching methodology to support the aim of teaching. It is important to improve the theoretical knowledge of resident physicians in the surgical department before the actual operation. It was noted that the higher the efficiency of teaching, the better proficiency for surgery. Thus, this study acknowledges the need for new approaches to medical education for better characterization of the link between the use of teaching rounds like surgical videos, PBL discussion and overall surgical skills of teaching and learning. We believe that more medical teachers should take part in faculty development programs, especially training in medical education, when they start their professional career.

Abbreviations

STR Standardized training for resident

TR teaching rounds

HS hysteroscopic surgery

PBL problem-based learning

Declarations

Author's contributions:

Yang Y analyzed and interpreted the patient data regarding the hysteroscopic surgery teaching programme. Li YL, Yang YB and Zhu YP collected information and participate in teaching. Wu Sf and Bao W worked equally as major contributor in writing the manuscript. All authors read and approved the final manuscript.

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Ethics and consent to participate

We confirmed that written informed consent was obtained from all participants.

We ensured the nature of the consent written was clearly indicated in the statement. All authors have read and approved this version of the article, and due care has been taken to ensure the integrity of the work. Our study did not involve human participants and reporting health related outcomes. This study had been approved by ethics committee of Shanghai General Hospital, Shanghai Jiao Tong University School of Medicine

Competing interests:

The authors declare that they have no competing interests.

Availability of data and material:

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

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Tables

Table 1 Focus of the categories of teaching rounds

| Case | Date | Theme of TR | Diagnosis | Focus | Main Methods in Section 3 |
|--|---------|---|--|--|---------------------------|
| 1 | 2017.8 | Indications and contraindications of hysteroscopic surgery | Dysfunctional bleeding, endometrial thickening | Treatment and diagnostic value of hysteroscopy in endometrial diseases and submucosal fibroids, patients with poor general condition are a contraindication for hysteroscopy | Video, PPT |
| Test 1: Treatment and diagnostic value of hysteroscopy in endometrial diseases? | | | | | |
| 2 | 2017.10 | Hysteroscopic surgical procedure and instrument assembly | Endometrial polyps | Hysteroscopic procedures: disinfection, dilatation of the cervix, etc. After observing the location of endometrial polyps, clamp the endometrial polyps by an oval clamp | Video |
| Test 2: Hysteroscopic procedures | | | | | |
| 3 | 2017.12 | Hysteroscopic resection of uterine submucosal fibroids | Uterine submucosal fibroids | Cut the submucosal fibroids in the uterine cavity by an electrode ring | Video, PBL |
| PBL questions: | | | | | |
| (1) What is the indication and complication of using electric-cutting function of hysteroscopic? | | | | | |
| (2) How to prevent the complication of using electric-cutting function of hysteroscopic? | | | | | |
| (3) How to use the electric-cutting function of hysteroscopic? | | | | | |
| Test 3: Indication and complication of using electric-cutting function of hysteroscopic | | | | | |
| 4 | 2018.2 | Treatment of hysteroscopic complications | Postmenopausal endometrial thickening | Slowly dilate the cervix, explore the location of the uterus, etc. to prevent uterine perforation. | Video, PPT |
| Test 4: Treatment of hysteroscopic complications | | | | | |
| 5 | 2018.4 | Problem-based learning (PBL) discuss | Endometrial cancer | Scratch gently to prevent uterine perforation, control the pressure of the uterine cavity to prevent tumor tissue from escaping through the fallopian tube | PBL |
| PBL questions: | | | | | |
| (1) How to prevent uterine perforation? | | | | | |
| (2) If uterine perforation happened in hysteroscopic produce, how to solve? | | | | | |
| (3) How to communicate complications with patients and their families? | | | | | |
| Test 5: How to prevent uterine perforation? | | | | | |
| 6 | 2018.6 | The impact of hysteroscopy in the diagnosis of mediastinal uterus | Mediastinal uterus | Perform MRI examination in advance | Video, PBL |
| PBL questions: | | | | | |

(1) What is the impact of hysteroscopy in the diagnosis of mediastinal uterus?

(2) How to resect mediastinal uterus?

Test 6: The impact of hysteroscopy in the diagnosis of mediastinal uterus

Table 2. Theoretical test scores within one week after each teaching rounds

| No | Grade | Sex | Test (Score) | | | | | | |
|------------------|-------|--------|--------------|-------|-------|-------|-------|-------|-------|
| Junior Residents | | | 1(20) | 2(20) | 3(20) | 4(20) | 5(20) | 6(20) | Total |
| J1 | 1 | Male | 10 | 13 | 13 | 15 | 15 | 18 | 84 |
| J2 | 1 | Male | 11 | 14 | 15 | 17 | 17 | 18 | 92 |
| J3 | 1 | Female | 10 | 15 | 16 | 18 | 18 | 17 | 94 |
| J4 | 1 | Female | 9 | 13 | 14 | 16 | 17 | 17 | 86 |
| J5 | 2 | Female | 12 | 14 | 15 | 16 | 19 | 17 | 93 |
| J6 | 2 | Female | 12 | 15 | 16 | 18 | 18 | 16 | 95 |
| J7 | 2 | Female | 11 | 17 | 17 | 18 | 19 | 18 | 100 |
| Mean Score | | | 10.7 | 14.4 | 15.1 | 16.9 | 17.6 | 17.3 | 92 |
| Senior Residents | | | 1(20) | 2(20) | 3(20) | 4(20) | 5(20) | 6(20) | Total |
| S1 | 3 | Female | 14 | 16 | 17 | 18 | 17 | 19 | 101 |
| S2 | 3 | Female | 16 | 17 | 18 | 19 | 19 | 18 | 107 |
| S3 | 3 | Female | 15 | 17 | 17 | 18 | 17 | 17 | 101 |
| S4 | 3 | Female | 15 | 16 | 18 | 20 | 18 | 18 | 105 |
| S5 | 3 | Female | 16 | 18 | 19 | 17 | 18 | 18 | 106 |
| Mean Score | | | 15.2 | 16.8 | 17.8 | 18.4 | 17.8 | 18 | 104 |

Table 3 The times of courses of the TR each resident participated in the gynecological ward;

| No | Date of rotation in gynecological ward | TR during HS program | HS Case | Case of uterus disease and skilled level evaluated by the directed teacher | Uterine curettage | Level | Removal of intrauterine device | Level | Endometrial polyps | Level | Mild intrauterine adhesions | Level |
|----|--|----------------------|---------|--|-------------------|-------|--------------------------------|-------|--------------------|-------|-----------------------------|-------|
| J1 | 2017.8-2017.10 | 2 | 7 | 4 | unskilled | 1 | unskilled | 2 | general | 0 | | |
| J2 | 2017.8-2017.10 | 2 | 8 | 3 | unskilled | 2 | general | 3 | general | 0 | | |
| J3 | 2017.11-2018.2 | 4 | 8 | 5 | general | 1 | general | 2 | unskilled | 0 | | |
| J4 | 2017.11-2018.2 | 4 | 6 | 4 | general | 0 | general | 2 | general | 0 | | |
| J5 | 2018.3-2018.6 | 6 | 10 | 4 | good | 2 | good | 3 | general | 1 | unskilled | |
| J6 | 2018.3-2018.6 | 6 | 10 | 3 | general | 2 | good | 4 | general | 1 | unskilled | |
| J7 | 2018.5-2018.8 | 6 | 13 | 5 | good | 2 | general | 5 | general | 1 | general | |
| | | Total | 62 | 28 | | 10 | | 21 | | 3 | | |
| S1 | 2017.8-2018.2 | 4 | 9 | 4 | good | 1 | good | 4 | good | 1 | general | |
| S2 | 2017.8-2018.2 | 4 | 11 | 4 | good | 1 | general | 5 | general | 1 | general | |
| S3 | 2018.3-2018.8 | 6 | 9 | 5 | good | 0 | good | 4 | general | 0 | | |
| S4 | 2018.3-2018.8 | 6 | 10 | 6 | good | 1 | good | 3 | good | 0 | | |
| S5 | 2018.3-2018.8 | 6 | 11 | 4 | good | 1 | good | 5 | general | 1 | general | |
| | | Total | 50 | 23 | | 4 | | 21 | | 3 | | |

Table 4 Different attitude towards the senior and junior resident in the interviews;

| NO | Question to residents | Residents Answer | |
|----|--|---|---|
| | | Junior Residents | Senior Residents |
| 1 | Which kind of TR help you improve your theoretical and practical knowledge in HS? | Video based TR | PBL discussion based TR |
| 2 | Do you hope to finish all the HS TR course before you operate? | We hope to participate as more as the HS TR course before we operate. | Because of the actual rotation plan, it was difficult to finish all the HS TR course before we operate. |
| 4 | Was the HS teaching program focused on your own concerns? | Yes, | Yes, our teachers engaged us in discussions, talking about medical facts and figures attracted us. |
| 5 | What do you think is the most difficult part of hysteroscopy | Dilation of cervix, removal of intrauterine device and extraction of endometrial polyps | Extraction of endometrial polyps and separate intrauterine adhesions |
| 6 | Continued with question 5, how did your teacher help you solve this problem? | Adjusting the direction when tract the cervix and exploring the uterine | Teach us how to use the clamp. |
| 7 | Do you think that your surgical skills were related to the guidance of the instructor? | Yes, | Yes, |
| 8 | When do you feel you were more familiar with the procedure in addition to clinical skills? | After learning the Medical knowledge and ability | Doing communication with clinician and patient-management |
| NO | Question to teachers | Teachers Answer | |
| | | | |
| 1 | What are your experiences related to bedside and operation teaching? | To transform novice medical students into competent doctors on a large volume of knowledge and hands-on experiences. | |
| 2 | What are the obstacles embedded in clinical education when teaching students on rounds? | During a round, we have to move to a classroom to show a slide to students. If using the smart phones during the rounds could allow access to the learning materials which enhances learning. | |
| 3 | Are there any ways to overcome the challenges in TR? | Focus the objectives of the TR at the beginning of the session and tried to have enough discussions which would help with transferability of the study. | |
| 4 | What are the skills of surgery teaching? | Complete the whole produce of the operation with explain. | |
| 5 | What is the most important part of becoming a clinical teacher? | The most important part of becoming a clinical teacher apart from gaining medical knowledge is professionalism and commitment which are embedded in the affective domain of learning | |

Table 5 Challenges to good clinical rounds and hysteroscopic surgery based on responses from the focus group discussions;

| Main category | Sub-category | |
|---------------|--|---|
| | Teacher-specific | Learner-specific |
| TR | Specialized discussions on rounds appropriate for residents; | Multiple tasks and responsibilities of residents; |
| | Theory-based medical education on rounds; | Passive recipients of medical knowledge; |
| | Medical teachers' lack of enthusiasm; | Students' lack of enthusiasm; |
| | Lack of teachers' attention to affective domain of learning. | Lack of students' participation on rounds. |
| HS | Lack of attention to teaching quality in teachers' evaluation and promotion; | Lack of feedback to teachers upon performance assessment; |
| | Evaluations are theory-based | Inappropriate student assessment methods. |
| | Lack of a standard for evaluating students' clinical performance | |

Figures

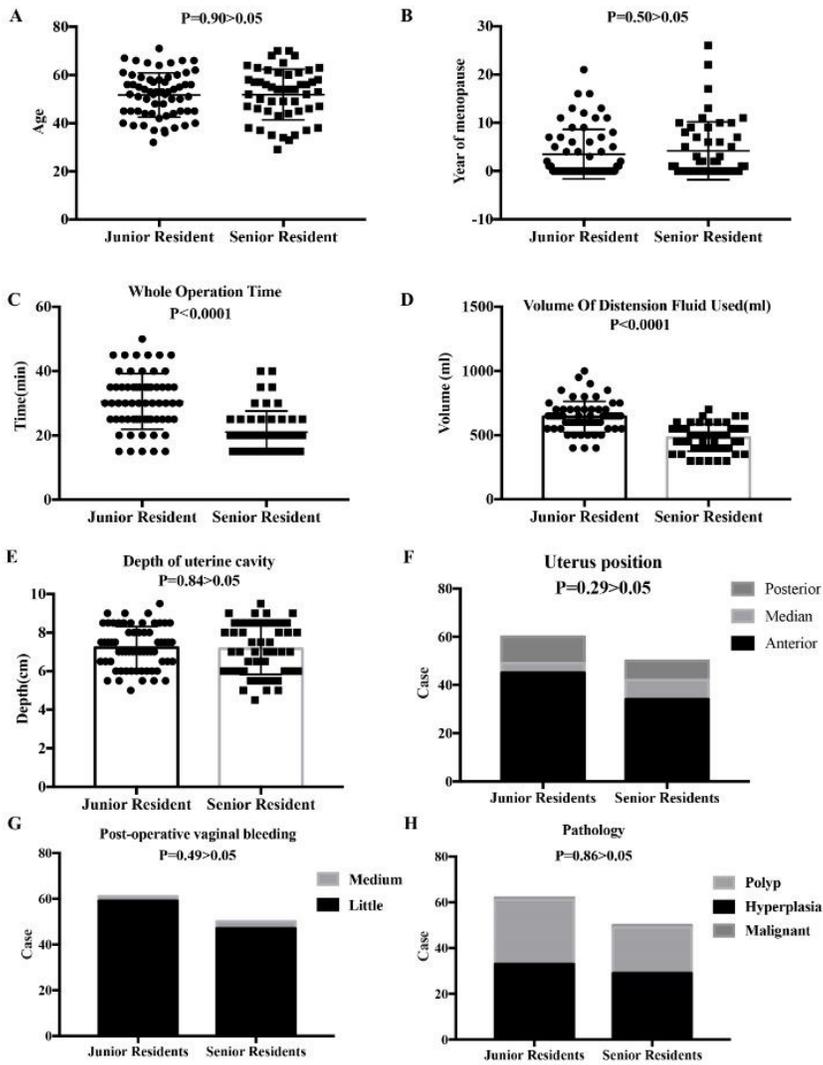


Figure 1

Patient characteristics in hysteroscopic surgery program. There was no significant difference between junior residents and senior residents in terms of patient age (A) and menopause age (B). C. Whole operation time in the senior resident group was shorter than that in the junior resident group (21.00 ± 0.92 min vs. 30.56 ± 1.08 min, $p<0.0001$). D. Junior residents involved in the procedures were more likely to use greater volume of distension fluid (ml) than senior residents (642.74 ± 14.82 ml vs. 480.00 ± 14.76 ml, $p<0.0001$). E. There was no significant difference between junior residents and senior residents with intrauterine depth (E), uterus position (F), post-operative vaginal bleeding (G), and pathology (H).