Original Article

Establishing a Low-Budget Hysteroscopy Unit in a Resource-Poor Setting

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Abstract

Objective: To report our experience in establishing a low-budget hysteroscopy unit in the Niger Delta Region of Nigeria over a 7-year period.
Materials and Methods: A retrospective descriptive study carried out between April 1, 2010, and March 31, 2017. Transaction receipts for the hysteroscopic equipment were retrieved. Situations where we had to improvise were documented. Patients' case files were retrieved, and relevant data were extracted.
Results: A cart was made by a technician; home television sets served as monitors. A back-up, handheld LED light source was used. The hysteroscopic forceps and scissors were detachable versions. Sterile urine bags were improvised for providing larger saline infusions for bipolar resections. A total of 1002 hysteroscopic procedures were performed. Majority of the patients (979 or 97.70%) presented with infertility. The most common indication for hysteroscopy was intrauterine adhesions (401 or 40.01%). While 765 (76.35%) operative hysteroscopies were performed, 237 (23.65%) were diagnostic. The most common surgical procedure performed was intrauterine adhesiolysis (483 or 63.14%). There were 4 (0.40%) cases of inadvertent uterine perforation and one case (0.10%) of glycine distension fluid overload.
Conclusion: Hysteroscopy with acceptable results is possible in a resource-poor setting using numerous innovative ways to circumvent the need for some of the expensive equipment.

Keywords: Hysteroscopy, low budget, resource poor

Introduction

Hysteroscopy is a valuable tool in the evaluation and treatment of infertility and numerous gynecological conditions. The first reported case of hysteroscopy use was by Pantaleoni in 1869, when he cauterized a hemorrhagic uterine polyp using silver nitrate.[1] Hysteroscopy has ended the need for the old practice of using blind procedures for the investigation and treatment of endometrial pathologies and in some instances obviates the need for open surgery, such as for uterine fibroids.[2] Pathologies that are amenable to hysteroscopic treatment include intrauterine synechiae, endometrial and cervical polyps, submucous fibroids, retained intrauterine fetal bones, Mullerian abnormalities such as uterine septa, missing intrauterine contraceptive devices, and the evacuation of retained products of conception.

Hysteroscopy can be performed in the operating room or in an office setting without the need for general or regional anesthesia.[3] Numerous intrauterine gynecological conditions can be diagnosed and treated in an office-based setting, thereby introducing the concept of the "see and treat hysteroscopy".[4] For this reason, some have advocated that hysteroscopy should form part of the armamentarium of every gynecologist.[5]

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Unfortunately, the cost of procuring the equipment necessary for an effective hysteroscopy unit is exorbitant and therefore not within the reach of the average gynecologist in most resource-poor countries. During a master class program, one of the manufacturers who was contacted to provide the prices of equipment, listed the price of a complete office tower (light source, camera, and monitor) at approximately 9,700 USD. The price of a rigid hysteroscope, sheath, and hand instruments were put at 6,500 USD.[6] Another problem is that resource-pooling systems to make health care readily accessible to all are nonexistent in most resource-poor countries. The result is that the majority of the population relies on out-of-pocket payments to access health care. All these factors combine to ensure that a hysteroscopic service based on conventional equipment cannot be afforded by those in need in resource-poor settings.

Objectives

1. To report our experience with setting up a low-budget hysteroscopy unit
2. To document the obstacles encountered and how they were surmounted
3. To analyze the different procedures performed during the study period.

Materials and Methods

A retrospective descriptive study carried out between April 1, 2010, and March 31, 2017 at a private fertility unit in the Niger Delta Region of Nigeria. The Institutional Review Board of Madonna University Teaching Hospital had approved human experimentation. Institutional Review Board Project Number 0001/2017 was obtained on April 17, 2017. Informed consent was obtained from all the patients.

Transaction receipts for the hysteroscopic equipment were retrieved from the accounts department. Situations where we had to improvise were documented. Case files of patients who underwent hysteroscopy during the period under review were also retrieved. Data, including age, indications for hysteroscopy, hysteroscopy findings, procedures performed, and complications recorded were documented.

Data obtained from the invoices were presented in tabular form, while data obtained from the case files were analyzed using Epi Info version 7 (CDC, Atlanta, Georgia, USA) and were presented as frequency distributions.

Results

- As shown in Table 1, the cart was built by a technician for $150
- The monitor was improvised using standard home television (TV) sets and later, high-definition (HD) liquid crystal display TV sets for $100 and $400, respectively
- A back-up, rechargeable, handheld LED pen light was purchased for $150 and prevented case cancellations due to issues with the main light source
- Sterile disposable urine bags were used as reservoirs for up to 2 L of normal saline following a change to bipolar cautery.

Some of the shortcomings included:

- Decreased image quality with some of the home TV brands/models
- Reduced fluid delivery pressures with a reduction in fluid volumes due to the use of a manual pump.

A total of 1002 hysteroscopies were performed during the period under review. The majority of the patients (979 or 97.7%) presented with infertility. The age range of the patients was 15–57 years, with a mean 38.3 ± 5.9 years. While 949 (94.71%) procedures were performed as office procedures, 53 (5.29%) were performed in a theater setting. As shown in Table 2, the most common indication for hysteroscopy was intrauterine adhesions (401 or 40.01%).

A total of 765 (76.35%) operative hysteroscopies and 237 (23.65%) diagnostic procedures were performed. The most common operative procedure performed as shown in Table 3 was intrauterine adhesiolysis (483 or 63.14%). There were a total of 5 (0.50%) complications, 4 (0.40%) of which were inadvertent uterine perforations and 1 (0.10%) resulted from glycine fluid overload. There was no case of postprocedure infection or anesthetic complication.

Discussion

Despite a population of over 180 million people spread across the 36 states of the federation, only a handful of hysteroscopy centers are available in Nigeria.[7] Most of these centers are privately owned, thus limiting the exposure of obstetrics and gynecology residents undergoing training to this fast-evolving and invaluable tool in gynecological care.

It is well established that hysteroscopy is an easy skill to learn.[8] Practitioners have the option of undergoing training in the few available training centers in Nigeria, or they can travel out of the country for a few weeks or months for training. However, following the successful completion of training, only a handful will successfully put their skills into practice. It is therefore logical to argue that the greatest challenge to the widespread availability of hysteroscopy services in Nigeria and other resource-poor countries is the cost of procuring equipment and setting up a practice that meets, at the very least, the minimum criteria for international best practices.

While hysteroscopy can be an office-based or a theater-based procedure, regardless of which form is practiced, it is important that a new setup observes the principles of ergonomics. For this reason, an office-based procedure does not necessarily have to be performed in a consulting room. A spacious dedicated room

Table 1: Equipment and cost saving measures

Equipment	Cost saving measures
Trolley (cart)	Cloned trolley made by a technician ($150)
Monitors	Conventional, home television monitors ($100–$400)
Light source	Halogen light source ($1000) with a back-up LED pen torch light source ($150)
Fiberoptic cable (brand new)	$200
Camera units	Single chip refurbished camera unit ($1800)
Hysteroscopic scissors and forceps	Detachable handle version (forceps/scissors $114, handle $166)
"Demo" operating sheath (inner/outer plus channel for 5F hand instruments)	$500
Fluid delivery system	Manual cuffed pump with a gauge at $138 Sterile disposable urine bags ($5)
Hysteroscope	2.7 mm, 12° and 30° "demo" hysteroscopes at $3242

Table 2: Indications for hysteroscopy

Indication	Frequency (%)
Intrauterine adhesions	401 (40.01)
Submucous fibroids	188 (18.76)
2 failed IVF cycles	154 (15.37)
Polyps	139 (13.87)
Thin endometrium	40 (3.99)
Retained fetal bones	26 (2.60)
Amenorrhea	15 (1.50)
Postmyomectomy	13 (1.30)
Others*	26 (2.60)
Total	1002 (100)

*Recurrent miscarriages, retained products of conception, missing IUCDs, postmenopausal bleeding, uterine diverticula, difficult embryo transfers, persistent endometrial fluid, septate uteri, and a rare case of a confirmed endometrial teratoma. IUCDs: Intrauterine contraceptive devices, IVF: Invitro fertilization

Table 3: Operative hysteroscopic procedures

Procedure	Frequency (%)
Adhesiolysis	483 (63.14)
Polypectomy	150 (19.60)
Myomectomy	56 (7.32)
Removal of fetal bones	26 (3.40)
Others	50 (6.54)
Total	765 (100)

away from the operating theater can serve the purpose of an office setting, as was the case in our practice. The majority of the cases (949 or 94.71%) were performed as office procedures. These included six of the 56 hysteroscopic myomectomies that were completed using hysteroscopic scissors and all but two of the cases of intrauterine adhesions. While we routinely administered sedatives (intravenous diazepam) and nonsteroidal anti-inflammatory medications (pentazocine) and used intracervical lignocaine for all office-based procedures, four cases (0.40%) were still canceled because the patients could not tolerate the procedure.

The hysteroscopy cart is an essential component of the endoscopy setup. It provides spaces for the equipment, thereby ensuring a more organized setting and proper use of available space. Unfortunately, most brand new carts are rather expensive. When we commenced our endoscopy practice in 2010, a brand new cart from a reputable company sold for about $2500. As a result, we employed the services of a technician, who was able to build a similar cart for $150. This served its purpose for over 5 years before we considered an upgrade [Figure 1].

The video monitor ensures that the surgeon, his assistant, and any observers have adequate views of the hysteroscopic procedure. The image resolution determines the picture quality. Horizontal resolution is the number of separate vertical lines available for the image, and the vertical resolution is the number of possible horizontal image lines. The greater the number of resolution lines, the sharper the image quality.[9] The very expensive 4K video monitor system is the current hallmark of monitors, with four times the resolution of existing 1080 HD systems, ensuring crystal clear pictures.[10] Video output types from endoscopy camera control units can include the following: composite video, S-video, component video, or digital visual interface (DVI) (for HD video systems). A typical video monitor can receive input signals from any of these, or the signals can be received indirectly from the output jack of another video monitor.[9] Most modern home TV sets have high-definition multimedia interface (HDMI), which supports very good resolution. For older, standard definition TV sets, the component video has the best resolution, followed by S-video and finally composite video, which has the lowest resolution and by extension, the worst image quality.[11]

For the first few years of our practice, we operated with home TV sets hung on three corners of the walls to serve as our monitors. These were less expensive than conventional medical monitors. Some of the TV brands, however, provided much clearer pictures than others; overall, we were able to obtain acceptable images to undertake different procedures [Figure 2]. Since we had three different TV monitors, we made use of all the available jacks in the camera unit. The composite video jack was connected via a special adapter – a Bayonet Neil–Concelman adapter to the yellow Radio Corporation of America (RCA) cable and RCA jack on the TV monitor [Figures 3 and 4]. An S-video cable connected the S-video jack of the camera unit to a second TV monitor via a radio frequency converter [Figures 3 and 5]. This converted the S-video signal into a composite signal, making it compatible with the RCA input jack of the TV monitor [Figure 4]. The component jack of the camera unit (where available) can also be connected via a red, blue, and green plug to the relevant component jacks of the TV monitor. For the third TV monitor, however, we used HD technology; a "male" DVI plug was connected to the DVI jack of the camera unit, and the other end (a "male" HDMI plug) was connected to the HDMI jack of the TV monitor [Figures 3 and 6]. A HDMI splitter is an alternative, splitting HD signals to two or more TV monitors without the need for the other cable connections described above. These plugs/cables are inexpensive and easy to connect, and lengths of up to 15 m are available at various electronic stores. The main drawback of some of the home TV monitor systems is that their resolutions might not be as high as that of the camera unit, thereby reducing image quality.[9] This limitation can be circumvented if one procures a TV set with a resolution equal to or higher than that of the camera unit, for example, a TV with a minimum resolution of 1080p.

The camera unit consists of a camera control unit connected to a camera head. A charge-couple device transforms the optical image into an electronic signal that is transmitted to the camera control unit. The first single-chip digital camera

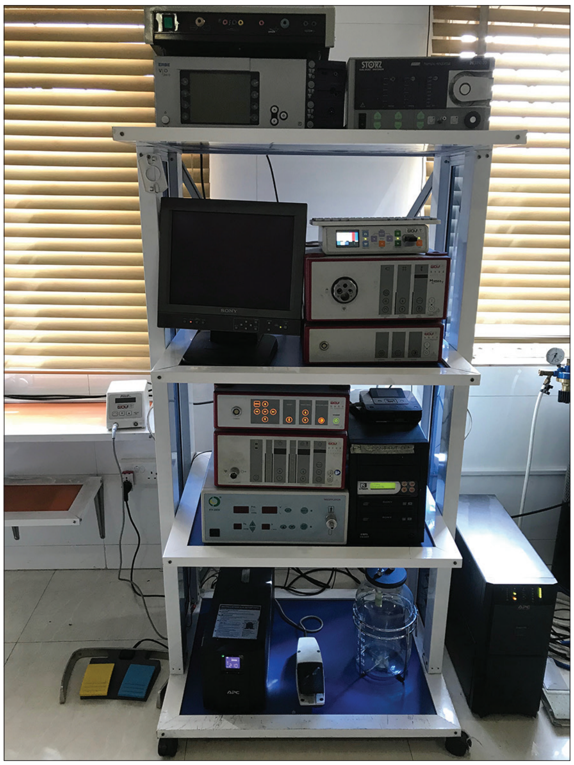

Figure 1: Cloned mobile cart

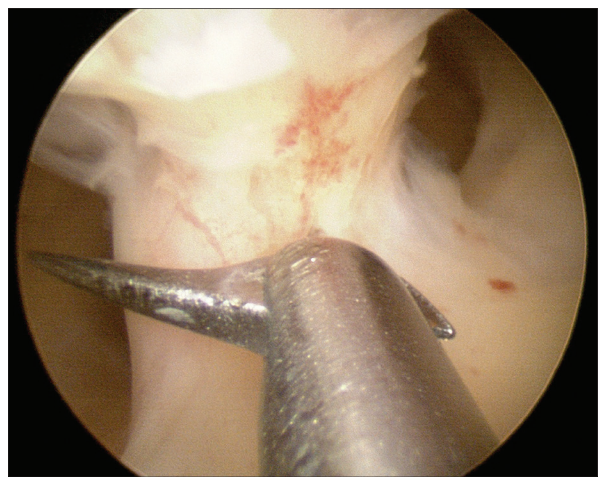

Figure 2: Hysteroscopic adhesiolysis

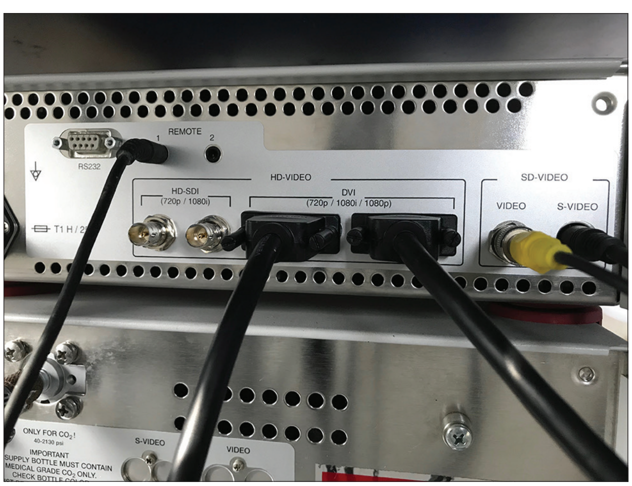

Figure 3: Three-chip camera system showing standard definition and high-definition connections

Figure 4: Radio Corporation of America plug connected to the television monitor

was introduced by Circon in 1992.[9] This later progressed to a three-chip camera system offering clearer images and later the HD camera system. We started with a refurbished single-chip camera system, which was the least expensive system we could obtain, before progressing to a three-chip system. It is worth noting that an HD image can be produced with either a single-chip or three-chip camera system.[12]

Light sources provide adequate illumination to perform the hysteroscopic procedures. Various light sources are available. We started with a halogen light source and later upgraded to an LED light source, which provides brighter and whiter light than a halogen light and lasts much longer than a xenon light.[12]

With respect to the recurrent power surges frequently experienced, we suffered two consequences of a damaged light source, which prematurely ended the hysteroscopic procedures being performed at the time. For a low-budget center, in addition to taking steps aimed at protecting the equipment from the undesirable effects of power surges, we purchased a handheld LED rechargeable flashlight [Figure 7]. These are inexpensive; our flashlight cost $150. Our flashlight could last for 2 h if the alkaline batteries were fully charged. As we could not afford a second light source at the time, this was an effective backup option.

While fluids can be delivered effectively with an automated pump, we started with a manual cuffed pump with an attached gauge, which cost $138. This pump was capable of delivering fluid from a 1 L bag. Unfortunately, it could not maintain a constant fluid pressure because a decrease in pressure occurred when the fluid volume was reduced. Following our upgrade to the automated pump, we could not obtain the normal 3 L saline bags for bipolar resections. The challenge with the 1 L bag was that it needed to be replaced often, causing blurring of vision secondary to blood loss caused by the replacements, increasing the operating times. This challenge became more relevant when we began to perform advanced hysteroscopic procedures, such as hysteroscopic myomectomies using bipolar cautery. Therefore, we improvised with sterile, disposable urine bags that could accommodate up to 2 L of normal saline at a time. After performing 36 hysteroscopic myomectomies with bipolar cautery (14 cases were performed with a monopolar current and glycine before the change), we have not had any patient experience a postoperative infection, although all were placed on prophylactic antibiotics, similar to patients that had an intrauterine Foley's catheter left *in situ* following hysteroscopic adhesiolysis. Our handling of the sterile urine bag, however, was done under very strict aseptic conditions.[13]

We opted for 2.7 mm "demo" hysteroscopes from a reputable manufacturer in Europe (all of our equipment was made in Europe). These were brand new hysteroscopes that had been showcased during conferences and workshops and later sold at significantly reduced prices. Fortunately, there are inexpensive hysteroscopes from Asia that should hopefully serve the same purpose for a low-budget unit.

Figure 5: Radio frequency modulator converting an S-video to composite video

Figure 6: High-definition multimedia interface plug connected to the television monitor

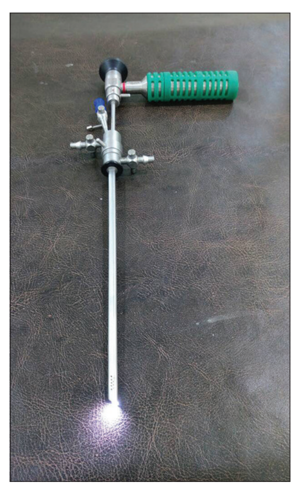

Figure 7: Hand-held LED torch light

We preferred detachable hysteroscopic scissors and forceps. These items went a long way in reducing costs, as only the working ends (inserts) were replaced when the scissors or forceps were broken or became blunt. The handles were only occasionally faulty and did not need to be replaced often.

Despite all the above challenges, we were able to perform both diagnostic and operative procedures with clarity and relative ease. Similar to our previous report, hysteroscopic adhesiolysis was the most common procedure performed.[7] The very high number of unsafe abortions on account of the our highly restrictive abortion laws, would probably explain the high intrauterine adhesion rate of 40.01% found in this study. Our complication rate was 0.50%, compared with rates of 0.28% and 1.20% that were observed in previously published studies.[7,14] For cases that required anesthesia, regional anesthesia (using spinal anesthesia) was preferred to general anesthesia; only one patient had general anesthesia, and it was for intrauterine adhesiolysis. No anesthetic complications occurred during the period under review.

Conclusion

It is therefore possible to create a low-budget hysteroscopy unit with the aim of upgrading it within a reasonable time frame using the aforementioned strategies that we put into place. With <$7000, it was possible to procure the necessary equipment and consumables required for the diagnostic procedures and for the treatment of most intrauterine adhesions, polyps, and even the removal of very small type 0 submucous fibroids, among others. While purchasing refurbished or preowned equipment online via one of the major online retail portals would have been a viable option, we worried about reliability and durability, as it would have been costly and significant time would have been lost if the equipment had to be returned, considering the distance.

Finally, to have a successful practice, issues peculiar to most resource-poor developing countries need to be taken into consideration. These include providing alternative sources of power (generating sets and inverters), surge protectors, stabilizers, and uninterrupted power supply units for all the equipment. These are all important for a successful practice in a developing country, as it is no easy feat to replace damaged equipment.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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