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AAGL ELEVATING GYNECOLOGIC SURGERY

Perspective

The Gynecologic Resectoscope: An Endangered Species

The introduction of the continuous flow resectoscope for gynecologic use in 1989 represented a far-reaching advancement in minimally invasive gynecologic (MIG) surgery. Although the hysteroscope had already been available for many years, it remained purely a diagnostic tool until the introduction of affordable accoutrements that permitted intrauterine surgical procedures. Soon the continuous flow gynecologic resectoscope (CFGR) emerged as the "gold-standard [1]" for accomplishing endometrial ablation (EA) as well as tissue removal techniques- endomyometrial resection, polypectomies, and submucous myomectomies −often obviating the need for more invasive procedures. Additionally, the CFGR would prove to be an important tool for managing the complexities associated with many uterine anomalies, isthmoceles, intramural myomas, and EA failures.

Despite the initial enthusiasm of instrument manufacturers and motivated surgeons, the growth of resectoscopic surgery grew haltingly. Reports of fatal hyponatremic encephalopathy, pulmonary edema, fluid and electrolyte disturbances [2], and visceral injuries [3] prompted thought leaders, medical device companies, and professional organizations to explore safer and simpler alternatives for intrauterine surgery that required less training and experience and could be more widely utilized. This demand spawned 3 separate categories of innovations: global EA (GEA) technologies, the introduction of the bipolar resectoscope, and hysteroscopic morcellators (HMs) to accomplish mechanical tissue removal.

In 1997, the US Food and Drug Administration issued its premarket approval for the first GEA device—the ThermaChoice uterine balloon therapy system (Gynecare, Inc., Sommerville, NJ); 3 other thermal balloon systems were soon introduced around the world. Today's market is dominated by radiofrequency devices including NovaSure (Hologic Inc., Marlborough, MA) and Minerva (Minerva Surgical Inc., Redwood City, CA) [4]. In 1999, the bipolar resectoscope was introduced in order to remediate many of the fluid and electrolyte disturbances associated with unipolar resectoscopic surgery [5].

Although these advances were helpful, the challenges associated with resectoscopic tissue removal−myomectomy and polypectomy—as well as the training challenges imposed by the limited utilization of the continuous flow resectoscope−motivated the creation of a new approach for intrauterine tissue removal. An important advance came in 2005 when Emanuel and Wamsteker [6] described the first use of a mechanical HM, which provided the advantages of eliminating electrosurgery along with simplified tissue removal. The first tissue removal system, TRUCLEAR (Smith and Nephew Inc., Andover, MA), received FDA approval in 2005, and MyoSure (Hologic Inc., Marlborough, MA) became available in 2009.

What Impact have Geas and HMs had on Resectoscopic Surgery?

The impact of the newer technologies−GEA devices and HMs−have varied throughout the world. By 2018, at least 10 separate GEA devices had been approved in the US, Canada, and Europe. Although establishing the number of GEA procedures performed throughout the world remains difficult, Hologic has reported the sale of some 3 million NovaSure devices between 2001 and 2018 [7], with the US representing its major market. Similarly, HMs, which have improved the safety and ease of intrauterine tissue removal, have replaced the resectoscope in many parts of the world.

The technological shift away from the resectoscope has been most dramatic in the United States, where today's residency and fellowship training programs face nearly insurmountable obstacles in achieving proficiency in resectoscopic surgery. These obstacles can be divided into 3 categories: (1) reports of randomized controlled trials that have demonstrated comparable outcomes for GEA and resectoscopic EA (REA), (2) the hurdles in teaching the use of the CFGR, and (3) the difference in health care financial models in the US compared to other countries.

Randomized Controlled Trials Demonstrating Comparable Outcomes of GEA and REA

There are numerous randomized controlled trials that have demonstrated equivalent outcomes for women undergoing both GEA and REA procedures [8−12]. Most of

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these studies are limited to 1-year follow-up but provide a compelling argument for substituting the safety offered by GEAs for the lengthier and more complex REA procedures. However, the result has been a net decrease in the volume of CFGR cases with which to hone trainees' knowledge and expertise.

The Hurdles to Teaching the Use of the CFGR

These can be divided as follows:

- First, resectoscopic surgery is relatively complex. In addition to a fluid management system and videotower, it demands a stable and well-trained staff along with an array of various scope diameters and electrodes. In contrast, self-contained GEAs or HMs are comparatively simple to operate and maintain.
- Second, there are few experts available to teach resectoscopic surgery. Since the introduction of these newer and simpler technologies have obviated many resectoscopic cases in the U S, the art and science associated with their use has resulted in fewer qualified mentors.
- Third, unlike most other gynecologic procedures, resectoscopic surgery permits only a brief pedagogical window—the time available for instruction before the patient is exposed to the adverse outcomes associated with excessive fluid absorption. These time restrictions, particularly evident with the use of older unipolar resectoscopy, make for a long and challenging path toward achieving surgical proficiency.

Health Care Financial Models in the US Compared to Other Countries

Compared to the financial models for health care delivery in Canada, the UK, the European Union, and South and Central America, physicians in the United States may be less likely to be aware of the costs associated with disposable equipment unless they are informed by their hospital systems or medical insurers. The net effect may be to diminish the potential financial advantages offered by CFGRs, thereby resulting in fewer impediments to the use of GEA and HMs.

Does the Resectoscope still have a Role in Gynecology?

One may rightly ask whether the CFGR remains a useful or necessary instrument for the MIG surgeon. Although various studies have indicated that the GEA devices and the CFGR produce equivalent results for managing menstrual disorders, they require careful interpretation because these studies fail to distinguish the impact of surgical experience on outcomes. This effect is highlighted by the findings of Curlin and Anderson [13], who in a series of 1751 patients demonstrated a 3-fold increased failure rate in EA procedures performed by a novice (resident) compared to an experienced resectoscopic surgeon. Interestingly, the relationship between experience and outcomes did not apply to GEA and likely contributed to its widespread acceptance by physicians with little training or limited surgical volume.

However, the CFGR, which utilizes a panoply of sheath diameters, optical angles, and inexpensive, disposable electrodes, allows a wide variety of intrauterine surgical interventions. The assortment of sheath diameters allows the efficient removal of large submucous myomas as well as the excision of endometrial polyps within the confines of the small postmenopausal uterus. The variety of optical angles allows the intrauterine surgeon to assess the uterine cavity in a manner not possible with the limited viewing angles available with HMs. The assortment of electrodes allows for a broad range of interventions. The "standard" angled electrode allows the management of most submucous myomas, endometrial polypectomies, and endomyometrial resections and biopsies. With experience, these electrodes can be used to "un-roof" and remove International Federation of Gynecology and Obstetrics type 3 and 4 intramural myomas [14,15]. Other electrode configurations facilitate the incision of a uterine septum and the removal of the base of fundally-attached endometrial polyps and fibroids that are not accessible with HMs. Coagulation electrodes—roller-ball, roller-barrel, or grooved barrel electrodes −can be utilized to perform EA and even vaporize submucous leiomyomas.

In summary, the vast array of resectoscope diameters, optics, and electrodes empower the well-trained gynecologist to expand the range of intrauterine surgery in a manner that is neither possible nor effective with other available devices. With a simple electrode exchange and the adjustment of electrosurgical unit waveforms, the CFGR is ideal for achieving concomitant goals such as EA, complex myomectomies and polypectomies, and addressing uterine anomalies that would preclude the use of GEA devices. This versatility makes the CFGR an unparalleled tool for the MIG surgeon.

What is Happening to the Role of the CFGR Around the World and why?

As previously stated, the impact of HMs and GEA devices on resectoscopic surgery varies throughout the world. Among representative members of the medical device industry and "seasoned old-guard" experts, both groups agree that, at least in the United States, the CFGR will likely be relegated within the next decade to the same fate as obstetrical forceps, a relic more likely to be found in a museum rather than a modern operating room. From the standpoint of most practitioners, the relative safety and simplicity of GEA and HM devices, whatever their limitations, provide an attractive

alternative to the CFGR. The contraction of cases requiring the use of CFGR will likely cause it to be used by a relatively small and dedicated group of experts who are declining in number. The limitations on resectoscopic training are not reflected in equivalent programs outside the US, where there is greater opportunity to become proficient at advanced hysteroscopic skills. There are 2 factors contributing to this difference.

First, most countries outside of the US are more sensitive to health care delivery costs, which favors resectoscopic surgery and, in the hands of appropriately trained surgeons, is just as safe and at least as effective as newer technologies.

Second, outside the US, patients are more likely to accept the concept of "regionalization of care" and referrals to centers of excellence. For instance, in Spain, Italy, and Israel, many university hospitals have dedicated hysteroscopy units which perform the vast majority of its procedures in an office-based setting. In Israel's Laniado University Hospital, more than 70% of its 100 hysteroscopic procedures each month are performed in an office-based setting. These units are equipped with an array of reusable resectoscopes and lasers to accommodate various anatomic and pathologic challenges. In contrast, women in the US often expect their gynecologist to manage all of their benign gynecologic surgical care needs.

The Future of Resectoscopic Surgery

The limited time and increasingly diverse focus of obstetrics and gynecology residency training in the United States does not favor an increased emphasis on gynecologic surgical training, much less resectoscopic techniques. Indeed, unless there are modifications in the structure or flexibility of residency training, it is unrealistic to expect that proficiency in resectoscopic surgery can be achieved at that level. Although it is fortunate that technological advances have provided devices that approximate the goals of resection without the requirement for extensive experience, there will always be uterine masses that cannot be adequately managed with HMs and uterine sizes and configurations that exceed the capabilities of GEA. Fellowship programs in MIG surgery may be a valuable training environment for providing a cadre of appropriately experienced gynecologists who can serve as a referral resource for patients requiring such expertise. Finally, regional centers of excellence could be established to share expertise utilizing existing appropriately trained and experienced providers similar to our European colleagues.

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