Reproductive surgery: decreasing skills and advancing technology—an existential conundrum

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Our article endeavors to be both a review of the recent past and a preview of the future of reproductive surgery. By reflecting on the rate of technological advancement over the past decade, we attempt to predict the trajectory of the next. We also delve into the changing nature and practical challenges of the practice of gynecologic surgery for the reproductive endocrinology and infertility subspecialist. We will explain how technological advances may alter our perception and expectations regarding the indications, timing and extent of surgical intervention in the infertile patient and in the patient seeking preservation of fertility. This review does not aim to be comprehensive, choosing instead to focus on those innovations that hold, in our view, true potential to shape the future of surgical practice. Ours is primarily a technology review. As such, it does not focus on novel surgical techniques, including uterine transplantation and ovarian tissue transplantation. (Fertil Steril® 2019;112:211–8. ©2019 by American Society for Reproductive Medicine.)

Key Words: Reproductive surgery, laparoscopy, robotics, laser, morcellator

THE IDENTITY CRISIS AMONG REPRODUCTIVE SURGEONS

Reproductive surgeons were instrumental in advancing the fields of microsurgery and laparoscopic surgery. The seminal works of reproductive surgeons like Raoul Palmer, Kurt Semm, and Victor Gomel laid the ground work for not only minimally invasive gynecologic surgery as it is practiced today, but also for minimally invasive surgery in all other disciplines. It is ironic therefore that we are at a crossroads in the history of reproductive surgery where we ask ourselves the question, what is the future of reproductive surgery?

Reproductive endocrinology and infertility (REI) is a vast and evolving field, where multiple ever-expanding fields of knowledge converge. The modern practice of reproductive endocrinology and infertility is now completely dependent on the combined expertise of clinical embryologists, geneticists, andrologists, and reproductive surgeons. That is because the proficiency expected in any one of these fields has reached levels that are impossible for a single provider to achieve and maintain. If most reproductive endocrinologists cannot be reproductive surgeons, then it goes without saying that the definition of a reproductive surgeon must evolve. Is the reproductive surgeon still a reproductive endocrinologist who focuses on the surgical aspects of this field? Or rather a general gynecologist with special training in laparoscopy, to whom REI subspecialists can outsource the minimally invasive microsurgery that they can no longer perform? This is not a matter of semantics. Definitions, standardization, and certifications are an essential feature of patient-centered care in developed countries. We should recognize however that cultural differences do exist between developed countries on this point. Reproductive endocrinology pioneers in the U.S. have fought particularly hard to establish a high bar for special certification. Indeed, our subspecialty was one of the first medical subspecialties to be established in the U.S., in 1972 (1). Similar pathways to certification have emerged more recently within the Royal Colleges of Canada, Australia, and New Zealand, while the achievements of the European Board and College of Obstetrics and Gynaecology in this field remain limited, and elsewhere in the world a separate REI subspecialty is virtually nonexistent. Hence, while most of the world's medical systems do not offer

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formal training and certification for REI, we are approaching fifty years of continuous development of this subspecialty in the U.S. As we continue to mature, one of the identity challenges that we face is how much of a surgical subspecialty we want to be.

The current Fellowship in Minimally Invasive Gynecologic Surgery (FMIGS), was organized in 2001 through the joint effort of the American Society for Reproductive Medicine, through its affiliated Society of Reproductive Surgeons, and the American Association of Gynecologic Laparoscopists (2). However, in the short span of a decade or so, this collaboration has ceased to exist, and only a minority of FMIGS programs include a reproductive endocrinologist on their faculty. Albeit the FMIGS is not recognized by the American Board of Medical Specialties, it has produced hundreds of gynecologists who can reliably tackle complex surgery by minimally invasive means. This achievement has changed the panorama of gynecologic surgery in the U.S. for the better but has not solved the reproductive surgery conundrum. Indeed, with the rise of a generation of general gynecologists who can perform minimally invasive surgery, REI is the only American Board of Medical Specialties-certified gynecology subspecialty that may relinquish its surgical component to general gynecologists, after almost fifty years of creating and leading this field.

As the future of reproductive surgery remains uncertain in terms of who is certified to perform it, we should at a minimum agree on a practical definition of its scope and requirements. For the scope of this article we will limit our views to the field of gynecologic reproductive surgery.

Reproductive surgery aims at fertility preservation in the face of disease, and at fecundity enhancement in the setting of spontaneous or assisted reproduction. This surgery must be highly personalized in terms of its timing and indications; strictly adherent to microsurgical principles; and minimally invasive whenever possible. Since these three principles must apply, true reproductive surgery is seldom practiced. Specifically, gynecologists lacking formal REI training and day-to-day experience in the treatment of reproductive dysfunction have a difficult time in providing personalized treatment, whereas many REI subspecialists in the U.S. lack the necessary skills to perform minimally invasive microsurgery. Consequently, on average, neither professional will be able to practice reproductive surgery to its full potential. A general gynecologist with minimally invasive gynecologic surgery training is more likely to offer the minimally invasive approach, but may over-treat benign pathology, or treat it at the wrong time over a woman's reproductive life (radical/untimely surgeries for fibroids, endometriosis, and adenomyosis would be examples of this).

On the other hand, an REI subspecialist is best equipped to personalize the timing and indications for surgery but may offer invasive surgical techniques, denying the patient access to decades of technological advancements in our field. Neither approach is patient-centered. Many notable professionals in both fields represent exceptions to this general scenario, but a whole nation of women cannot base their care on exceptions. The best way forward is through a process of standardization that provides adequate access to proper reproductive surgery for most women. Standardization in this field will occur when all surgeons involved in it will follow its basic tenets. To achieve that, we see two logical alternatives: to educate and embrace some minimally invasive general gynecologists as active members of the infertility team; or to make minimally invasive microsurgery practically accessible to some REI subspecialists. Note that the emphasis remains on a selective choice of professionals because our field is based on a minimalist surgical philosophy, where surgical volume is relatively contained, while surgical expertise must be vast.

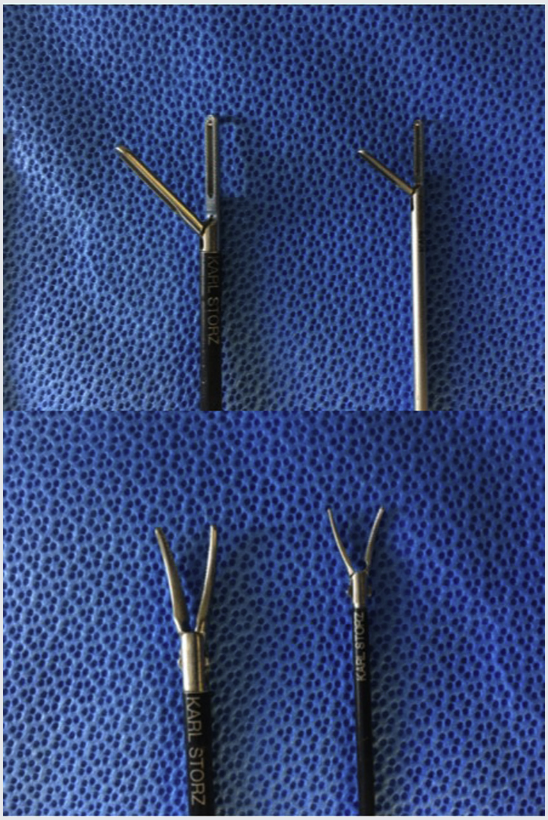
ADVANCES IN TECHNOLOGY AND INSTRUMENTATION

Despite its widespread popularity today, conventional laparoscopy introduces inverted fields (left is right, up is down), monocular vision, obligatory triangulation (no wrist), and ergonomic challenges. Consequently, the ability to perform complex surgical tasks by laparoscopy is objectively limited by the individual physical aptitude to operate under such challenging conditions (3, 4). Conversely, robot-assisted laparoscopy removes inverted fields, monocular vision, obligatory triangulation and ergonomic challenges, enabling all competent gynecologists to master laparoscopic surgery (5). The universally enabling nature of surgical robotics goes well beyond the elimination of laparoscopic handicaps, to confer full ambidexterity to laparoscopic surgeons (6).

The cost of robot-assisted surgery is an ongoing debate. All published studies on this subject suffer from multiple biases including that of considering the cost of the robotic surgical platform itself as contributing to the cost of surgery. For example, studies on the value of conventional laparoscopy have never included the cost of an integrated laparoscopic operating room, even when they sold (installed) for over one million dollars by the time the robot was introduced in the U.S. That is because the amortization of operating room equipment depends on too many variables, many of which do not pertain to the surgery under study. For the robot, specifically, it depends on how many surgical services use it, how many hours a week it is being used, how efficiently it is used by the surgical teams, and how efficiently the operating room can manage turn-over times. If cost had been considered a driving issue in infertility care, we would not have developed assisted human reproduction to the level that it is at today. Fertility care is central to the self-realization of one in six couples (and single individuals) and therefore, it cannot be trivialized. If robot-assisted laparoscopy is needed to re-engage REI subspecialists in direct patient care, then it is probably worth the cost.

Of greater concern is the remarkably slow rate of technological improvement over four consecutive iterations of the existing robotic platform spanning two decades. This is certainly not in keeping with the exponential growth observed for most computer technology (Moore's Law) (7). To make our point, consider that when we started robot-assisted laparoscopic surgery in gynecology the iPhone had not yet been released and now we carry in our pockets a computerized phone that can process faster than many of

FIGURE 1



Comparison of (*left*) 5 mm and (*right*) 3 mm (*top*) atraumatic graspers and (*bottom*) Maryland graspers.

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our desktop machines. In comparison, four generations of robots later, we perform the same operations that we accomplished with the original machine. Although vision and ergonomics have significantly improved, no quantum leap has occurred. Such slow pace of development is surprising, and not limited to a single company in this market space. Recently, a new Food and Drug Administration (FDA)-approved robotic surgical platform has focused on simulated haptic feedback, vision-controlled movement of the camera, and reusable (but mostly non-articulated) laparoscopic instruments of any size as the main differentiators (8). These represent relatively small improvements, with no substantial impact on the surgical capability of the robot.

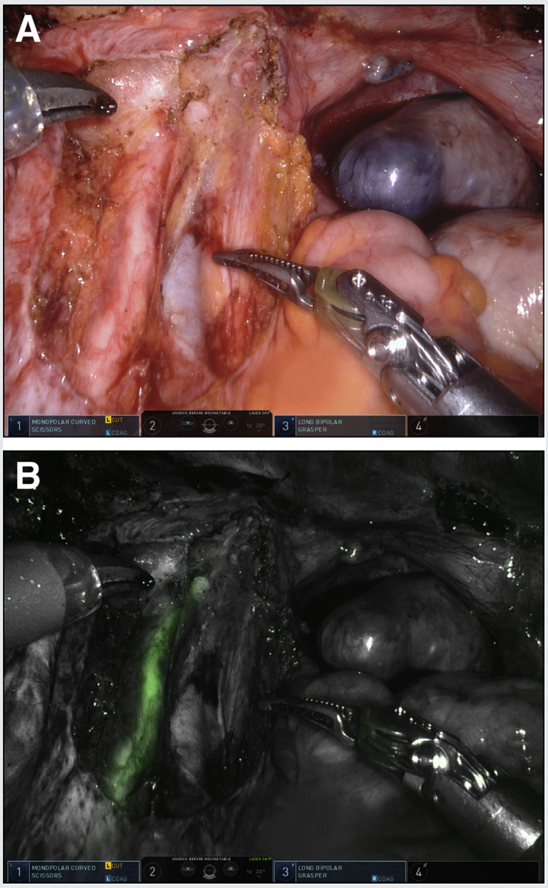
However, there are clear signals in the industry that times are mature for a robotic revolution in surgery. Currently, no less than ten robot-assisted surgery (RAS) products are being developed by as many companies (we are counting only those robots destined for use in abdominal surgery). We expect future competition to be high, with a huge emphasis on cost-containment and miniaturization. We predict that robotic instruments and laparoscopic ports in all future surgical platforms will match the 5 mm laparoscopic ones (and should already aim to emulate the 3 mm minilaparoscopy standard) (Fig. 1). However, building miniaturized fully wristed robotic instruments has proven very hard. Snake tip 5 mm instruments have always been available, but these cannot compare with pulley-based instruments in terms of versatility. Longer-lasting semi-disposable (or better non-disposable) instruments would further reduce the operating costs of RAS. Robotic arms should be less intrusive and less prone to collisions amongst themselves and with the bedside personnel. This may be achieved by a simple reduction in arm diameters but may also involve more sophisticated technology such as an increase in the number of joints per arm, as well as the development of self-aware arms that can register their own location in space and adapt as required by the movements of the other arms.

Vision is expected to improve further, with 4K visors probably replacing the current 1080K visors. However, physical limitation based on camera size and the need to maintain stereoscopy may limit the level of clarity that we can achieve while miniaturizing laparoscopes. Image fusion and smart vision will likely evolve. The only currently available smart vision feature is FireFly fluorescence imaging, available on the two more recent generations of the da Vinci robot. In FireFly, a special camera uses near-infrared imaging to detect an injected tracer, indocyanine green and highly vascularized tissues are highlighted. Other uses of FireFly include highlighting lymph nodes and even ureters (with transurethral injection via catheter/cystoscopy) (Fig. 2) (9–11). Even though the use of the FireFly in reproductive surgery is limited, it is easy to envision how similar technologies could change the way we operate on conditions such as endometriosis (12), for example, when fluorescence can be linked to specific tissue markers (13, 14). Image fusion can be expected in future robotic/non-robotic platforms, with imported data from 3-dimensional (3D) ultrasound, 3D computed tomography, and magnetic resonance imaging being "locked" onto specific anatomical points that the robot is able to recognize during surgery, allowing for image scaling and real time 3D image fusion. Applications in reproductive surgery could be deep myoma mapping in complex multiple myomectomies, and location of distorted adnexal, urological and rectal anatomy in complex adhesiolysis, endometriosis excisions, and unusual müllerian anomaly cases.

Automation and artificial intelligence (AI) would be considered a major quantum leap, and it may not be reasonable to expect that they are introduced in RAS within the next decade. When available, automation could optimize repetitive actions such as suturing of the myometrium, or performance of an ovarian diathermy procedure. Enhanced automation with AI could perform more complex actions, where many variables need to be continuously re-assessed. Examples of this would be keeping the visual field free of blood though automated suction and irrigation or excising certain lesions based on information from smart vision, while sparing unaffected tissues. It is likely that automation will be the very last improvement in RAS, and that AI may be introduced before that, to optimize maintenance, prevent human error (in energy activation, for example) and make integrated robotic simulation software more personalized, based on instrument preference and actual procedures performed.

Single incision RAS is already a reality. Single-site set-up based on semirigid instruments crossing in the midline has

FIGURE 2



Indocyanine *green-based* real-time fluorescence imaging is the first example of smart vision for robot-assisted surgery. In this case, the ureter is clearly delineated in the pelvic allowing for safer dissection of the left pararectal space. **(A)** Regular chromatic vision and **(B)** fluorescence vision. (Courtesy of Dr. Andrea Vidali, New York, NY).

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been studied in reproductive surgery in the management of small uterine fibroids (15). However, its undeniable technical complexity makes it a technology with limited applicability. At five years after its introduction (16), this remains a niche technology, and we predict that its clinical use will not continue. Significant technological improvements on single incision RAS are already available, with single channel robotics that bring in a fully wristed camera plus three fully wristed and elbowed instruments through a 2.5 cm rigid cannula (17).

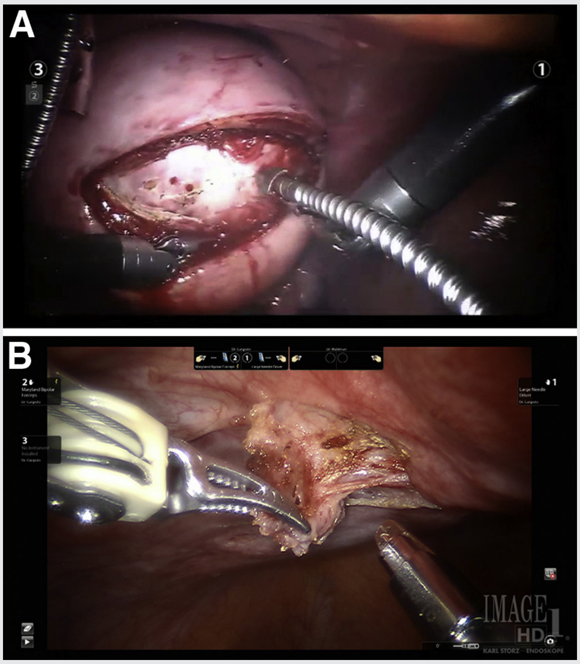
It is hard to predict whether this improved technology will find practical applications in reproductive surgery. At the time of this article, this single-port technology is not yet FDA-approved for use in gynecology (approval is still limited to urology and otolaryngology). The need for a 2.5 cm entry, usually set within the umbilicus (with the caveat that most women umbilici are smaller than 2.1 cm (18) makes this technology more suitable for those operations that will necessitate the extraction of solid specimens, given that several surgeons use the umbilicus to extract specimens in a contained system. Colposcopic applications of rigid channel single port robotics are a future possibility. A clinical advantage could be derived in the treatment of rare complex vaginal anomalies, such as marsupialization of high blind vaginal pouches in patients with obstructed hemi-vagina and ipsilateral renal abnormalities. Culdoscopic applications of single site robotics will necessitate significant technological adaptations. That is because the pathology at hand will be located at a 180-degree angle from the point of entry and we cannot envision a practical use for currently available technology in this specific setting.

Novel Energy Sources in Reproductive Surgery

Advantages of laparoscopic surgery include minimal injury to abdominal tissue and decreased injury to the peritoneal surface which result in decreased scar tissue formation and faster recovery. In addition, better visualization due to magnification makes the surgery safer, efficient and precise. The advantage of increased magnification with possibility to perform precise surgery utilizing microsurgical principles (19) is probably squandered a little with the use of electrosurgery. Clinical proof does not yet exist to confirm that one energy modality is better than the other in reproductive surgery, including radio frequency electrical energy, kinetic energy, light amplification by the stimulated emission of radiation (laser) and plasma energy (20). Use of monopolar energy has clearly been shown to have the maximal lateral spread of thermal injury. It is in this setting that laser energy, which is making a comeback after losing ground to radiofrequency energy sources, and the newly developed plasma energy may become favored energy sources once clinical evidence accumulates to show an advantage.

Light is composed of waves of multiple wavelengths. With a laser, the light emitted consists of waves of a single wavelength. Lasers operate at different wavelengths and have different properties. CO2, Nd:YAG, and KTP532 are all different types of laser energy sources developed and used extensively from the 1960s to mid-1990s. The bulky nature of the equipment, cos,t and cumbersome rigid instruments were a disadvantage, although they were remarkably precise and safe (21). Carbon dioxide laser is highly absorbed by water in tissue and water is heated and vaporized, producing steam mixed with tiny solid particles. Energy effects are limited to an area immediately adjacent to the laser-tissue interface, at a depth of approximately 150 μ (compare that to the up to 5000 μ of monopolar energy). Carbon dioxide laser is not pigment-seeking, so energy is distributed evenly throughout the tissue independently of the presence of hemoglobin. Tissue effects of the laser depend on power density (power output combined with beam diameter), duration of application, and the target organ (based on water content of cells). The tissue effects of electrosurgical instruments (monopolar and bipolar electrosurgery) are based on these same characteristics, but also on the energy waveform and the shape of the electrode. Because of this, effects of electrosurgical instruments on tissues are less predictable than those of the laser. Monopolar electrosurgery, in both cut and coagulation modes, damages uterine tissue significantly more than the CO2 laser. Collateral tissue damage (lateral thermal

FIGURE 3



Miniaturized carbon dioxide laser fibers. Flexible miniaturized laser fibers allow wristed robotic instruments to wield extremely precise laser dissectors in all possible angles. In this fashion, the angle of incision is optimized, and the thermal spread is minimized. **(A)** Intramural myomectomy and **(B)** excision of endometriosis overlying left uterine artery.

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spread) increases in proportion to the power setting with electrosurgery significantly more than with the laser. This means that the CO2 laser has a higher incising efficiency than electrosurgery. Similar to a knife, it will cut deeper, but not wider, with any increase in energy (22). Laser energy remains the most underutilized energy option in gynecologic laparoscopy today despite its well documented precision, safety, and accuracy. This could rapidly change with the introduction of miniaturized, flexible laser technology that was specifically developed with minimally invasive surgery in mind. Flexible CO_2 laser fibers are extremely small (under 2 mm diameter) and bendable, and feature beam divergence (Fig. 3). The latter allows the surgeon to decrease power density simply by moving the beam slightly away from the tissue. A smaller beam diameter (close-up action) concentrates the energy to produce a cutting effect, while a larger beam diameter (more remote action) contributes to hemostasis or superficial ablation. The versatility of this tool is largely based on its intuitive use, which gives the operator a wide range of tools in a single small package: the laser fiber it is primarily a precision knife, but also a superficial coagulator and an ablation device. Beam divergence is exponential: consequently, the profound drop in power density with distance is also a major safety feature of this tool, which minimizes damage from past-pointing. The flexible steel guide that holds the laser fiber has a spatula tip that becomes the fourth tool of these devices: this tip functions as an effective dissector, which remains cold, even if laser energy went through it until a millisecond before. A unique application of the flexible CO2 laser fiber is its use for myomectomy with single-incision robotic technology, recently described by our team (16). The miniaturization and flexibility of the laser fiber are essential to this technique and provide a glimpse of its future as a device of choice in future miniaturized RAS systems. Flexible lasers are an excellent tool for endometriosis and complex adhesiolysis, excision of uterine isthmocele, and ovarian diathermy (23–25).

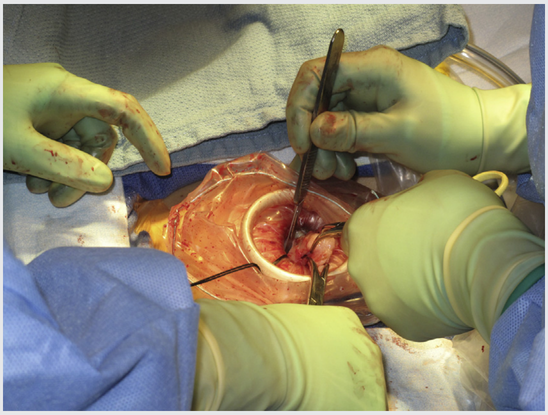
The laser devices described have a higher cost than most electrosurgical devices currently in use. However, the reintroduction of laser in gynecologic surgery, and particularly in reproductive surgery, represents a technical and safety improvement. While it may be challenging to demonstrate improved reproductive outcomes, some evidence can be cited in support of the choice for laser. For example, patients undergoing myomectomy with CO2 laser have a significantly lower chance of being admitted overnight after surgery compared to those in whom an ultrasonic scalpel is used (mostly due to differences in levels of postoperative pain). Postoperative considerations are something to keep in mind when considering the cost-effectiveness of adding laser to your armamentarium (26). Similarly, relevant is the consideration that uterine dehiscence or uterine rupture has never been described following a myomectomy performed with laser of any kind. It is always useful to make additional practical considerations when considering a re-adoption of laser in one's reproductive surgery practice. For example, the same fiber and generators are used for otolaryngology, neurosurgery, and for colposcopic, laparoscopic, and robotic applications in gynecology: if the hospital already owns one of the new-generation CO_2 laser units, the cost per case will be lower.

Plasma energy by comparison, is a relative newcomer. Matter exists as solid which upon absorbing energy turns into fluid and then gas. When gas is further heated, it ionizes to plasma. This ionized gas is unstable and releases its energy in three forms: light (aids in visualization), heat (seals and coagulates) and kinetic (vaporization and cutting of tissues).

The device has been evaluated in the U.S., U.K., and France and noted to be better at preserving ovarian tissue in endometriosis surgery (21). Plasma energy does not face the additional requirement such as training and need for additional person in room that some institutions require. Also, it is less expensive. Plasma energy has similar properties to laser such as precision and decreased thermal spread. However, it cannot compare with flexible lasers for its flexibility, versatility, and applicability to robotic surgery. However, it could become a viable alternative to electrosurgery and laser in the realm of conventional laparoscopy.

In conclusion, the past decade has seen a proliferation of energy tools that position themselves as an alternative to conventional electrosurgery and ultrasonic energy instrumentation. The main new players in this field are the flexible CO2 lasers and the plasma energy devices. While the technological improvements, in terms of precision and safety, are undeniable, their clinical superiority and ultimate value propositions need further study.

FIGURE 4



A safer alternative to morcellation. A 2.5 cm incision (the exact size of a classic Hasson open laparoscopy incision) can always be used to extract uterine tissue in a contained system. In this picture we feature umbilical extraction of myomas (contained in an endoscopic bag) through an umbilical incision.

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Contained Tissue Extraction: Unnecessary Challenge or a Step Forward?

One cannot look back at the past decade of reproductive surgery without pausing on what may appear to have been a substantial technological setback: the disappearance of electromechanical morcellators from the armamentarium of reproductive surgeons. For the benefit of new generation of surgeons who may not have used these tools, laparoscopic morcellators were made of an 8 mm to 20 mm metal shaft containing a cylindrical rotating blade which allowed a laparoscopic tenaculum to be inserted into the patient through the entire apparatus and pull the solid tumor towards the rotating blade's edge through the entire metal shaft and out of the patient's body. The tumor was therefore removed in strips and fragments, rather than intact. This allowed solid tumors of all sizes to be extracted through a small laparoscopic incision. For over two decades, beginning in the early 90s, morcellators have been the essential tool for minimally invasive myomectomy (27) (Video 1).

A growing number of publications highlighting the risk associated with morcellators resulted in a safety communication by FDA in November 2014. Without entering into the merits of this action that sparked an ongoing global surgical controversy, we can agree on the fact that the rationale for avoiding morcellation of uterine tissue is based on data indicating upstaging of uterine cancer in those patients where the uterine integrity is compromised inside the abdominal cavity (through morcellation, that is). However, reproductive surgery for uterine tumors (myomectomy, adenomyomectomy) is conservative and in these patients the uterus is incised and later repaired after abnormal tissue has been extracted from it. Our patients choose to avoid extirpative surgery (which would remove the organ and tumor en bloc), and therefore knowingly accept the risk that tumor cells will be spread inside their abdomen, independent of the modality of uterine tissue extraction chosen. In fact, even when myomectomy is performed in an open abdomen, tumor cells are spilled. Because of this, minimally invasive myomectomy is the innocent bystander of the morcellation ban. Avoiding morcellation in minimally invasive myomectomy because of avoiding cancer upstaging is not based on any scientific rationale. However, morcellation of nonmalignant uterine tissue has been linked to parasitic fibroid formation, disseminated leiomyomatosis and even endometriosis. These rare, complications can probably be reduced by avoiding uncontained morcellation in the abdominal cavity, although this has not yet been demonstrated (28, 29).

Be that as it may, uncontained morcellation of uterine tissue has fallen so much out of favor that even after the 2016 FDA news release announcing the marketing of the PneumoLiner (the first tissue containment system for use with certain laparoscopic power morcellators; Olympus) the technique has not bounced back. Instead, a certain regression of minimal invasiveness has taken place for myomectomy. Many gynecologists have abandoned minimally invasive myomectomy altogether, while many others still perform laparoscopic or robotic myomectomy, but then complete their elegant surgery with a minilaparotomy to allow for contained tissue extraction. Minilaparotomy is defined as a full thickness abdominal incision, spanning in length between 4 cm and 6 cm. The choice of minilaparotomy in the setting of minimally invasive uterine surgery makes very little sense, given that many myomectomies can be accomplished entirely through incisions of this size, hence denying the advantage of the minimally invasive portion of the operation (30). Truly, minimally invasive myomectomy should never include minilaparotomy as a step for contained tissue extraction. We know that this incision is never required, even when dealing with large myomas. Umbilical or lower quadrant access of 2.5 cm or less (the size of a classic open laparoscopy entry, to be clear) has been described, and is universally applicable to minimally invasive myomectomy (31, 32). These extraction techniques involve the acquisition of special manual skills and represent a new challenge to the diffusion of reproductive surgery (Fig. 4). Current robotic platforms cannot lend a hand here, and a return of open morcellation appears extremely unlikely: future technology that can facilitate the contained extraction of uterine and other tissues will probably see the light in the next decade.

QUO VADIS, REPRODUCTIVE SURGERY?

It is interesting to reflect on how much has changed in the world of reproductive surgery in the relatively short span of a decade. The obituary of open surgery as a standard surgical modality has been written, advanced laparoscopic techniques have become mainstream (though out of the reach of most), robotic surgery (the antidote to the hegemony of laparoscopic uber-surgeons) has penetrated the U.S. surgical culture with surprising vigor and is now likely on the verge of changing the face of all future surgery, and novel high-precision energy tools have become available. Moreover, patients are now better informed than ever about their pathology and about the armamentarium of tools to address them, thanks to the ease of access to information on the internet. Reproductive surgery is therefore alive and well, and never in the history of our specialty have we had so much exciting technology at our disposal. Yet, most reproductive endocrinology and infertility subspecialists are either inadequately trained for it or are simply not interested in entering this field. It is this apparent counter-current phenomenon that emerges as the most striking conclusion of our reflection on the past decade of this aspect of our subspecialty.

We, fertility experts, can continue to claim that we own reproductive surgery and that we always know best when to apply it, but this will only be a nostalgic cry if we do not make a more decisive move on reclaiming this field. Our commitment to surgery, if we are destined to embrace it, must be based on the support of our entire constituency: from our professional organizations and journals, to the credentialing bodies that regulate subspecialty certifications and the training programs. The space dedicated to reproductive surgery in our professional meetings and journals has decreased over the years and this is a symptom of a professional constituency that is focused on the molecular, on the microscopic, but forgets that reproduction still occurs within organs that are susceptible to disease, and that remain central to the goal of a healthy birth. Our subspecialty has been historically resistant to addressing the physical dimension of reproduction since medically assisted reproduction has entered the field. As a prime example of this, we should ponder that it took us a couple of decades to even realize that blocked tubes (a prime indication for in vitro fertilization) were actually a major impairment to in vitro fertilization success when they became hydrosalpinges. So, we all need to agree that reproductive surgery is an essential dimension of what we do to help our patients achieve a healthy pregnancy.

In terms of training and certification, our subspecialty may have to evolve culturally to a position of selective inclusiveness. We should welcome and support our general gynecology colleagues who have an interest in reproductive surgery and special training in minimally invasive surgery. But we must hold them to the principles of reproductive surgery if they must be trusted with the care of our patients. The tenets of our surgery do not change: highly personalized in terms of its timing and indications; strictly adherent to microsurgical principles; and minimally invasive whenever possible.

We should also value (and seek ways to associate with) those in our own ranks of REI subspecialty who chose to focus on reproductive surgery, as they will always by virtue of their long subspecialty training, and through the assistance of digital-age surgery, be better qualified to engage in the comprehensive care of infertile patients. Most large infertility practices can generate enough surgical volume to keep one or more of their associates very busy in the operating room, while still fully engaged in the running of the assisted reproduction program. Creative practice models where medically assisted reproduction and surgical revenues are distributed and can allow full integration of this professional figure in any large infertility practice. Depending on the geographical area and the local referral culture, this model may or may not represent a viable option. In some areas it can certainly benefit the practice, as it can make it stand out as a center of higher specialty for patients and referring physicians to rely on.

In conclusion, a decade of technological innovation has created more opportunity for both REI specialists and general gynecologists to engage in the fascinating field of reproductive surgery. As long as patients stand to reap true benefit from such improvements, who will provide them matters less.

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