

Clinical Opinion

When Will Video-assisted and Robotic-assisted Endoscopy Replace Almost All Open Surgeries?

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ABSTRACT This article traces the development of laparoscopy, and establishment resistance to its emergence as the technique to replace almost all laparotomies. *Journal of Minimally Invasive Gynecology* (2012) 19, 238–243 © 2012 AAGL. All rights reserved.

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Jacobaeus performed the first successful series of operative laparoscopies in 1910 [1]. The introduction of the scope into an area once thought inaccessible seemed to captivate the world, and soon the fledgling new field of laparoscopy was on the ascendancy [2–5]. So enthralled were many during this early 20th century heyday that soon the literature was teeming with soaring superlatives, with one early enthusiast describing laparoscopy as “the fulfillment of a dream” [6]. Interest in the new field was said to have been so piqued that by the 1930s, concerns about overenthusiasm arose [2]. Voicing such cautionary sentiments well was C. Abbot Beling [7], a successful laparoscopist-internist from New Jersey, who noted in 1941 that “Miracles were wrongly hoped for in situations where the use of the peritoneoscope was not indicated.”

Such optimism was not unwarranted because most immediately realized the new technology had the potential to end at last the practice of exploratory laparotomy, the procedure it was designed to replace, bemoaned by endoscopists since

at least 1898, and one that mid-20th century laparoscopist John Ruddock [8] declared “should be condemned.”

Then all was quiet on the laparoscopic front [2]. Like clockwork, it seems, the repeating pattern of institutional inertia began anew, bringing innovation to a withering halt, an effect plainly evident when one considers that until the early 1980s, operative endoscopy had essentially progressed no further than the same procedures introduced earlier in the century: draining cysts, lysing adhesions, biopsying, and coagulation of neoplasms [2]. As for one of gynecology’s most advanced laparoscopic procedures until the early 1980s, tubal sterilization, got its start decades earlier when Boesch, a Swiss surgeon, performed the first laparoscopic tubal sterilization in 1936 [9].

Indeed, with the exception of contributions from the 20th century’s few virtuosos, including Bruhat, Cohen, Frangenheim, Gomel, Manhes, Palmer, Semm, and Steptoe, the entire discipline of gynecologic operative laparoscopy seemed stalled.

Such arrested development was not the exclusive domain of gynecology. By the end of the 1970s, laparoscopy in general surgery had essentially advanced no further than liver biopsy, the same procedure that Germany’s Heinz Kalk and Carl Fervers had achieved in the 1930s [2,10,11].

The Price We Pay for Institutional Inertia

In terms of the toll on human lives, the cost of such delays in advancing minimally invasive surgery is not so readily apparent, especially since they occurred in a forgotten past that

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invariably fades from our memory like a fleeting aberration. Yet, when comparing surgical outcomes of today with those from just 30 years ago, we can see that the price paid was staggering, in particular for those with chronic disorders, which can require multiple surgical interventions to treat. For example, before endoscopy, female patients with chronic disorders such as endometriosis often had no choice but to undergo multiple laparotomies to treat sometimes only minimal disease. Research centers such as the World Endometriosis Research Foundation estimate that as many as 170 million women worldwide have endometriosis. By this example alone, we can see that the hidden cost of our collective inertia may have adversely affected millions of lives [12]. And so it was that worldwide, in all surgical disciplines, shock-inducing incisions were made in treating what sometimes were the mildest of maladies [10].

“Sometimes Good Things Fall Apart So That Better Things Can Fall Together” [Jessica Howell]

Like disruptive technologies are apt to do, the introduction of endoscopy called into question nearly 2 centuries of cherished traditions, ushering in the inescapable new reality that 170 years of surgical norms were no longer optimal care and that large incisions were not only unnecessary in most cases, but they often risked causing even more chronic pain and morbidity than the original illness.

After witnessing outcomes that seemed nothing short of miracles, even for notoriously difficult surgeries such as bowel, bladder, or ureter resection or reanastomosis; radical hysterectomy; advanced ovarian cancer; pelvic and para-aortic lymph node dissection; sacral colpopexy; management of ovarian remnant syndrome; and laparoscopy in advanced pregnancy, in 1990, our team could not help but proclaim that “In 20 years, major abdominal surgery will be nearly extinct.” Carrying on with our unabashed declaratives, we went on to state that with endoscopy “You can see better; and if you see better, you can do better,” noting too that “Wherever in the body a cavity exists or...can be created, laparoscopy is indicated and probably preferable. The limiting factors are skill and experience of the surgeon and the availability of proper instrumentation” [13–26].

What we failed to foresee, however, was just how many epic academic brawls would ensue as a result of this unwelcome threat to the entire order of things [27–32]. In the early 1980s, for example, one reviewer lambasted our first manuscript to bits, declaring in no uncertain terms that “The authors’ [Nezhat et al] recommendation to operate on the monitor instead of looking through the laparoscope is dangerous and irresponsible. It could lead to severe complications and death of...patients. Only 1 out of 200 surgeons might be able to operate on the monitor and off the images the way Nezhat recommends” (personal communication). In the late 1980s, another reviewer found our first report on laparoscopic bowel resections so

unconscionable that he could barely contain his ire, calling the entire enterprise “barbaric” (personal communication).

Even after collecting years of sound clinical data [2,4,34–52], video-assisted endoscopy continued to be the subject of nearly universal derision for most of the 20th century, dismissed as a glitzy gimmick of sorts, an implausible bubble just waiting to burst into oblivion [14,53–60].

The Moment of Reckoning Is Finally Here

It was only after overwhelming evidence in favor of the new surgical philosophy accreted to a point where it became impossible to ignore that open surgery was finally subjected to more rigorous critical analysis, a nearly 30-year process that ultimately has led to its worldwide downfall as the criterion standard of surgery [2,13]. More remarkable, even with elderly, pediatric, obese, emergency, and oncologic patients, in whom video-assisted endoscopy had remained staunchly contraindicated for most of the 20th century, a breathtaking reversal has occurred as physicians in these fields are now beseeching their colleagues to phase out overreliance on large incisions and embrace video-assisted endoscopy as their criterion standard of choice [2,13,61–65].

Even the most advanced laparoscopic procedures, those referred to as imprudent and infeasible for most of the 20th century [66], are now considered so superior to laparotomy that the *New England Journal of Medicine* dedicated an entire editorial on the subject, noting that “Technological advances, which are followed by long periods of catch-up while clinicians learn how to use the new techniques appropriately, often precede true medical progress. Early on, surgeons were hampered by having to steady the laparoscope with one hand and look through a small lens while performing surgery with the other hand. Advances in laparoscopic surgery were facilitated by a series of innovations that allow true video surgery, in which two surgeons work together with both hands to perform operations. Surgeons must progress beyond the traditional techniques of cutting and sewing..., to a future in which...minimal access to the abdominal cavity [is] only the beginning” [59]. How ironic that the procedure of laparoscopic colectomy referenced in this editorial, the same one first presented at the American Fertility Society in 1988, was the very procedure referred to as “barbaric” just a few years ago [29,31,33,67,68].

Critical Reappraisal

Perhaps of greatest significance, the introduction of minimally invasive surgery is catalyzing a long-overdue moment of reckoning, when all surgical traditions are finally being held to the light of scrutiny. For example, with the new minimally invasive philosophy leading the way, emphasis on sparing reproductive organs is becoming the norm in gynecology, rather than the exception. Another profound effect has been the way video-assisted endoscopy has revolutionized our understanding of anatomy. Just through these new

insights alone, most likely all of the anatomy textbooks that relied on the old techniques of open surgery will need to be entirely rewritten. And surgical outcomes once considered unavoidable in the days of open surgery are suddenly being reevaluated as physicians are finally acknowledging just how many severe complications such aggressive surgeries have been subjecting patients to all along [69–77].

Enigmatic Disease States Are Finally Being Understood

A greater understanding of disease states has also been achieved as a direct result of video-assisted endoscopy. The case of endometriosis is particularly striking. Often invisible to the naked eye and inscrutable in its etiology, for most of the 20th century, many patients with endometriosis were just as likely to be referred to a psychiatrist as a gynecologist, their inexplicable multiple-organ symptoms mistaken as psychosomatic disorders instead [2,54,77–80]. With studies as recently as 1995 reporting that in up to 50% of patients with chronic pelvic pain there was no apparent organic basis, this meant that nearly half of all women seeking medical care because of pelvic pain were susceptible to receiving inadequate care or to enduring unflattering assumptions about their character [2,54,81]. Also, since endometriosis is capable of producing acute symptoms commonly mistaken for life-threatening conditions such as ectopic pregnancy, kidney disease, malignancy, and appendicitis, in the days before video-assisted endoscopy, women with the disorder commonly underwent multiple laparotomies, which sometimes proved entirely unnecessary. Although the large incisions of laparotomy should have helped practitioners to detect its presence, endometriosis continued to evade the clinical gaze. Not until late in the 20th century was the multitude of morphologic features the disorder can take more fully recognized, a change many attribute to video-assisted endoscopy, which began displacing laparotomy as the preferred diagnostic and operative method for treating endometriosis during the same time frame [82,83].

Like many of my colleagues who are familiar with this confounding disorder, I had long suspected endometriosis was the cause behind many cases of chronic pelvic pain, even when the anatomy appeared normal at first glance. When I switched to video-assisted endoscopy, what I saw took my breath away. For the first time in my career, I was able to consistently visualize atypical lesions that could have easily been mistaken for normal tissue but that now, under video magnification, could be clearly seen as pathologic formations. I had never obtained such stunning visualization while performing diagnostic laparoscopy using the old method of peering into the eyepiece, or even from the vantage point of the supposedly superior views obtained via large incisions. Now I was able to find an organic cause in patients more than 90% of the time [84]. By the late 1980s, other converts to video-assisted laparoscopy began reporting similar clinical findings, which overturned nearly

a century of statistics that had misrepresented the true prevalence and proclivities of endometriosis, finally revealing what patients had been experiencing all along [85–94].

Where We Stand Today

Although it is encouraging to see that we have finally broken free from beliefs that stood unchallenged for centuries, it staggers the senses to consider how long it took to achieve this change, how many proverbial guns were drawn and battles waged, just so we could arrive where we are today, at the mere tip of a new era in which still no more than 30% of all major surgeries are being performed using minimally invasive techniques [95].

Why is this? Why do surgeons apparently ignore the preponderance of evidence demonstrating the unequivocal advantages that minimally invasive surgery can offer?

It seems the most likely answer takes us back to the inescapable issues of tradition, training, and instrumentation, the same roadblocks that nearly derailed endoscopic pioneers from 200 years ago, and the same ones we identified decades ago [13,24]. Just as it was 30 years ago, video-assisted endoscopy continues to be one of the most difficult techniques to learn, which means that most surgeons simply have not been able to gain the depth of experience necessary to reach a level of proficiency comparable to that with laparotomy. This is especially true considering that the typical practitioner performs surgery infrequently, perhaps only several times a month. At that rate, it will take years before most can attain competency in advanced procedures. Compounding the problem is that only a limited number of surgeons today are experienced enough themselves to teach advanced laparoscopic procedures. Meanwhile, the lack of proper instrumentation has proved to be an especially persistent nuisance, standing in the way of progress. No matter how great a pianist you are or want to be, you cannot play if you do not have a piano or if the one you have is utterly out of tune. While somewhat of a peripheral factor, the issue of inadequate reimbursement also serves as another potential disincentive, an unfortunate trend one author recently characterized as “a seemingly inexorable decline in reimbursement for operative procedures” [96].

The ethos of orthodoxy still permeating many medical institutes completes this vicious circle, standing ever stalwart against the new and unknown, making it difficult at times to initiate the changes needed to overcome these outstanding obstacles. Just as many resisted the transition to video-endoscopy, critics today are now focusing their sights on new-generation technologies such as robotics, a field some have dismissed as nothing more than an expensive superfluous flop, a criticism nearly identical to that once made about video-assisted endoscopy [97–99]. An article from 2009 even asked: “Robot for Coronary Artery Bypass Grafting: A ‘million dollar coat hanger’?” [100]. With impediments such as these still bogging us down, it is no wonder that

the traditional, more readily mastered method of open surgery has remained the default procedure of choice.

As for dilemmas, more confounding ones could scarcely be imagined; yet this is exactly where the opportunities lie. Thirty years ago, when few could see past the seemingly insurmountable shortcomings of video-assisted endoscopy, including its 2-dimensional field, encumbered dexterity, and counterintuitive motions, what most were also unable to imagine was the day when enterprising engineers such as Ajit Shah and Al Greene would develop the Da Vinci robot, overcoming in an instant the obstacles that seemed destined to be the eternal doom of our discipline.

From this example alone, we can see that it is only a matter of time before others will tap into those hidden reserves of potential lying just beneath the surface of things, so that even the most urgent situations, such as hemorrhage from large-vessel injuries, will one day be routinely managed through minimally invasive means. Even now, technologies exist that could enable “robots” to perform surgeries based on the programmed movements of advanced surgeons as recorded by motion-detection sensors. Or, if we could solve the shortcomings of trocar insertions, which account for approximately 40% of laparoscopic complications and most laparoscopy-associated deaths [101–105], perhaps this could prove to be just the sort of tipping point needed to bring surgeons closer to achieving greater confidence and competency in minimally invasive surgery.

Urgent Call to Action

As for the estimated 4 million to 7 million [106,107] laparotomies still being performed in the United States every year, it is my belief that this figure should be considered unacceptable, if not appalling, especially considering that we have spent the last 30 years proving that even the most advanced procedures can be safely performed in a minimally invasive manner [2,34–52].

If patients could vote, we know they would have elected to end large incisions long ago, considering that they are the ones paying the greatest price for these disappointing delays in progress. Take, for example, the issue of laparotomy-induced adhesions, thought to occur in more than 93% of all patients who undergo the procedure [108–110]. Based on several long-term studies, the more severe forms of these iatrogenic adhesions are estimated to cause intestinal obstructions that require additional open surgery to manage in as many as 15% of cases, statistics that translate to nearly half a million patients potentially affected by this adverse outcome each year [108–113].

For millions of patients, then, the clock is definitely still ticking. In view of how much is at stake for patients, I believe it is time to renew our commitment to advancing minimally invasive surgery, to recognize that “the fierce urgency of now” is before us, urging us to take back the reins and begin anew.

There is no doubt in my mind that the era of large incisions is surely coming to an end, and that almost all open procedures will be replaced by minimally invasive surgery, with only a few exceptions such as cesarean section deliveries and organ transplantations, which, in any case, will be performed in part using minimally invasive methods. Whatever the odds, whatever it takes, my ardent wish is that we do not have to wait too much longer to see the day when large incisions are finally shipped back to the heap pile of history.

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