

Unreasonableness Redefined

The reasonable man adapts himself to the world; the unreasonable one persists in trying to adapt the world to himself. Therefore all progress depends on the unreasonable man - George Bernard Shaw

One of the greatest achievements in modern medical history has been the shift away from large incision surgeries and into the realm of videoendoscopy, the method referred to over the years as “keyhole”, or “Band-Aid” surgery, but now simply known as minimally invasive surgery. Its impact on patients has been profound and unparalleled in modern times, with many now describing videoendoscopy as a change to surgery as “revolutionary to this century as the development of anesthesia was to the last...”(1,2)

Today, the minimally invasive method of videoendoscopy is now unanimously hailed as the gold standard in every category of surgery.(3,4,5,6 ,7,8,9,10,11) Even the large incision abdominal hysterectomy, long considered the method of choice for most gynecologists, has finally been reconsidered, with the American Association of Gynecologic Laparoscopists (AAGL) declaring in 2010 that “abdominal hysterectomies are seldom indicated and patients should be offered minimally invasive approaches.”(12) More remarkably, in oncologic, pediatric, and emergency medicine, where videoendoscopy had remained staunchly contraindicated for most of the 20th century, a breathtaking reversal has taken place, as physicians in these fields are now beseeching their colleagues to phase out over-reliance on large incisions once and for all and embrace videoendoscopy as their aspirational gold standard of choice.(13,14,15)

Surely the greatest legacy, however, has been to witness in our lifetimes a medical revolution that has freed millions of patients from the injustice of enduring outdated surgical interventions that often imperiled lives, and in so many countless cases, took them too.

The great scalpel-scope showdown of the 20th century

Someone once said that videoendoscopy was “an overnight surgical sensation that was 75 years in the making.”(1) As it turned out, getting to the point of general acceptance – a process that isn’t even complete yet – actually did take years of relentless insistence before surgeons would abandon centuries of tradition and agree to re-learn how to perform surgery. We all know, of course, that attempting to convince surgeons to do anything against their will is a headache in the making. But to force upon their heads changes so radical was like un-friending the entire medical establishment. An outsized catalyst would be needed to rend surgeons loose from the mighty clasp of custom. This was when the great scalpel-scope showdown of the 20th century all began.

With his lithe frame and soft, almost melodic voice, Camran Nezhat doesn't seem the type to go around starting epic academic brawls. At least that's not what he set out to do. As Nezhat explains, helping patients heal faster and avert greater risks didn't seem exactly revolutionary to him at the time; it was what he thought he was supposed to do as a doctor. It stunned Nezhat to realize that others didn't initially see videoendoscopy in this way at all. What they saw was an innovation that appeared to be not only unnecessary, but a dangerous deviation from established norms without any possible present or future value.(16, 154,) Faced with institutionalized beliefs like this, for many years it proved exceedingly difficult to convince anyone that videoendoscopy could – or should - replace traditional large incision (open) surgeries.

Marooned in Mediocrity: the 1960s-1970s timeframe, just before videoendoscopy

Powerful indeed is the empire of habit – Publilius Syrus, Maxim 305

Of course, today minimally invasive surgery may seem so natural, so evolutionarily inevitable, like the story of man walking upright. Yet, videoendoscopy was not so obvious a solution during its 1970s debut, nor was it an idea that came gently into being. Looking back, one actually finds that its birth was more like a case of gravity defied; like suggesting a baseball player look the other way right when the ball is pitched; totally counter-intuitive. To get a feel for just what Nezhat was up against, it's helpful to evaluate endoscopy's role in both gynecologic and general surgery prior to videoendoscopy, in terms of the types of procedures commonly performed, available technologies, and surgical traditions.

Videoendoscopy's predecessors: Gynecologic Laparoscopy

The late 1970s skepticism concerning the use of endoscopy in surgical applications is not so clearly spelled out in other historical accounts. Many suggest that gynecologists in particular had “fully embraced” endoscopy as a standard modality by the 1970s.(3,17) While there is a grain of truth to this with respect to diagnostic endoscopy and some simple operations, for advanced operative procedures, the story was quite different.

To understand this paradox, it's important to consider the separate histories of videoendoscopy's two most important predecessors: diagnostic and operative endoscopy. Diagnostic endoscopy in modern times has antecedents stretching back as early as the 16th century, when polished metal reflectors, combined with modified tubes or specula were used to attempt visualization of internal body cavities. However, most regard Philip Bozzini's 1806 introduction of a (relatively) more sophisticated system as the beginning of modern-day diagnostic endoscopy.(18) Yet, for most of modern history, applying the endoscope abdominally (**laparoscopy**) proved far too treacherous an enterprise, which meant that for centuries the body's most critical organs could not be viewed or easily accessed through minimally invasive means. Some attempts of diagnostic laparoscopy from the 19th century

and even earlier have been reported, but most consider the German gastroenterologist, Georg Kelling, as the first to successfully utilize an abdominal approach when he viewed the abdomen of an anesthetized dog in 1901 and later performed this new minimally invasive diagnostic technique on a small series of patients.

As for endoscopy's operative history, French urologist Antoine Desormeaux is usually cited as the first in 1853 to perform a large series of clinically successful therapeutic cystoscopic procedures guided by true endoscopic visualization. Yet, it wasn't until 1910 that the first successful *operative* laparoscopy would be achieved by Swedish internist Hans Christian Jacobaeus, who laparoscopically lysed adhesions in the abdominal cavities of seventeen patients and in the chest area of two. Jacobaeus's work seemed to captivate the world, as soon the fledgling new field of laparoscopy was on the ascendant, shining with imponderable promise for approximately the next 30 years. Laparoscopic pioneers from around the world, like Bernheim, Nordentoeft, Orndoff, Korbsch, Fervers, Kalk, Boesch, and Ruddock, just to name a few, were among the earliest after Jacobaeus to perform simple therapeutic and diagnostic laparoscopies. (19,20,21) Interest in the new field was said to have been so piqued, in fact, that concerns about over-enthusiasm arose. Soon, though, calls for restraint echoed throughout the medical literature as news of the method's possible serious and sometimes fatal complications spread far and wide. Indeed, with so many vital organs, veins, and arteries headquartered in the abdomen, initially all forms of laparoscopy were plagued with significant morbidity and mortality rates. As a result, laparoscopy eventually fell into relative obscurity, abandoned by the majority of US practitioners by the 1950s. Precipitating this change was the fact that open abdominal procedures had become safer, which helped transform it into not only the preferred operative approach, but also ushered in the era of the infamous *exploratory laparotomy*, a favorite diagnostic modality for much of the 20th century. With all forms of laparoscopy now effectively demoted as the oppressed other, it would take years to fully revitalize interest in the field. Even as recently as 1972, for example, there were only approximately 30 centers in the U.S. in which laparoscopic procedures of any sort were being performed.(33)

Conceptual plateaus persist despite modest revival of interest during the 1960s-1970s

It was only after the introduction of a few key technologies during the 1950s-1970s, along with influence from several prominent international laparoscopists, that a modest revival of interest in laparoscopy emerged in the U.S. once again, especially in gynecology. (22,23,24) For example, by 1981 training in laparoscopy had been added to "all major gynecologic residency programs" in the U.S. (20) The volume of procedures being performed also skyrocketed, with one source reporting that the number of tubal sterilizations performed laparoscopically increased from just 1% in 1971, to an astonishing 60% by 1976.(27) Eventually, though, it became clear that laparoscopy was of limited utility for more advanced operative procedures, a fact attributable to its seemingly inescapable, centuries-old design, which required surgeons to hunch over, squinting with one eye closed and one hand encumbered in order to view the surgical field directly through the small aperture of the scope. In this manner, there was no way for endoscopists to avoid those infamous painful contortions they found themselves in just so they could obtain what amounted to no more than a negligible view of the anatomy. As

a result, for most surgeons advanced operations with the laparoscope were essentially infeasible at best and perilous at worst.

Given such historical baggage as a fatally flawed modality considered devoid of any real potential, it's easier to understand why progress toward more advanced laparoscopic procedures had essentially stagnated by the 1970s, entrapped by imaginary boundaries beyond which it was forbidden to go. Up until recently, in fact, most surgeons were aghast at the mention of using the laparoscope to remove even just ectopic pregnancies, let alone resecting the bowel with it. As for gynecology's operative laparoscopic superstar of the 1960s-1970s – the tubal sterilization - it actually got its start back in 1936, when Swiss surgeon Boesch performed the world's first documented laparoscopic tubal sterilization using electro-cauterization.(25,26) Naturally, the technique had been perfected over the years. Yet, by the end of the 1970s, conceptually the procedure had not changed much from its 1930s debut. Indeed, with the exception of contributions from the era's few virtuosos - Palmer, Frangenheim, Semm, Steptoe, Bruhat, Gomel - the entire discipline seemed stalled for what felt like was going to be forever at tubal sterilizations, as if it were the final frontier. Even as recently as 1977, Germany's Kurt Semm, the foremost laparoscopic pioneer at the time, received a decidedly cool reception at an AAGL medical conference where he demonstrated various operative laparoscopic procedures he performed in the traditional manner of peering directly into the scope. "Kurt Semm's pelviscopy presentation struck people in that meeting as going too far," recalls Soderstrom, one of the founding members of the AAGL. And this was the response from one of the most welcoming societies in the world for new laparoscopic ideas. With the debate titled '*Laparoscopy is replacing the clinical judgment of the gynecologist*', it was abundantly clear that advancing the scope beyond its proscribed therapeutic and diagnostic roles was simply too unsettling and unacceptable for most.(27)

Videoendoscopy's technological predecessors: TV, film, video, & light sources

Despite these areas of inertia, there were still many amazing endoscopic milestones being achieved, at least in technological terms. In fact, precursors to video had been established for many years prior to the 1970s. Cinematography and television had actually been used modestly for endoscopic procedures since roughly the early 1940s. (28) And, by 1950, Japanese pioneers Uji, Fukami and Suginara, in collaboration with Olympus, had developed the gastro-camera, the world's first miniaturized endoscopic camera, about the size of a nickel.(29) Still, these systems were not designed with operative videoendoscopy in mind. Even as late as 1977, an article summarizing the latest in endoscopic TV and video devices – referred to back then as "teaching attachments" – described these technologies as useful for teaching and documentation purposes only; there is no mention of changing the *method* of performing endoscopic procedures to advance its operative potential. (30,31) And, as the figures from this article show, even though 1977-era laparoscopes were equipped with cameras, surgeons were still using the endoscope in the traditional manner; hunched over, peering awkwardly through the eye piece.(see figure __) (32,33)

In other words, although some of the technological rudiments to support videoendoscopy had been extant for at least forty years in some cases, the most crucial missing link was not technological in nature, but rather was an issue of missing an opportunity to re-imagine reality.

Overcoming the mythology of laparotomy

We would rather be ruined than changed; We would rather die in our dread Than climb the cross of the moment And let our illusions die – W.H. Auden

Perhaps the greatest mythology to overcome, however, was the nearly universal consensus that a large abdominal incision – laparotomy - was irreplaceable as a surgical modality. Even though female patients had been insisting on vaginal entry surgeries since at least the 1890s, just to avoid laparotomies, and even though surgeons had been bemoaning its significant mortality rates since at least the 1920s, after improved antibiotics and anesthesia became available, by about mid-century laparotomy's perceived benefits began to overshadow its formidable downsides. (23) Transformed now into a paragon of surgical virtue, its often serious complications were somehow downplayed as normal and necessary for the sake of saving a patient's life.

With classical surgery's large incision allowing ample room to view and palpate the internal viscera, to be free of any spatial confinements or depth of field distortions, to see in 3-D and directly (as nature intended), attending to hemorrhages with the greatest of ease; these were undeniable advantages for surgeons, believed to be crucial for the very survival of patients and thought to be unattainable by any other means. And, with the introduction of even more advanced medical adjuvants in the late 20th century that made laparotomies even safer - improved anesthetics, intramuscular antibiotics, anti-hemorrhagic agents - morbidity and mortality rates did in fact begin to decline at a precipitous clip. Meanwhile, microsurgery, a more refined version of large incision surgery, emerged as a popularity modality. By the late 1970s it was beginning to be touted as a possible panacea for all the flaws associated with the more traumatic "gross" laparotomy.(31) Although microsurgery was still open surgery, only in disguise, nevertheless at first glance it actually had a lot to offer, apparently almost as much as videoendoscopy; a more comfortable operating position, magnification, and reduced damage to tissue, resulting in fewer adhesions. And, when applied to fertility surgery, spectacular results with microsurgery were reported, with purportedly doubled, even tripled, fertility rates commonly cited. (33) Other sensational milestones soon followed, like the world's first vascularized Fallopian tube transplant by Brian Cohen in 1975, achieved with the aid of microsurgical techniques. (31) With rock star moments like these, who needed a new surgical philosophy? The existing ones appeared to be working just fine.

So just who is the antagonist in this story?

To be fair, such sentiments were understandable for much of the 20th century, when there were indeed few other choices to open surgery. The fact is that large incision surgeries during modern times saved more lives than they took; which is why attempting to define just who the real antagonist is in this story is not only futile, but an exercise which wouldn't provide much meaningful insight anyway. Rather, these historical vignettes provide a greater understanding of just how easily biases can slip past the scientific process, how beliefs can become "a form of blindness", even when they're slipping toward obsolescence. By the time Nezhat came onto the scene, the surgical opinions he began questioning had been viewed as nearly infallible truths for almost two centuries. But prevailing opinions are only as good as the data that inform them. We assume that evidence-based medicine and the peer-review process will weed out the bad and usher in the good; but don't such systems fall apart if the right questions are not being asked in the first place? Even with the best of intentions, aren't clinical observations imperfect inputs, viewed as they so often are through the distorted lens of an observer's own flawed assumptions? These were the sorts of issues that had to be carefully considered in order to convince others that 150 years of tradition was no longer optimal care, that large incisions were not only unnecessary in most cases, but that they often risked causing even more complications, permanent disability, and mortality than the original illness.

Backlash to laparoscopy for second time in the 20th century

As if these conceptual plateaus were not enough, gynecologic laparoscopy in America was actually experiencing another season of discontent, just beginning to surface in the late 1970s.^A Growing concerns over complication rates associated with out-patient laparoscopic sterilizations began to surface. Though some aspects of the reporting were sensationalized, nevertheless the unexpected rise in complications triggered a nearly instantaneous backlash against laparoscopy in general, as articles forewarning of its potential for serious mishaps began seeping into the medical literature, and eventually the lay press. One of the first such articles to gain national attention was published in 1977 by the well-respected founder of the AAGL, Jordan Phillips. Phillip's exposé, which outlined in stark detail the estimated complication rates associated with laparoscopic tubal sterilizations, struck a raw nerve within surgical communities and served for a time to temper enthusiasm.(34)

Soon thereafter, urgent congressional hearings and other governmental advisory panels were called into session to address concerns about the rapid technological changes affecting endoscopic medical devices in particular and medical technologies in general. Symbolic actions were taken against all forms of endoscopy, beginning most conspicuously with the Congressional Health Device Act, passed in 1976. Later, in 1981, the CDC in Atlanta issued a terse public rebuke over patient deaths apparently linked to unipolar electricity sources used

A) European laparoscopists, you will recall, had already experienced this wave of backlash about a decade earlier.

in laparoscopic sterilizations.(35,36,37)^B In such an environment of growing controversy, eventually failed sterilizations became the second leading cause of lawsuits for obstetrician-gynecologists in America.(62) Since the medical community tends to err on the side of caution, such adverse reports – whether exaggerated or not - were nearly the death-knell for endoscopic innovation in those days.

Operative progress ossified in its tracks

Men become accustomed to poison by degrees - Victor Hugo

The effects of this growing controversy and lingering conceptual constraints are plainly evident when one reviews the literature and textbooks from the 1970s-1980s, which reveal that the laparoscopic procedures being performed were essentially no more advanced than those that had been introduced nearly fifty years earlier; draining cysts, lysing adhesions, biopsies, cautery of neoplasms, and tubal ligations.(38,39,40,41,42,43) For all of the most complex gynecologic pathologies that required surgery, large incision laparotomies remained the only surgical solution available. And, this wasn't just a gynecologic thing. By the end of the 1970s, laparoscopy in general surgery had essentially advanced no further than liver biopsies, the same procedure that Germany's Heinz Kalk had achieved in the 1930s.(3)

Близок локоток, да не укусишь - Blizok lokotok, da ne ukusish

And thus it unfolded that, for the second time in the 20th century, interest in endoscopy laparoscopy had soared to the heights of unfathomable popularity, only to plunge back down to earth after the veil had been lifted and its inherent limitations were revealed. The revivalist hey-day that American laparoscopists had so enjoyed during the 1965-1975 timeframe had been nearly neutralized by the end of the 1970s, leaving operative progress practically ossified in its early 20th century tracks.(44)

Impossible, you might say! Fifty years without a new operative procedure? How could this be? After all, extraordinary technological advances were proliferating at an astonishing clip during this era; fiber optics, automatic insufflators, electronically-controlled thermo-coagulators. Yet, here we were in the late 20th century, with men and monkeys flying to the moon and back, while laparoscopists were still stuck back at the farm, performing mainly simple tasks and routine diagnostics. It seemed to be a clear case of *Blizok lokotok, da ne ukusish*. This old Russian proverb, translated as “your elbow is close, yet you can't bite it” was an apt description for the times, as new technologies were bringing laparoscopy elbow-close to breaking through and beyond its old limitations. Yet, the field ultimately remained far

B) However, later in 1987, new reports were presented which contradicted the CDC's initial findings, thereby somewhat vindicating unipolar technology.

away from the bite because overcoming psychological resistance to change proved to be the far more formidable element to overcome.(45)

Point of no return

Necessity knows no law except to conquer – Publilius Syrus, maxim 553

Given this parade of impossibles, the timing truly could not have been worse for Nezhat to introduce such a radically new concept as that of advanced operative videoendoscopy.

To take on the veritable empire of so-called classical surgery, surely one would have to have been either totally insane – or totally on to something. As luck would have it, Nezhat happened to have a peculiar talent for completely disregarding reality and this skill sure came in handy now. With odds like these, most reasonable men - actually, most crazy ones too - would have started backing away, very, very slowly. To watch him bet it all so soon, “the foreign boy”, so fresh off the boat, so barely speaking English, surely this was the very definition of a train wreck in the making. If a man from a farm with sod for walls could actually pull this off, it would have to rank as one of the most stunning upsets of the century.

No matter the outcome, there was no place to back away to. This was 1979 and Nezhat’s homeland of Iran had been practically reduced to ruins, ravaged by revolutionary fervor, blighting forever any comforting notion of a ‘home’ to return to. In any case, too, by the time he had finished medical school, there really was no turning back; he had simply seen too much, too many instances of laparotomies gone wrong, when the cure became the ill. Failed laparotomies, of course, were not inanimate entities; they had names, like Katia, the 21-year-old whose fate marked the point of no return for Nezhat. The laparotomy she had undergone for what was feared to be a ruptured appendix seemed to have been relatively uneventful. Even so, less than 48 hours later she was gone. Aside from mild nausea and sharp, endometriosis-associated menstrual pain emanating from her left side, all other indicators pointed to a robustly healthy young woman with an unremarkable medical history. Still, by nightfall her symptoms had grown worse, though it wasn’t known until after surgery that a burst ovary was the cause. Fearing something worse, however, the lead surgeon was called in and preparations for a laparotomy began.

You had to essentially cut the abdomen wide open, cutting through 5 layers and up to 12 long inches worth of a densely-packed, highly vascularized network of skin, nerves, fascia, ligaments, lymphatic vessels and muscle, which support nearly all of the body’s most vital organs.(46) Then you had to expand the fresh wound with a metal devise called a retractor, the jaw-like clamps of which gouged still further into the wound, at times tearing even more nerve and tissue than the incision itself. Meanwhile, pressure differentials caused the intestines to spill out of the incision, so surgeons had to pack it all back down with heavy cotton padding, another process that could cause considerable nerve damage to the bowel and rectus muscle, sometimes leaving patients fecally incontinent for several months, or even

years after surgery.(79) It was also a bloody mess, “gruesome” as some surgeons describe laparotomies even to this day. (79) And, you did all of this just so that you could get to a 5 cm endometrioma; or sometimes nothing at all.

Even with the meticulously etched 12-inch vertical incision that had been perfectly placed in about the middle left of the young patient’s abdomen, the tangle of endometriosis-induced adhesions and extensive amount of blood that filled the surgical field had obscured the anatomy just so, making it difficult to see the loops of small bowel that had somehow fixated to the left pelvic side wall, right in the path of the otherwise perfectly hewn incision. With vitals appearing normal at first, no one was prepared for the cascade of events that ensued. What initially seemed to be a simple incisional infection turned into one mess of a necrotizing fasciitis, a dreaded complication in which so-called flesh-eating bacteria from deep within the body begin destroying the incisional tissue with stunning rapidity; fatal outcomes are estimated to occur in as many as 18-35% of all cases. (79) The septic shock that was beginning to materialize from the unrecognized bowel perforation definitely didn’t help matters and catalyzed one of the most terrifying events Nezhat has ever witnessed; incisional evisceration, otherwise known as a burst abdomen, when the swelling from a raging internal infection causes the sutured incision to burst wide open. Bowel, blood, tissue, and bile explode out while the patient is usually fully conscious. (79)

With endometriosis’s penchant for producing acute symptoms commonly mistaken for life-threatening conditions, such as ectopic pregnancies, kidney disease, malignancies, and appendicitis, in the days before videoendoscopy women with the disorder often underwent multiple laparotomies that sometimes proved to be unnecessary; sometimes fatally unnecessary. No one said it, but everyone knew that the burst ovary found at surgery would not have killed Katia.

Nezhat was officially haunted, not only by the many other similarly fatal outcomes that followed, but also by the high rates of less life-threatening, but nevertheless serious complications that were devastating in terms of quality of life, such as cases of irreparable ischemia of vital organs.

And, in terms of the multiple laparotomies commonly needed to treat chronic disorders such as endometriosis or infertility, to think all this was endured, even though cure rates were actually abysmal by today’s standards. Yet, women of this era were driven to the edge of despair, willing to risk everything for the chance to be freed, even for just one moment, from the greater horror of being imprisoned forever in a lifetime of unbearable pain or infertility.

Such scenes were not the exclusive domain of gynecology. In his surgical rounds, Nezhat saw these same harrowing results crisscrossing the landscape of all disciplines, where even higher mortality rates and more invasive techniques prevailed. The gridiron incision, a crisscross of two 10-14 inch incisions - the horizontal one, hipbone to hipbone, followed by a similarly aggressive vertical incision - was standard procedure for many general surgeries of the upper abdomen. Surgeries for tumors embedded inside the jaw were even more extreme;

the jaw had to be broken, with 4 to 5 teeth extracted. The incision was made either across the throat, from ear to ear, or from the top of the ear, running clear down to the bottom of the neck. It was only after all of that skin and tissue had been peeled back with those same metal retractors that the tumor could finally be accessed. Not only left with disfiguring facial scarring, in as many as 30% of the more severe cases, patients would end up losing their ability to swallow, requiring them to eat through a feeding tube for the rest of their lives. (47) All around the world, in all surgical disciplines, shock-inducing incisions were chasing after what sometimes turned out to be the mildest of maladies.(48,49,50)

A dream is born

Whether it's the best of times or the worst of times, it's the only time we've got. ~Art Buchwald

Nezhat simply could not reconcile what he was seeing, the glaring inconsistencies of laparoscopy itself, fully actualized in its diagnostic domain, then bounding forward so seamlessly toward essentially just one operative procedure, tubal ligations, gynecologic laparoscopy's apparent operative endpoint. Meanwhile, progress toward other surgical procedures remained elusive rarities, isolated achievements performed by a few virtuosos in just a few centers throughout the world.(51) It was such a peculiar paradox, to see the entire field stopping short of more advanced procedures that were just anatomical inches away. Seeing too how quickly patients recovered from laparoscopies compared to laparotomies, and it became inescapably clear that something was terribly amiss.

It seemed evident that one of the most significant hindrances thwarting laparoscopy's surgical progress was the awkward positioning it required. Whether in diagnostic or operative mode, the entire enterprise left everyone contorted in the most absurd positions; bent-over sideways, craning to peer down the scope's tiny aperture held by one hand, leaving only one free to perform procedures. It was essentially a futile enterprise, like performing surgery with flippers instead of hands. Nezhat knew that if he could just find a way to circumvent these physical constraints that more surgeons would be able to tap into endoscopy's true potential as an advanced operative force.

Far away from the prying eyes of peeping pessimists, Nezhat set out to find a solution, working late at night in the lab where he began to piece together fragments of an awakening idea. Of course, before any degree of success could be achieved, all manner of logistical nightmare ensued. The early prototypes Nezhat had rigged together with duct-tape looked more like a Home Depot project gone terribly wrong than the future of surgery. Even so, after many a misadventure, by 1979 Nezhat had somehow stumbled upon just the right configuration of positions and parts. With the equipment thusly transformed, he began operating 'off the TV monitor', which became the defining factor that enabled him to perform advanced laparoscopic procedures, avoiding large incisions in favor of tiny port holes. Both of the surgeon's hands were free now and both eyes could remain open, now that squinting

through an eyepiece was no longer necessary. Surgeons could also finally operate in a comfortable, upright position, which meant that operator fatigue was no longer standing in the way of performing more lengthy and complex operations. And, with the entire surgical team able to see what the surgeon was doing on the TV monitor, assistants could better anticipate the surgeon's needs, transforming surgery from a "one-man band", into a 10-piece "orchestra."

This crucial breakthrough occurred right as Nezhat was starting his 2nd year of a reproductive endocrinology fellowship with Robert Greenblatt, one of the nation's most preeminent fertility and endometriosis specialists at the time. Working with Greenblatt's patient population, Nezhat gradually transformed diagnostic procedures meant only to identify pathologies into opportunities to treat the disorders laparoscopically with his new technique.

By the mid-1980s, Nezhat was taking on cases once deemed inoperable by minimally invasive methods, with many considered impossible even by today's standards. The first completely laparoscopic and truly comprehensive treatment of severe endometriosis involving multiple organs and the infamous 'frozen pelvis'; bowel, bladder, ureter, diaphragm, lung, and liver resections and reanastomosis; para aortic node dissection and radical hysterectomy; ovarian remnant; myomectomy for large myomas; sacral colpopexy; dermoid cyst removal; tumor debulking of advanced cancer; adnexal mass removal during advanced pregnancy, and vesico and recto-vaginal fistula repair were some of the procedures performed laparoscopically for the first time by Nezhat and his team. (52,53,54,55,56,57,58,59,60,61, 62, 63,64,65,66, 67, 68,69, 70, 71, 72, 73 74,75, 76,77,78, 79,80)

Patients flocking in; colleagues beginning to doubt

One man with courage makes a majority -Anonymous

It wasn't long after Nezhat opened his private practice that the dramatically more successful clinical outcomes with the new minimally invasive methods became well-known.^{81,82} The lay press couldn't get enough of these fantastical, sci-fi surgery stories; videos and lasers and long metal sticks siphoning organs out of small holes; patients up and about in a day, all patched up with Band-aids instead of sutures. It was as if James Bond had entered the OR.

Of course, the reality was not that simple. There was a lot of work to be done, namely perfecting the instrumentation, refining the procedures, and, most importantly, gathering sufficient clinical evidence to prove that this decidedly more complicated and costly method was providing benefits to patients which were more than just marginally better than traditional surgical techniques.

But with glowing lay press reports that described seemingly miraculous results still inundating the airwaves, it wasn't long before concerns about the accuracy of Nezhat's data arose: Were they rigorously measured for statistical significance? What about selection bias? And why

wasn't he experiencing more complications? It all seemed so suspicious, technological and biological aberrations almost too good to be true.(138,154)

To help address these legitimate concerns, Nezhat was invited to present at AAGL's 1984 annual meeting. It was a welcomed slice of good luck. Finally, he would be amongst other free thinkers, referred to by some as laparoscopy's lunatic fringe, so daring were many of its members in pushing laparoscopic boundaries. Yet even here the perceived risks of videoendoscopy were viewed as far outstripping any conceivable benefits.

1985: ASRM - striking out again

Speak the truth, but leave immediately after – Slovenian proverb

Despite such setbacks, by the mid-1980s, things were looking pretty good. With now thousands of clinical successes to his name, this time Nezhat felt certain he had enough irrefutable data to convince his colleagues in academia of videoendoscopy's safety and vast potential. In 1985, just as today, the American Fertility Society (now American Society of Reproductive Medicine) was one of the world's most prestigious medical societies. At the time it seemed perfectly logical to head straight for the big leagues, to let the most respected minds consider for themselves videoendoscopy's case. Had it not been for such sound clinical evidence that he had secured, Nezhat might have found himself rather anxious; after all, compared to all of these luminaries of medicine, who was he to so brazenly postulate new surgical theories that implicitly questioned the entire order of things?

Yet surely, everyone would instantly understand the implications of it all? Surely they would see that videoendoscopy had the potential to finally break the chains of centuries and allow patients to be cured of debilitating diseases without enduring debilitating consequences. Who wouldn't want that?

On the conference stage now, Nezhat didn't realize how nervous he was until he attempted to speak, when, out of nowhere, his English vanished. His beautiful, beloved new language, nearly nine years in the making, lay in utter shambles upon his stunned tongue, all lost in one astonishing instant; Farsified Farglish came tumbling out instead. All he could do was smile and pretend that there was nothing wrong while gesturing energetically toward the video of his procedure that was playing in the background, which, in any case, was actually telling the story better than anyone ever could.

After the lights went up, Nezhat was smiling broadly, despite himself. He was expecting his colleagues to feel the same joy he had felt when he realized what this could mean for patients everywhere. Blank faces stared back at him. Perhaps they were just momentarily stunned? Overwhelmed by all of the overflowing joy?

The moderator shot Nezhat a scathing smirk. He had just one question for the audience: 'Raise your hand if any of you think this idea has anything to offer to man or medicine?' There

were about 400 of them out there; their stifling silence began sucking the air out of the room. Nezhat stood taller, mainly to keep from passing out, the air had turned so pale and grim. Out of the darkness, there came an arm! A live arm came clamoring out of nowhere, piercing at last the thick pall of suffocating silence. Everyone craned to see who this madman was. The arm belonged to one of his friends - a brave man - one of the first to attend his post-graduate courses.

Alas, the hearts and minds of medical academia remained totally unmoved, a vast tundra of impenetrable indifference. Nezhat didn't realize it at the time, but he had entered a new era, when he would be practically chased out of every town for suggesting something which even he had to admit sounded quite preposterous; the notion of surgeons looking at a TV screen and pulling whole organs out of little holes with long sticks instead of scalpels. For many years thereafter, Nezhat languished in a sort of outlier purgatory, unable to get any of his work recognized by mainstream medicine. Although his debut work on the laparoscopic treatment of extensive endometriosis was finally accepted for presentation and publication in 1985 and 1986, respectively, years would go by before anyone would come anywhere near some of the more controversial surgeries, such as those involving advanced stage ovarian cancer. (83,84)

Indeed, this - and much worse - would be about the same sort of reception he would continue to receive for the next 20 years, wherever he went and whenever he opened his mouth.

Curiosity seekers turned converts

It's been said that holding on to hope can drive a man insane, and during times like these, it certainly seemed like that's where all of this was heading. With academic medicine now foregone to his overtures, Nezhat decided to go straight to the people by starting his own post-graduate courses so that he could teach his methods to one individual at a time.

From the experience of holding those courses nearly every weekend, he found ways to help others overcome the long learning curve that the new surgical discipline presented. One by one converts were born. From far away, most viewed the stories they were hearing about Nezhat as some sort of grand ruse. Yet when they came to the courses and actually saw him perform these advanced operations laparoscopically, they walked away forever awakened to the new horizon of possibilities that had been laid before their eyes. By the mid-1980s, thousands had attended Nezhat's courses, including some of laparoscopy's future preeminent pioneers who later went on to achieve some of the world's first laparoscopic milestones using videoendoscopy.

Endometriosis's role in shaping surgical history

In a strange way, endometriosis may have played an indirect role in shifting surgery toward minimally invasive methods. Often invisible to the naked eye, inscrutable in its etiology, for most of the 20th century many patients with endometriosis were just as likely to be sent to a psychiatrist as a gynecologist, their inexplicable, multi-organ symptoms mistaken as psychosomatic disorders instead. Some reports even suggested that women with pelvic pain

without apparent organic basis tended to be more emotionally disturbed, neurotic, or hysterical than those without such symptoms.(85,86,87) Lingering beliefs associating pelvic pain with promiscuity also meant that patients were sometimes blamed for their illnesses. Women from American minority communities were especially susceptible to being misdiagnosed with diseases that implied sexual transgression. One study from 1993 found that “as many as 40 percent of African American women [were] misdiagnosed as having a sexually transmitted pelvic inflammatory disease (PID) when in fact they [suffered] from endometriosis.”(88) ^C

And with studies from as recently as 1995 reporting that, on average, up to 50% of patients complaining of chronic pelvic pain were found to have no apparent organic basis, this meant that nearly half of all women seeking medical care for pelvic pain were susceptible to receiving inadequate care, enduring unflattering assumptions about their character, or viewed as suffering from imaginary ailments.(89,90) In sum, even though the large incisions of laparotomies should have helped practitioners detect its presence, endometriosis continued to evade the clinical gaze.

Videoendoscopy helps to secure greater understanding of disease-states

Our beliefs are a form of blindness – Siddhartha Mukherjee

It was not until late in the 20th century that the multitude of morphologies the disorder can take was actually more fully recognized, a change many attribute to videoendoscopy, which began displacing laparotomy as the preferred diagnostic and operative modality for endometriosis during the same time frame.(91,92)

Like many of his colleagues familiar with the confounding disorder, Nezhat suspected endometriosis was the cause behind many enigmatic symptoms, even when the anatomy appeared normal at first glance. When he switched to videoendoscopy, what he saw took his breath away. For the first time in his career, Nezhat was able to consistently visualize atypical lesions that could have easily been mistaken as normal tissue, but that now, under the video magnification, could be clearly seen as pathological formations. He had never obtained such stunning visualization while performing diagnostic laparoscopies in the old method of peering into the eyepiece, or even from the vantage point of the supposedly superior views afforded by the large incisions of open surgery. With an improved ability to see pathologies that had gone undetected for centuries, videoendoscopy actually began contributing to an era of greater understanding about the true nature of endometriosis, as well as many other disorders. Now Nezhat was able to find organic causes in patients more than 90% of the time.(93) By the late 1980s, he and other newly converted videolaparoscopists began reporting clinical findings that overturned nearly a century of statistics which had misrepresented endometriosis’s true prevalence and proclivities, finally uncovering what

C) Unfortunately, the summary of this study did not provide the corresponding rates of similar misdiagnoses in white women, making it difficult to compare the differences among these two groups from this one statistic.

patients had been suffering from all along. (94,95,96,97,98,99,100,101) And, remember those 50% of patients from the 1990s, the ones with supposedly no organic cause to their pelvic pain? As it turned out, in the early 2000s, reports began to surface demonstrating that endometriosis had been routinely overlooked in the days before videoendoscopy as often as – you guessed it – 50% of the time.(102, 124) Today, when female patients complain of pelvic pain, they are given reprieve from those stinging words “it’s all in your head,” and are instead assumed to be suffering from a verifiable, decriminalized organic disorder.

Poor Resolution almost foils the thought

Nothing else in the world... not all the armies... is so powerful as an idea whose time has come -Victor Hugo

Unfortunately, it didn’t matter how many sound clinical successes accrued, at this point in time, Nezhat could not overcome one crucial dilemma; the era’s existing technologies were not advanced enough to support videoendoscopy to its fullest. Specifically, operating off the monitor was barely feasible because the early generation optics, TV, and video systems could not produce the level of high pixel resolution needed to make the images of the anatomy clearly visible when projected onto the monitor. Nezhat attempted to avert these deficiencies by using an extra endoscope to provide additional illumination. Still, this failed to solve the problem. This was because, even by the late 1980s, the highest level of resolution in medical TV monitors and cameras was still only between 275-450 lines; no match for the naked eye. (103) And despite the superior illumination afforded by the latest fiber optics, it was still not enough to effectively split the images toward the monitor. “Illumination sources are in a chaotic state” is how one frustrated surgeon described the situation as it stood in 1977.(70) Modest improvements were made when more advanced technologies were finally invented, such as beam splitters like the ones introduced by Japanese company Topcon in 1981.(62) However, these technologies were not always widely available. All of these deficiencies made images so grainy that most could not see how operating off the monitor through tiny incisions would ever be possible or provide any benefits, leaving many to wonder about Nezhat’s sanity.

Forever-scopy

Videoendoscopy was certainly not without its flaws. And we wouldn’t want to delude the reader by providing only the pretty pictures of its past. Indeed, one of its least attractive features was the extra time it took for most new converts to initially perform advanced procedures, so much so that videoendoscopy used to be called “forever-scopy”. During this extended learning curve, for example, laparoscopic ectopic pregnancy surgeries were taking up to 4-5 hours, while Nezhat’s and the word’s first laparoscopic radical hysterectomy with para aortic and pelvic lymphadenectomy actually took seven hours. Although today many laparoscopic procedures are commonly completed in less time than laparotomies, during the early days this wasn’t the case, making the increased duration a factor that wasn’t helping to convince anyone that videoendoscopy was better or safer than open procedures.(104) The

loss of haptic feedback has also been one of the more challenging changes to adjust to. Without the ability to palpate organs, it's difficult for surgeons to estimate the physical force needed to handle tissue or determine how extensively organs have been affected by pathology. Insufflating the abdomen also brought with it special new categories of complications. Eventually, though, these were ultimately resolved after Fishburne and other innovators invented new anesthetic techniques that were more suitable for the deep Trendelenberg positioning and insufflation pressures that came with the territory.(105)

“Agony in the Garden” – The Era of Hostility

Scandal has ever been the doom of beauty –book ii, properties

Like a rite of passage, the quintessential pioneer story wouldn't be complete without an element of abject suffering to startle us out of our reverie. Like Semm, Muhe and so many others, Nezhat was a favorite target of derision for many years. Even after more than 30 years of sound clinical data had been carefully uncovered about videoendoscopy's ability to free patients from more serious sequelae (25, 40, 106,107,108,109,110,111,112,113, 114,115,116,117,118,119,120,121,122,123,124), it continued to be met with nearly universal ridicule for most of the 20th century. “Why look through the keyhole” they quipped, “when you can open the door?”(125,126,127,128,129,130,131)

In terms of endoscopy's history, such responses were far from unique, as resistance to unconventional ideas nearly derailed endoscopy's progress since Bozzini and beyond. Yet, opposition to operative videoendoscopy proved to be especially fierce, for it forced surgeons to lose three vital sensory mechanisms: tactile, spatial, and direct visualization.(132)

The decisive tipping point came in the late 1980s, when it became clear that videoendoscopy had breached beyond gynecology, finally infiltrating the hitherto untrammelled territory of general surgery.(133) Although gynecologic surgeons had already achieved some of the most complex operative procedures laparoscopically by the late 1980s, it was Mouret's, Saye's and McKernan's famous firsts - the world's first ever completely video-assisted laparoscopic cholesterectomies - that became the proverbial last straw, pushing dissenters over the edge into a growing defiance against anything with “scopy” in its name.(37,134,135,136,137,138,139,140,141,142,143,144,145,146)

By now, Nezhat had become accustomed to all manner of harsh criticism, having already been accused of advocating methods that, as one opponent put it bluntly, would end up “killing patients” – or, as another warned, would “bring God's wrath to the earth,” despite the fact that his complication rates were much lower than those performing even diagnostic laparoscopies.

Yet now, it was searing hostility toward those who dared to flout convention that would scour the laparoscopic landscape. The first provocateurs threw their slurs into the safe space between the pages of medical journals. Medical articles, usually named with merciless

banality, suddenly were shining with soaring rhetoric, questioning minimally invasive surgery with such titles as ‘Operative laparoscopy: surgical advance or technical gimmick.’ (147) Soon the literature was teeming with similar accusations of intemperance, with another author stating “After several years of euphoria with the laparoscope, surgeons have started to look critically at the extravagant claims of minimal-access surgery.” (141)

Even as recently as 2003, some continued to call into question the safety and necessity of videoendoscopy, insinuating the worst with rhetoric such as “just because we can [do endoscopy] doesn’t always mean that we should.”(148) The same article goes on to implicate excesses of industry and the “glitz” of new technology as culprits with the following:

Surgical technology in the area of endoscopy seems to be exploding, but at what cost? ... Today, I ask the question: Who is driving the bus? Industry or physician? The focus on the basic principles of surgery is fast becoming blurred amongst the glitz of new technology.(156)

Eventually, though, the cheekiness decayed into scathing invectives which seemed to aim straight for Nezhat, who had come to symbolize minimally invasive surgery’s most vocal and visible leaders. So unprecedented was Nezhat’s surgical skill that opponents simply refused to believe that his clinical results could be real. From this pretext, some began accusing him of hiding complications and experimenting on patients.(149,150,151) Their claims were such colossal falsehoods, ones so easy to disprove, that it never occurred to Nezhat that anyone would take them seriously. After all, he had not been operating in some deep dark cave; he was working at Stanford Hospital, where dozens of witnesses were present at all times.

Nevertheless, on the sidelines of this ascending scalpel-scope ideological impasse was lurking the quintessential opportunist; a personal injury lawyer who ended up joining ranks with a small group of particularly zealous dissenters who collectively began feeding to the world a brew of fantastical fabrications. Truth was brought to its knees, while its swaggering imposter was swallowed whole by an unsuspecting press and public. The strong-arm tactics used to discourage others from supporting Nezhat were simply too much for most to endure, especially when threats of lawsuits were repeatedly invoked. Ultimately, many caved in to the pressure, with one medical journal retracting two of Nezhat’s articles after enduring years of threats from the attorney.

When all was said and done, Nezhat and his brothers, Drs. Farr and Ceana, withstood accusations of barbarism, commercialism, and even medical terrorism. (152,153) As Nezhat jokes, he was actually surprised they didn’t throw in charges of cannibalism, just for good measure. At the height of absurdity, the FBI, IRS, the criminal division of the Justice Department, and multiple state medical boards, were all chasing after him, all at the same time!

So suspect had Nezhat and the new surgical revolution become that he and his brothers ultimately had their academic integrity called into question. In a random turn of events, a change in personnel at Stanford precipitated the final blow. Although the previous presidents

and deans of Stanford had conducted their own investigations which cleared Nezhat, when a new dean arrived, things turned decidedly sour. Anxious to rid himself of such a controversial figure, the new dean urged Nezhat to resign. Nezhat refused. Soon after the ultimate coup d'état was exacted. Forced to answer to the misinformed medical and media fervor, the dean felt there was essentially no choice but to act in the most politically expedient manner by launching a highly publicized, formal investigation of Nezhat's work, issuing in the process a temporary suspension of his professorship to appease the public outcry.

Nezhat fell headlong into that bleak abyss reserved especially for the falsely accused, for surely there is nothing quite like being condemned for a crime you didn't commit to crack you up for good. It didn't matter that the charges had been repeatedly proven completely baseless; it didn't matter at all because Nezhat the man had been transformed into a burning effigy, one that played right into an ancient ambivalence about doctors that had existed in the popular imagination for centuries. Two hundred years earlier, Benjamin Franklin expressed similar sentiments when he decried: "God heals and the Doctor takes the fees": "Doctors", chimed in Chekhov, "are just the same as lawyers. The only difference is that lawyers merely rob you, whereas doctors rob you and kill you, too"(154): Meanwhile, gynecologists have been viewed with particularly harsh skepticism throughout the ages, referred to by such derisive names as "baby catchers and uterus snatchers."(155)

Indeed, such was the power of propaganda that the mere suggestion of impropriety was enough to convict Nezhat in the eyes of the public. Officially crowned as medicine's most favorite villain, friends turned to stones; once happy patients suddenly were seething inquisitors; lawsuits, death threats, all were delivered to his doorstep with perfect impunity. With his own practice thusly destroyed, the only thing he could think to do was go about town, offering his services free of charge to public clinics. They declined with barely concealed contempt.

There was just one problem, of course; they had the wrong guy.

The long journey back to the truth

Back at Stanford, top brass from around the country – experts from Harvard, former State Supreme Court Justices - were called in to examine the files which the accusers had offered as evidence against Nezhat. They poured over thousands of documents and crisscrossed the nation interviewing hundreds of physicians, patients, nurses, technicians, and other medical personnel who had worked side by side with Nezhat for years in the operating room. All the dark corners of the earth were searched, but not a sliver of evidence was found. Thousands of man hours, hundreds of thousands of dollars, endless evidentiary hearings, dozens of journalists across the nation, all turned out to be chasing after one heck of a red herring all along. The committee of experts offered only one terse conclusion concerning this decades-long drama: *next time anyone accuses the Nezhat's of anything, those doing the accusing ought to be investigated first.* In other words, the wisest counsel since time began: consider the source.

After the blue ribbon committee released their findings – and to the surprise of no one in the know - Nezhat's work was finally cleared by the highest authorities from Stanford University, two state supreme courts, and the California and Georgia State Medical Boards, thus ending a decades-long persecution that surely ranks as one of the most malicious in medical history, an obscene price to pay for daring to disrupt the status quo.(156,157,158)

In what can only be described as one final bizarre twist, just a few years after all of this, studies began pouring forth which confirmed Nezhat's initial impressions of videoendoscopy's advantages.(159,160) The procedures that triggered Nezhat's suspension just two years earlier, the ones referred to as "barbaric", were now being encouraged by the most prestigious journals.(13) Referencing the same procedures that Nezhat had performed in the mid-1980s, a 2004 editorial from the New England Journal of Medicine stated, "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."(15) Meanwhile, with prompting from William Parker, one of videoendoscopy's most distinguished early converts, the steadfast skeptic who described videoendoscopy as a gimmick in 1992, graciously agreed to reassess his views, finally acknowledging in a 2010 article that "operative laparoscopy confers unequivocal advantages over older surgical techniques."(161)

Final reflections

History may be servitude, history may be freedom – from "Little Gidding", TS Elliot

Sometimes history can become an unbearable weight. Operating off the monitor and inventing the accompanying advanced procedures - and then performing them successfully - were the crucial links which allowed surgery to be set free from large incisions and hundreds of years of history of peering directly through a tube, specula, or scope. Most accounts of videoendoscopy's history leave out its formative years, when those at the forefront were balancing on the brink, struggling between the exhaustive extremes of dreaming and doubting. In fact, many set videoendoscopy's launch date as the late 1980s, after general surgeons had finally discovered its teeming shores, after its happy destiny was already under way. Yet, a laparoscopic cholecystectomy – the starting point for most general surgeons – did not come to be via immaculate invention. For that procedure to have been possible at all, the old method of performing laparoscopy - hunched over, peering into the eyepiece - had to be completely abandoned and replaced with a way that made more advanced operative procedures safe, feasible and reproducible on a broad scale.

And the person who delivered that critical change was Nezhat.

When he introduced the idea of operating off the monitor, Nezhat provided the platform that made it possible for operative procedures to actually be practicable on a large scale.(162) It was like going from block print to the Guttenberg; Model T to Ferrari. While a few surgeons – perhaps a half dozen - had used the laparoscope to perform a limited number of basic operations in the old way, the vast majority would never be able to perform operative

endoscopic procedures of any kind by peering into the eyepiece. It was essentially this one factor, as unassuming as it may seem today, that had actually stood in the way of nearly all operative progress.

The impact has been profound. In the early 1980s, before videoendoscopy had yet to be embraced, the majority of all operations worldwide were performed using large incisions, meaning that upwards of 50-100 million people each year underwent procedures fraught with painful and often crippling effects.(163) As a result of videoendoscopy, millions of people have now been spared such outcomes. By introducing a medical breakthrough that so drastically reduced surgical morbidity and mortality on such a global scale, Nezhat's work has indirectly saved countless lives and profoundly improved millions of others, one of the few true advances in medicine that our world has witnessed for generations. Authorities such as the New England Journal of Medicine now recognize the advent of videoendoscopy as the crucial catalyst responsible for inaugurating minimally invasive surgery as a viable surgical discipline, a change that is said to have "revolutionized the practice of surgery, just as antibiotics have changed the practice of medicine". (15, 2) This is essentially why Nezhat is now referred to as the father of modern-day operative laparoscopy.(164,165)

A new philosophy is born

Perhaps of greatest significance, the painful transformation from the old ways of open surgery to minimally invasive modalities set off intense scientific and philosophical debates, calling into question centuries of unexamined assumptions about pain, patient rights, disease-states, and surgical complications. An entirely new way of thinking emerged, one that catalyzed a long-overdue moment of reckoning, when all surgical traditions were finally held up to the light of scrutiny. For example, with the new minimally invasive philosophy leading the way, emphasis on sparing reproductive organs became the norm in gynecology, rather than the exception.

An eventual rethinking in expectations about surgical outcomes also arose. Complications once considered unavoidable in the days of open surgery were suddenly reevaluated and revised in the minimally invasive era. After videoendoscopy became available as an alternative to laparotomy, physicians finally were able to recognize just how many serious, permanent, and life-threatening complications, including a higher incidence of death, that laparotomy had been subjecting patients to.(16,39,40,166, 22,90,167,188) Though these open methods were convenient for the surgeon, the large incision wounds actually caused patients to undergo acute, multi-organ distress. Excessive injury to tissue activates a cascade of deleterious physiologic mechanisms, with the systematic inflammatory process alone causing the release of a bewildering array of tissue-damaging enzymes like fibrinogen, plasminogen activators, and tissue thromboplastin, just to name a few.(76) Since the inflammatory response is actually maintained long after the initial surgery, a patient's health can deteriorate for weeks after a large incision surgery, while a chronic condition of "continued malfunction of one or more organ systems can occur, despite...the absence of persistent infection, and other identifiable insults..."(168)

The extensive, de novo adhesion formations after large incision surgeries also had the potential to cause years of severe complications, including compromised organ function and chronic pain, all of which were completely unrelated to the original illness. Life-threatening bowel obstructions caused by these de novo adhesions were an especially dangerous potential complication that required additional open surgery— sometimes more than one – to restore organ function.

As well, by today's standards, the loss of blood was staggering, often exceeding 1000 ml and necessitating large volume blood transfusions in up to half of all cases, And serious, chronic wound disorders were nearly inescapable, with the potential to leave patients in pain for months or even years with incisions that just wouldn't heal, gaping and oozing with infection for seeming eons. (90,169,170)

The combination of these effects had patients wreathing for weeks in unrelenting agony, with 2-3 weeks in the hospital, including time in the ICU, considered as normal outcomes; so normal, in fact, that the literature prior to minimally invasive surgery rarely mentioned these events as complications at all, demonstrating that they had come to be viewed as unavoidable, and therefore, acceptable aftermaths. If one had only the medical literature of the pre-minimally invasive era as a gauge, it would seem as if all was right in the world of surgery, so thoroughly legitimized as scientific truths had these assumptions become. If deaths did occur, laparotomy had become so beyond reproach that such outcomes were invariably attributed to other causes, such as anesthesia-induced effects or the patient's advanced age, with the age of 60 often counted as "advanced." Relieved from any meaningful culpability, "death by laparotomy" was rarely suggested as a cause, as it would have held little explanatory power.

In short, with open surgery reigning as an unchallenged authority over human lives for so long, catastrophic outcomes remained unrecognized as such, even after the alternative of minimally invasive surgery became readily available. It was only after overwhelming evidence in favor of videoendoscopy accreted to a point where it became impossible to ignore, especially by patients themselves, that large incision surgeries were finally subjected to more rigorous critical analysis, a nearly 30 year process that finally has led to its worldwide downfall as the gold standard of surgery.

Of equal importance, it wasn't just the category of surgery that was reevaluated. Rather, questions arose having to do with a wide range of aspects in medicine, with concepts relating to pain management emerging as one of the most critical changes to have come about due to the minimally invasive movement.

Still, the advocacy work to perfect and promote minimally invasive surgery is not done. There are still too many patients who are enduring needless open procedures. Statistics from 2004, for example, estimate that more than 2 million laparotomies are performed every year for benign conditions in the US alone. (171) Even now, in 2010, only one-third of the estimated 600,000 hysterectomies in the U.S. are performed minimally invasively.(14)

Nevertheless, humankind is closer than ever to the ideal of performing the most advanced surgeries through the least traumatic incisions. For this reason, the move toward minimally invasive surgery turned out to be one of the greatest achievements of 20th century medicine. More than that, it transformed into one of the world's most important human rights movements, a change which touched the lives of millions of patients who had suffered too long in the shadows of silence.(172)

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