Non-Obstetric Surgery During Pregnancy

A Comprehensive Guide

Ceana H. Nezhat *Editor*

Michael S. Kavic
Raymond J. Lanzafame
Michael K. Lindsay
Travis M. Polk *Associate Editors*

Springer

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ISBN 978-3-319-90751-2 ISBN 978-3-319-90752-9 (eBook)
https://doi.org/10.1007/978-3-319-90752-9

Library of Congress Control Number: 2018951633

Printed on acid-free paper

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

To the mother and twins whose story planted the first seed of this project years ago and to all mothers and infants worldwide, past, present, and future.

Foreword I

"She's Pregnant"

No two words create more doubt, angst, and heartburn for a surgical consultant.

Every surgeon has been there. After hearing about a case from an ER doctor or a trainee and formulating a mental model and plan, the conversation closes with "by the way, she's pregnant."

Suddenly a twinge, perhaps a jolt, or maybe even a cold sweat ensues. The consultant surgeon's mind kicks into overdrive churn. The clinical problem and solution, previously obvious, is now in question! There is an agonizing reappraisal. Do the fundamental principles of care for a general surgical or specialty surgical problem remain valid, or do they "go out the window"? Now every intervention holds the possibility of a 200% morbidity or 200% mortality.

While concurrent surgical disease arises infrequently during pregnancy, pregnancy is common. Thus, this is a nontrivial problem, usually arising at the worst possible time.

"What to Do?"

Enter Nezhat's volume *Non-obstetric Surgery During Pregnancy: A Comprehensive Guide*. More than just a "how to do cookbook" this book provides a rational framework of thinking about the health of both the fetus and the pregnant mother. Dr. Nezhat brings three decades of deep experience and expertise in obstetrics and gynecology to us all in this superb book. Ceana is recognized as a leading authority and he does not disappoint.

In crisp clean sequence, the fundamental groundwork is laid; preferred imaging strategies, anesthesia considerations, and OR setup are wonderfully outlined. Subsequent sections target general surgical and specialty surgical conditions often arising during pregnancy. Each, in turn, is methodically covered. Treatment options, risks, and benefits are all carefully and thoroughly described. Finally, gynecological conditions, obstetric complications, and in utero operative approaches to spinal bifida round out this exceptional book.

Forearmed with the knowledge gained from this book, the general surgeon or the specialty surgeon will no longer quake when they hear the words, “She’s pregnant!”

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Foreword II

I congratulate Dr. Ceana H. Nezhat and his associate editors Drs. Michael S.Kavic, Raymond J. Lanzafame, Michael K. Lindsay, and Travis M. Polk on highlighting the much ignored topic of non-obstetrical surgery during pregnancy. In addition to the surgical procedures themselves, it is imperative the surgeon is knowledgeable about the pathophysiology of pregnancy and its impact on both the mother and fetus. Hypertension and diabetes during pregnancy can result in increased morbidity and mortality when compared to women who are not pregnant. A 50% increase in blood volume, as well as changes in renal function, can impact the procedures being performed. This book provides the reader with an in-depth knowledge of surgical procedures and anesthesia challenges in the gravid patient. Procedures reviewed range from establishing a pneumoperitoneum in pregnancy to exploratory laparotomy.

Abdominal surgery is presently the most common surgical procedure for the pregnant patient. Unfortunately, even if done by the most experienced surgeon, the procedure can result in a miscarriage and loss of pregnancy. The authors recommend surgical procedures be delayed when possible and elective procedures avoided until completion of the pregnancy. However, there are many conditions that require emergent surgery, such as appendicitis. The authors have provided their readers with a road map to perform these procedures. The ultimate goal is to protect both the mother and the unborn fetus.

This book provides an evaluative review of the surgical management of urgent and emergent procedures during pregnancy as well as a thorough analysis of gynecologic surgery and the surgical management of obstetrical complications. This comprehensive guide is a must-read not only for obstetrician gynecologists but also for any clinician involved in the management of a pregnant patient.

Dr. Nezhat has brought together both national and international experts to contribute their years of experience for this book. It is through knowledge we will be able to decrease the unacceptable morbidity and mortality of the pregnant and postpartum patient observed throughout the world today.

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Preface

Non-obstetrics Surgery During Pregnancy: A Comprehensive Guide was conceptualized from an identified gap in education and fills a major void as one of a few texts which provides a comprehensive evidence-based approach to the management of major non-obstetric surgical procedures. Surgery for non-obstetric causes during pregnancy is not uncommon and a timely topic. The book is written in "cookbook style" and geared towards most specialties. It is my intention that this book provides a compendium that will assist clinicians by guiding their management of pregnant patients and hopefully improving outcomes for both mother and baby.

The text flows logically with introductory chapters, such as history of laparoscopy, instrumentation, room setup, and patient positioning, laying the groundwork for performing non-obstetric surgery in a pregnant patient. Moreover, there will be individual chapters covering various specialties and detailing surgical complications that may arise specific to each field. The book concludes with an overview of various obstetrics-related complications that require surgical management. I trust the readers will find this to be a useful, well-rounded, and educative resource.

Ideally, every child is "well-born," physically, mentally, and emotionally which is fundamental to human dignity. The contributors to this book represent the vanguard in their respective specialties. They highlight critical factors for consideration while caring for the pregnant woman and her unborn child, aspiring to build human dignity one birth at a time. I greatly appreciate the editorial assistance/review provided by my associate editors whose extensive experience in varying disciplines brought expert-level evaluation to the review process. Special thanks to Ms. Sarah Kyle McClellan, MPH, who contributed greatly to the review process and preparation of the book. We are very proud of the depth of information we are providing to our readers owing to the knowledge and experience of our contributors.

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Introduction

As I reflect upon the days when I delivered babies, I recall hearing the much-awaited cry of the newborn filling the room with joy and a sense of relief. It was one of the most rewarding moments of my career. Months of caring for both mother and her unborn child had finally come to fruition. During my last call as a chief resident in obstetrics, I was called on a code for an antepartum mother in cardiac arrest around 30 weeks twin gestation in preterm labor on tocolysis. When I arrived, Emergency Medical Services (EMS) announced unsuccessful resuscitation attempts on the mother. I proceeded with emergency bedside cesarean delivery of the twins in seconds. Following delivery, the mother responded to resuscitation and all survived. What I did not know at the time was this event would stay with me throughout my career and one day blossom into the idea for a comprehensive guide on maternal obstetric and non-obstetric complications for all physicians caring for a pregnant mother.

Obstetrics is a multifaceted specialty relating closely to other branches in medicine. Since pregnant and nonpregnant women are subject to the same diseases, physicians must be well versed with surrounding various ailments. Extensive knowledge of pregnancy physiology and pathophysiology of obstetric disorders must then be applied, improving perinatal outcome.

Fetal and infant safety and survival have taken priority over maternal health and well-being during pregnancy. Neonatal wards today are staffed by highly trained specialists who are ready for the worst in regard to infants, while mothers are tended to by nurses and doctors who expect the best and are unprepared when complications arise. Research has shown that pregnant women who undergo non-obstetric surgery have a higher risk of postoperative septicemia, pneumonia, and urinary tract infections (UTIs). They are also at an approximate fourfold higher risk of in-hospital mortality following non-obstetric surgery compared with nonpregnant patients [1]. The lack of education provided to doctors, nurses, and other health care professionals regarding maternal health in pregnancy demonstrates the absence of risk the modern world associates with childbearing.

Historically, pregnancy has been a time of joy and apprehension. During the Renaissance, women would write out their wills as soon as they became pregnant [2]. History is, in fact, full of maternal death. Thomas Jefferson lost his wife after childbirth in 1782. Princess Charlotte of Wales, granddaughter of King George III and cousin to Queen Victoria, died after giving birth to a stillborn in 1817. Charlotte Bronte died of hyperemesis gravidarum in 1855.

In the seventeenth century, childbirth predominantly took place in the home in the presence of a midwife and a group of *female* friends, neighbors, and family members [3]. However, in France, the "man-midwife" was becoming more accepted [4], and in Britain, the Chamberlen family had developed obstetrical forceps, which would be kept a secret for more than 100 years [3, 5].

Early on, successful cesarean sections typically occurred in remote rural areas without access to adequate medical care or hospitals. The first record of a successful cesarean section was performed by a "sow gelder" in Switzerland in 1500. Not only did both mother and baby survive, but fertility was preserved and the woman went on to conceive and deliver five more children naturally [3, 4]. Cesarean section can be traced back to ancient times in both Western and non-Western cultures. The initial purpose of cesarean section was to retrieve the infant from a dead or dying mother, either in an attempt to save the baby or for religious purposes. Regardless, it was a measure of last resort and the mother was not expected to survive.

There are several possible explanations as to why operations in remote rural areas yielded more successful outcomes; first, with the absence of professional care, cesarean sections were executed without delay in earlier stages of labor in stronger women and less distressed fetuses, resulting in greater chances of success; and second, hospitals were riddled with infections spreading between patients by the unclean hands of the medical staff. In rural areas, cesarean sections were performed in people's homes, which were less contaminated with sickness and disease. However, it was urbanization and the growth of hospitals when cesarean sections became largely accepted and regularly performed [3].

Today, the average global rate of cesarean section is 18.6%. Latin America and the Caribbean report the highest rate of births by cesarean section (40.5%), followed by North America (32.3%), Oceania (31.1%), Europe (25.0%), Asia (19.2%), and Africa (7.3%) [6]. In 2015, the World Health Organization (WHO) released a statement on cesarean section rates. They concluded that cesarean sections are effective in saving maternal and infant lives, but only when medically necessary, as they can cause significant and sometimes permanent complications. WHO further reported, at population level, that cesarean section rates higher than 10% have no association with further reductions in maternal or newborn mortality rates [7].

Advancing knowledge and development of anesthesia opened doors for obstetrics. Opium and its derivatives, including laudanum, morphine, and heroin, are the oldest method of pain relief and have been used in childbirth for thousands of years. In the nineteenth century, chloroform was popular owing to the support of several prominent women: Frances Longfellow, wife of the American poet Henry Wadsworth Longfellow; Emma Darwin, wife of Charles Darwin; and Queen Victoria, who was given chloroform by Dr. John Snow during the births of her eighth and ninth children [2, 8–10]. Today, anesthesiologists know the physiological effects anesthesia have on developing fetuses and should be consulted before any surgery is performed on a pregnant patient.

Maternal mortality ratio (MMR) is defined as pregnancy-related deaths per 100,000 live births. In 2015, the estimated global MMR was 216 (80%

uncertainty interval (UI) 207–249) showing roughly a 44% drop over the past 25 years; the MMR in 1991 was 385 (80% UI 359–427) [11]. Trends for maternal mortality mirror those for many other health statistics; developing regions accounted for approximately 99% of the global maternal deaths in 2015. WHO Sustainable Development Goals (SDGs) explain, "Drivers of success in reducing maternal mortality range from making improvements at the provider and health system level to implementing interventions aimed at reducing social and structural barriers" [11]. According to data collected by WHO and its partners, the United States is one of only 11 countries worldwide and the only developed country to have experienced a negative (−16.7%) change in MMR between 1990 and 2015 [11]. A study published in *Lancet* (2016) systematically compiled and processed all available data sources from 186 of 195 countries and territories. Researchers reported a 56% rise in MMR in the United States between 1990 (MMR = 16.9 [95% UI 16.2–17.8]) and 2015 (MMR = 26.4 [95% UI 24.6–28.4]) [12]. The reason behind this unexpected increase in maternal mortality in the United States is unclear. Possible explanations include the implementation or improvement of surveillance systems, such as the addition of pregnancy questions to state death certificates starting in 2003 [13]. MacDorman et al. estimate that 79.9% of the increase in MMR was a result of improved surveillance. Other possible explanations for the observed increase in maternal mortality could be advanced maternal age and/or the increasing number of pregnant women in the United States with a chronic disease [14]. The Centers for Disease Control and Prevention (CDC) launched its nationwide surveillance system for pregnancy-related deaths in 1986. Data released in 2017 revealed 26.5% of maternal mortality is associated with cardiovascular disease including cardiomyopathy [15]. The obesity epidemic in the United States may play a role due to increased risk for cardiovascular disease. The 2013 ACOG Committee opinion on obesity in pregnancy reported that "more than one third of women are obese, more than one half of pregnant women are overweight or obese, and 8% of reproductive-aged women are extremely obese, putting them at a greater risk of pregnancy complications" [16]. Rates of severe maternal morbidity or mortality increased from 143.2/10,000 births among women with normal body mass index (BMI) to 167.9, 178.3, and 202.9/10,000 in women with Class I, II, and III obesity, respectively [17]. Other medical noncardiovascular disease was attributed to 14.5% of maternal deaths, followed by infection and sepsis (12.7%) and hemorrhage (11.4%) [15]. One factor that could play a role, regardless, is the lack of associated risk afforded to pregnancy and childbirth in a "healthy" mother in the modern world.

Throughout a pregnancy, attention must be paid to both mother and fetus. However, this is not always the case. Poor communication between health care providers, hospital staff, and departments is a structural barrier within the health care system that can result in life-threatening situations for both mother and baby. For example, neonatal intensive care units (NICUs) and labor and delivery staff operate independently of each other. NICU nurses may come in to check on an infant and not notice the mother's elevated blood pressure. The same dynamic occurs between other departments. There is a need for physicians of all specialties to know how to handle a pregnant

patient; odds are they will be confronted with such complications. If a pregnant woman comes through the emergency department with a head injury that requires immediate surgery, there is not always time to consult an obstetrician regarding the appropriate anesthesia or anesthetic to use, proper patient positioning, or appropriate postoperative instructions and warning signs.

Physicians need to stay up to date with organizational recommendations regarding antibiotic use in pregnant patients. UTI occurs in about 8% of women, most commonly during the first trimester. Some UTIs are "asymptomatic bacteriuria," which has been associated with premature birth, low birth weight, and death in newborns and developing fetuses. If a UTI goes untreated, it can spread and cause permanent maternal kidney damage. Since 2011, the American College of Obstetricians and Gynecologists (ACOG) has recommended against the use of two types of antibiotics, sulfonamides and nitrofurantoin, during the first trimester of pregnancy. In 2017, ACOG revisited its stance to add that nitrofurantoin and sulfonamides may be used in the first trimester when "no other suitable alternative antibiotics are available." Sulfonamides and nitrofurantoin have both been associated with birth defects, including brain malformations, heart defects, and cleft lips and palates [18]. However, according to a report published in January 2018 by the CDC, doctors do not seem to be following recommendations or do not know they exist [19]. In 2014, about 35% of privately insured first-trimester moms filled prescriptions for nitrofurantoin and 8% filled prescriptions for the sulfonamide antibiotic, trimethoprim-sulfamethoxazole. Since UTIs occur most commonly during the first trimester, some patients do not yet know they are pregnant. It is important for doctors to always ask patients complaining of UTI symptoms if they are sexually active and possibly pregnant before prescribing any antibiotics.

Changing trends in maternal age at first birth are of particular interest and importance to obstetricians due to the varying risks of complications and maternal outcomes in pregnancy. The CDC published a report in January 2016 [20] stating that mean age of first-time mothers increased 5.3% from 24.9 in 2000 to 26.3 in 2014. First births in women aged 30–34 rose the most (28%) from 16.5% to 21.1% followed by women aged 35+ from 7.4% to 9.1% (23%). Women aged 35+ have been found to be at greater odds of preterm delivery, hypertension, severe preeclampsia, and superimposed preeclampsia. Furthermore, analysis showed women aged ≥40 years at time of delivery were associated with increased odds of mild preeclampsia, poor fetal growth, and fetal distress [21]. The number of first births for women under 20 decreased 42% from 2000 (23.1%) to 2014 (13.4%). Women aged ≤19 years, compared to 25–29-year-old women, have elevated odds of preterm delivery, chorioamnionitis, endometritis, and mild preeclampsia. Within the same age group, women 15–19 years of age also have significantly elevated odds for severe preeclampsia, eclampsia, postpartum hemorrhage, fetal distress, and poor fetal growth [21].

Looking past external, structural, and maternal risk factors such as medical advancements, communication issues, and maternal age, undergoing non-obstetric surgery while pregnant incurs risks of its own. In a recent study by Balinskaite et al., researchers identified pregnancies where non-obstetric

surgery occurred via maternity admissions using hospital administrative data. Of all recorded pregnancies, less than 1% (47,628/6,484,280) had undergone non-obstetric surgery. Abdominal surgery (any kind) (26.2%) was the most common surgical group and patients who underwent abdominal surgery were found to have a high risk of miscarriage associated with hospital admission aRR = 1.90 (95% CI 1.81–1.99) and preterm delivery aRR = 1.62 (95% CI 1.54–1.70) compared to women who did not undergo surgery while pregnant. Abdominal surgery was followed by dental (11.3%), nail-skin (10.0%), orthopedic (9.6%), ENT (6.4%), perianal (6.3%), and breast (4.0%). Further analysis found fewer than 6% of operations occurred within 1 week of the end of pregnancy. Researchers estimated that every 287 surgical operations were associated with one additional stillbirth, every 31 operations were associated with one additional preterm delivery, every 39 operations were associated with an extra-low-birth-weight baby, every 25 operations were associated with an additional cesarean section, and every 50 operations were associated with one additional long inpatient stay [22].

Trauma, appendicitis, cholecystitis, pancreatitis, and bowel obstruction are some of the major non-obstetric abdominal indications for surgical intervention during pregnancy. Approximately 7% of pregnant women will experience physical trauma during pregnancy. Trauma is the leading cause of maternal death, accounting for approximately 50% of deaths during pregnancy. Roughly 1 in 500 pregnant women require surgery and the most common non-obstetric surgical condition during pregnancy is acute appendicitis. Acute cholecystitis is the second most frequently reported non-obstetric emergency in pregnancy, with approximately 40% of acute cases requiring surgery. The incidence of acute pancreatitis in pregnancy ranges from 1 in 1066 live births to 1 in 3000 pregnancies. It appears to be more prevalent with advancing gestational age and occurs more commonly in the third trimester or during the postpartum period. Bowel obstruction, or more specifically, adhesive small bowel disease and volvulus, is the third highest cause of surgical admissions in the pregnant patient.

Elective surgery is generally avoided during pregnancy if observational and medical management are possible. Ideally, it is best to perform surgeries during the second trimester as risks from teratogenicity and preterm labor are lower. However, carefully planned non-obstetric surgeries may be performed during any trimester, if required, while still ensuring the safety of two patients, mother and fetus. Any physician contemplating surgery on a gravid patient should obtain an obstetric consultation prior to surgery, if possible, as obstetricians are uniquely qualified and familiar with the physiological changes in pregnancy and the pathophysiology of obstetric disorders [23]. A multidisciplinary team should also be present during all non-obstetric surgeries. Pathologies may present differently or inconsistently due to changes in pregnancy requiring good physician understanding of altered pelvic neuroanatomy and neurophysiologic pathways of pain to accurately diagnose and effectively manage conditions. The configuration of a safe and effective operating room, active monitoring of patient positioning throughout surgery, and adherence to appropriate protocols for prophylactic measures for peripheral neuropathy are vital components when performing non-obstetric surgery.

The aim of this book is to provide health care professionals and students with a comprehensive resource for non-obstetric surgery to better prepare for appropriate intervention and surgery, be it of a routine or emergent nature that may arise in a pregnant patient.

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Part I

Laying the Groundwork

1 The History of Non-obstetric Endoscopic Surgery During Pregnancy

Megan Kennedy Burns, Stacy Young, and Camran Nezhat

History of Surgery in Pregnancy

Approximately 1 in 500 women will require non-obstetric surgery during pregnancy, but it was not until the 1970s and 1980s that researchers began looking critically at the effects of non-obstetric surgery on the pregnant mother and developing fetus [1, 2]. Surgical intervention in pregnancy, regardless of the operative approach or trimester of pregnancy, can increase the incidence of adverse pregnancy outcome, with the most serious of these complications being pregnancy loss and preterm labor [3]. Earlier studies in the 1960s demonstrated that intra-abdominal procedures were associated with a greater risk of preterm labor than extra-abdominal procedures and intraoperative cervical manipulation increased the risk even further [4, 5].

In 1989 Mazze and Kallen published a study of adverse fetal outcomes after non-obstetric surgery in pregnancy, examining the Swedish Birth Registry between 1973 and 1981 and finding no increased risk of congenital malformation or stillbirth [6]. This study showed that patients who underwent non-obstetric surgery during pregnancy had an increased risk for low birth weight (<2500 g) and very low birth weight (<1500 g) infants, due to growth restriction as well as preterm delivery. Another finding from this study was the increased rate of neonatal death within the first 7 days of life [6]. The study did not, however, differentiate between complications due to the surgical procedure and complications due to underlying pathology that necessitated surgical intervention.

Cohen-Kerem et al., in 2005, published a review of the surgical literature critically evaluating maternal and fetal outcomes following non-obstetric surgery [7]. This study revealed a miscarriage rate of 5.8% of all patients who underwent surgical intervention in pregnancy and 10.5% of patients who underwent surgical intervention in their first trimester. The rate of preterm delivery induced by the surgical procedure or the underlying pathology was 3.5% and was most prevalent in patients undergoing appendectomy, while the overall preterm delivery rate was 8.2%. A total of 2.5% of patients experienced fetal loss, and 2.0% of pregnancies were complicated by a major birth defect. Importantly, this study demonstrated that surgical intervention and general anesthesia are not major risk factors for miscarriage and do not increase the risk of major birth defects, concluding that surgical interventions

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C. H. Nezhat (ed.), *Non-Obstetric Surgery During Pregnancy*,
https://doi.org/10.1007/978-3-319-90752-9_1

should be performed when indicated in pregnancy [7].

A later study published by Balinskaite et al. in 2017 confirmed these findings, looking at a retrospective cohort of 6.5 million pregnancies in the United Kingdom [8]. This study measured adverse outcome in attributable risk, with an AR of 0.4% for stillbirth and 2.6% for low birth weight in patients who underwent surgery compared to patients who did not, but there was no difference between patients who underwent laparoscopy and open abdominal surgery. This study also demonstrated that risks increased with increasing gestational age. Again, investigators were unable to differentiate the risk of the underlying pathology from the risk of the surgery itself, but the overall risk of adverse birth outcome in women who underwent non-obstetric surgery in pregnancy was generally low compared to women who did not, providing reassurance to both expectant mothers and the practitioners caring for them [8].

History of Laparoscopy

It was not long before the time when researchers were beginning to more critically look at the effects of non-obstetric surgery during pregnancy that Camran Nezhat was revolutionizing the world of surgery with the invention of video-assisted laparoscopy (Table 1.1) [9–11]. Prior to this development, surgeons directly visualized intra-abdominal pathology through the eyepiece of the laparoscope, requiring them to bend over the operating table [12–14] and limiting them to relatively simple procedures such as cyst drainage, lysis of adhesions, biopsies, cautery of lesions, and tubal ligations [15–18]. The invention and pioneering of video-assisted laparoscopy allowed them to stand upright and operate "off the monitor," allowing the entire operative team to visualize the surgical procedure from a television screen in the operating room. In 1985, Camran Nezhat finally reported the use of videolaparoscopy for the treatment of severe endometriosis with ureteral resection at the annual meeting of the American Society of Fertility after years of skepticism and intense criticism [19–22].

Camran Nezhat invented and pioneered the use of video-assisted endoscopy and its use for the most extensive pathology for the first time in 1979 [9–11, 19, 22]. By doing so, he revolutionized surgery and opened the vista for endoscopic surgeons all over the world to help their patients. He has advocated and proven that a majority of procedures previously performed by laparotomy can be converted into minimally invasive procedures, providing countless benefits to patients, opening the door for other surgeons to further advance the field and improve outcomes for patients around the world. Early in this field's development, he declared that, "wherever in the body a cavity exists or can be created, minimally invasive surgery is possible and probably preferable. The limiting factors are only the skill and experience of the surgeon and availability of proper instrumentation" [19, 23].

The development of videolaparoscopy was by no means smooth. Dr. Kurt Semm of Germany performed the first laparoscopic appendectomy in 1983 and was greeted with derision and condemned by the German Board of Surgery [24]. The first laparoscopic cholecystectomy was similarly received when presented at the Congress of the German Surgical Society by Erich Muhe in 1986 [25]. A year later, Philippe Mouret performed the first laparoscopic cholecystectomy with video assistance, followed by Francois Dubois in 1988 [26]. In October 1989, video-assisted laparoscopic cholecystectomy was presented at the American College of Surgeons' annual meeting, sparking a rapid expansion of the horizons of minimally invasive surgery. Leonard Schulz and John Corbitt developed several approaches to laparoscopic herniorrhaphy [27–30], and Petelin, Reddick, and Olsen reported on laparoscopic common bile duct exploration [10]. Camran Nezhat published the first video-assisted laparoscopic partial colectomy in 1991 [31], followed by Redwine, Fowler, and Jacobs performing minimally invasive segmental colon resections [32–34]. That year, Katkhouda, Dallemagne, Zucker, and Bailey developed a minimally invasive vagotomy tech-

Table 1.1 Procedures performed by Camran Nezhat and collaborators for the first time in surgical history [23, 31, 40, 42, 64, 222–250]

1985	**Videolaparoscopy for the treatment of severe endometriosis involving the bowel, bladder, and ureter** Nezhat C, Nezhat F. Videolaseroscopy for the treatment of endometriosis, American Fertility Society (ASRM) 1985, Canada. American College of Obstetricians and Gynecologists Annual Meeting, Las Vegas, Nevada, 1987
1988	**Videolaparoscopy for the treatment of bowel endometriosis** Nezhat C, Nezhat F. Evaluation of safety of videolaseroscopic treatment of bowel endometriosis, Scientific Paper, 44th Annual Meeting of the American Fertility Society, Atlanta Hilton and Towers, Atlanta, Georgia, October 8–13, 1988
1989	**Safe laser excision and vaporization of endometriosis with laparoscopic repair of the bowel after disk excision** Nezhat CR, Nezhat FR. Fertil Steril, 1989; P 52(1): 149–151 (reported repair of the bowel after disk excision of endometriosis)
	Laparoscopic removal of dermoid cysts Nezhat C, Winer WK, Nezhat F. Laparoscopic removal of dermoid cysts. Obstet Gynecol, February 1989;73(2): 278–281
1990	**Laparoscopic management of interstitial pregnancy** Nezhat, C. & Nezhat, F. Conservative Management of Ectopic Gestation. Fertil Steril 53, 382–383 (1990)
1991	**Laparoscopically assisted anterior rectal wall resection and reanastomosis for deeply infiltrating endometriosis** Nezhat C, Pennington E, Nezhat F, Silfen SL. Laparoscopically assisted anterior rectal wall resection and reanastomosis for deeply infiltrating endometriosis. Surg Laparosc Endosc, June 1991;1(2): 106–108
	Laparoscopic ovarian cystectomy during advanced pregnancy Nezhat F, Nezhat C, Silfen SL, Fehnel SH. Laparoscopic ovarian cystectomy during pregnancy. J Laparoendosc Surg, June 1991;1(3): 161–164
	Laparoscopic radical hysterectomy with para-aortic and pelvic lymph node dissection Nezhat, C.R., Burrell, M.O., Nezhat, F.R., Benigno, B.B. & Welander, C.E. Laparoscopic Radical Hysterectomy with Para-aortic and Pelvic Node Dissection. Am J Obstet Gynecol 166, 864–865 (1992) Nezhat C, Nezhat F. Silfen SL. Videolaseroscopy: the CO_2 laser for advanced operative laparoscopy. Obstet Gynecol Clin North Am. 1991; 18:585–604 Nezhat CR, Nezhat FR, Ramirez CE, et al. Laparoscopic radical hysterectomy and laparoscopic assisted vaginal radical hysterectomy with pelvic and para-aortic node dissection, *J Gynecol Surg.* 1993;9:105–120
1992	**Laparoscopic ureteroureterostomy** Nezhat C, Nezhat F. Laparoscopic repair of ureter resected during operative laparoscopy. Obstet Gynecol, September 1992; 80(3 Pt 2): 543–544
	Laparoscopic segmental bowel resection/proctectomy for infiltrating endometriosis of the rectum Nezhat F, Nezhat C, Pennington E. Laparoscopic proctectomy for infiltrating endometriosis of the rectum. Fertil Steril, May 1992;57(5): 1129–1132
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	Laparoscopic treatment of ovarian remnant syndrome Nezhat F, Nezhat C. Operative laparoscopy for the treatment of ovarian remnant syndrome. Fertil Steril, May 1992;57(5): 1003–1007
	Laparoscopic ureteral resection and ureteroureterostomy for ureteral obstruction Nezhat C, Nezhat F, Green B. Laparoscopic treatment of obstructed ureter due to endometriosis by resection and ureteroureterostomy: a case report. J Urol, September 1992;148(3): 865–868
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