# Historical Foundations of Liver Surgery

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*For Tom*

# Preface

There have been remarkable advances in the field of liver surgery over the past one hundred years. What had once been feared as an unforgiving and treacherous domain has now been almost routinely assailed, prodded, sliced, gouged, and even, without remorse or trepidation, removed and replaced. The massive blood losses of which the liver was notoriously capable have been tamed, controlled, and allayed.

But progress has not been linear nor has it been parochial. Through fits of stops and starts and spread over centuries, understanding of the anatomic mélange that we have come to know as liver parenchyma in all its venous, arterial, and biliary intrigue slowly emerged as a rational partitioning of liver elements into (now) recognizable segments, sectors, and "lobes" (more properly, of course, "hemi-livers"). Contributions have literally been worldwide, from Europe, Asia, and the Americas through a myriad of investigator-surgeons, many of whom were simply inquisitive generalists who, once it could be done painlessly and aseptically, separated the tissues of the abdominal wall to delve into the recesses of the viscera, into territory formerly deadly and forbidden. It was here that a seemingly natural curiosity about that large reddish organ so apparently central to human metabolic workings expanded to boldly unravel the inner environment of this most mysterious of organs.

This work is not meant to be an exhaustive clinical review of current practices in liver surgery. Instead the authors have attempted to provide an admittedly rough sojourn through the pivotal moments and times that led to our present understanding of liver anatomy and surgery. The trail was roughly hewn with turns and twists, disappointments and successes that typifies scientific progress in medicine and surgery. We highlight those pioneers who, unintentionally, took courageous steps that furthered our ability as healers to offer hope to patients faced with conditions that had formerly defied treatment—cirrhosis, liver cancer, metastatic liver disease. In so telling, we used vignettes to illustrate and scientific literature to rationalize the numerous anecdotes that, together, comprised progress.

And of course liver surgery did not develop in a vacuum. It was the product of those monumental advances in medicine that suddenly provided abilities and opportunities only previously dreamed: general anesthesia, antisepsis, asepsis, and blood transfusions. The operating rooms of the twentieth century were radically different

than those theaters of the nineteenth, as much as surgeons of the past century were far different from the brusque, arrogant, and, yes, theatrical ones who were their illustrious predecessors. In the twentieth century operating rooms took on the trappings of a laboratory instead of stage, the surgeons able to carefully and precisely define their objective rather than exhibit the callousness and speed necessary to overcome the shrieks and wails of their awake patients. And, following the holocaust of World War II, "modern" anesthesia came of age so that the operating rooms became well-orchestrated exhibitions of joint expertise and support. All fell under the watchful gaze of anesthetists who furnished the hemodynamic support for procedures and critical as liver resection and, then, liver transplantation. In so doing, surgeons were allowed to focus on the meticulous anatomic unweaving that now characterized the detailed labor necessary for eradication of deep-seated diseases. Those that focused on this organ and its mysteries developed a new particularization of general surgery, that subspecialty now representing yet another branch of the surgical tree. Through their efforts to define, analyze, minutely dissect, and innovate—based on the sound anatomic and physiologic endeavors of their forbearers (and, yes, their trials and errors)—manipulation of this organ, what the ancient Greeks considered the mysterious seat of the soul, has become a matter of distinctly corporal and common practice.

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# Chapter 1
# Introduction

*In injuries of the liver, as well as in resections of this organ, hemostasis presents the greatest difficulties*

Professor Carl Garre, 1907

*And ready-witted Prometheus [Zeus] bound with inextricable bonds, cruel chains, and drove a shaft through his middle, and set on him a long-winged eagle, which used to eat his immortal liver; but by night the liver grew as much again everyway as the long-winged bird devoured in the whole day*

Hesiod's Theogony 521–526 [1]

In Greek mythology Prometheus, as punishment for defying Zeus and stealing fire to give to the human race, was chained to a rock in the Caucasus where, helpless to resist, an eagle pecked away by day at his liver only for it to regenerate at night and the ordeal repeated the next day. Such a torment extended not to the physical pain suffered, of which there seemed not a great amount, but to the spiritual, for the liver, for the Greeks, was considered the seat of the soul. So it was psychological torture, not physical, that plagued Prometheus, his very soul—his essence—violated but not destroyed, its capacity for renewal virtually immortal.

Yet, surgeons would not be so lucky as the long-winged eagle of Prometheus, both bird and man seemingly unaffected by the daily nibbling into blood-rich liver tissue. For surgeons—these gallant healers of antiquity—meddling in affairs of the liver was not meant as punishment but as salvation. And the elusive soul, if indeed the liver were its home, would be a formidable opponent, its invasion an unnerving task. In truth, the liver was a tarnished soul, host to an array of lethal diseases—tumors, cysts, and infections. The price to be paid from those intent to relieve suffering within, even by the most facile technicians, was usually exsanguination. Forays into the veritable seat of life–the heart—proved less deadly.

Within the liver coursed veins so large and thin-walled that violation produced a hemorrhage of such magnitude and virulence that death quickly followed. The operator stood helpless to comprehend a jungle of crisscrossing anatomy so unforgiving



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that sutures were of little avail, as dark blood poured from diminishing reservoirs. And the pale victim receded into the throes of profound shock until no pulse at all could be felt. Soon life fled; an experience so distasteful that most surgeons vowed never to return. Age old literature reported such adventures, hepatic wounds belching forth great volumes of venous blood, the task of hemostasis nigh impossible. Only by the most genteel of suturing could compression be achieved to staunch the flow, by then the lucky surgeon beaded with sweat near collapse himself, his patient pallid but blissfully unaware. Replacement of spent blood, of course, inconceivable; such miracles awaited courageous pioneers—patients and doctors—of the Twentieth Century. Without replenishment all peered down with subdued hopes to see if somehow their patient could rebound, mobilizing reserves that, for the time, escaped understanding. In 1897 noted surgeon and Boston Brahmin John Wheelock Elliot of the Massachusetts General Hospital, after completing an admittedly limited liver resection, noted in rather civil terms that "bleeding was profuse" (the patient apparently survived) [2].[1] Yet, reports of operative death rates over 60% were the norm, exsanguination the likely terminal event. In his chapter on liver surgery in Warren and Gould's *International Textbook of Surgery* Elliot would caution: "The organ is so friable, so full of gaping vessels, and so evidently incapable of being sutured, that it has always seemed impossible successfully to manage large wounds in its substance." As a result, in his mind, patient selection was imperative. "Only primary cancer as a single nodule is suitable for operation", he wrote [4]. It would be a full half century from the close of the *Belle Époque* before surgeons had at their means an understanding of the convoluted anatomy and an array of resources to compensate for the sanguine bloodlettings their surgery would produce.

To be sure, surgeons at the dawn of the Twentieth Century were a different breed of physician. With the advent of general anesthesia and use of aseptic techniques much more intricate operations were possible, delving into structures with the patience and painstaking efforts only dreamed about a half century before. There was now an air of caution in breaching those deeper, internal zones, a valid concern of whether such adventures would truly impact the course of disease. Even aside from the rampant infections of previous decades, surgeons were keenly aware of the consequences of their cutting. The one exception was cancer. Only surgery could effect a cure in those days before blood-borne cytotoxic agents. The wider the cut, the more likely the cure. And with refinements in anesthesia and supportive care, the cuts could be quite generous. Perhaps too generous, some felt. By mid-Century caution was advised. The fabled French surgeon René Leriche wrote:

> Ablation surgery is beautiful only sportively speaking: from the biological point of view, it is brutal, unnatural, and it is basically a poor therapy that cures the diseased organs by permanently removing them. We must have other ambitions for the future [5].

[1] Doctor Elliot indeed had a rich heritage. His great-grandfather had soldiered at Bunker Hill. A fastidious and orderly surgeon, he was of the mind that no operation should take more than 1 h, and often operated in his patient's homes. A master of the aseptic laparotomy, his surgical results were superb regardless of the site. See also Ernest Codman [3].

But little did Leriche know that not 20 years later the most dreaded of visceral organs, the liver, would be hacked, partitioned, and, yes, even completely removed in order to cure disease. It would be an odyssey of adventure filled with some of the most notable surgeons of the Twentieth Century, not barbarous types as Leriche may have thought, but true scientists and entrepreneurs who would advance the understanding of the liver and its central role in life itself. Perhaps those "other ambitions" for which Leriche had hoped would be far beyond his expectations.

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# Chapter 2
# The Bold Adventure of Lortat-Jacob


Jean-Louis Lortat-acob (1908–1992) cut an imposing figure, a man of amazing physical strength and endurance. Outwardly aloof and reserved, this demeanor actually concealed a character of great modesty [1]. To intimates he was warm, friendly, and prone to loving anecdotes. He was a man humbled by his accomplishments; loathe to inwardly acknowledge what was so obvious to others. Outwardly he was a task master, intent on quiet perfection, disciplined by his upbringing. Jean-Louis was born into a medical family in 1908, the fourth of six children whose father was a dermatologist in Paris. From a strong Catholic family (he was educated by the Dominicans), Jean-Louis began the study of medicine and was drawn to surgery. He trained under the grand masters of surgery, Louis Bazy, Pierre Brocq, and Henri Mondor, among others [2], facilitated, possibly, by his father's professional and personal acquaintances with these men. The young Lortat-Jacob joined the faculty of the *Hôpital St-Louis* in 1944 as a prosector and assistant to Professor Bazy. Despite his sorties into hepatic surgery, the name Lortat-Jacob is inextricably linked to surgery of the esophagus. Jean-Louis performed the first esophagectomy in France in 1944 via a thoracic approach [3]. He left *the Hôpital St-Louis* for the *Hôpital Broussais* where he joined the prestigious surgical team of Professor François de Gaudart d'Allaines (1892–1974). Gaudart d'Allaines had been a pioneer in foregut surgery, including a fascination with the liver and biliary system. This may have stimulated Lortat-Jacob's interest. It was at this time that he may first have pondered the daunting approach to surgery of the liver, and thus acquainted himself with the anatomy of the Glissonean pedicles and hepatic veins, learning temperance and patience at the side of his mentor.

The *Hôpital Broussais* itself was a remarkable edifice. It had been built in less than 3 months in 1883, erected in the 14th arrondissement on the southern outskirts of Paris, straddling the communes more colloquially known as Gentilly and Montrouge, those formerly rural habitats of monasteries and goldsmiths and sites of royal hunts. An ideal location, it was said, for the terrible cholera epidemic that swept through Paris that very year: "the most perfect arrangements, from a sanitary



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point of view" [4]. Initially designated as a hospital for seafarers, the name was changed to "Broussais" in 1885, in honor of the renowned François Joseph Victor Broussais (1772–1838), physician and surgeon of the Empire. Piece by piece from 1928 until 1940 the hospital was rebuilt. In 1935 the new facility opened under the surgical leadership of the *debonair* Gaudart d'Allaines, "a man of gentle manners … who emanated great charm" [5]. It was there that Gaudart d'Allaines began his innovating work in foregut surgery and operations on the biliary system. Later, after time in the United States with Alfred Blalock, Gaudart d'Allaines shifted his interest to operations on the heart. But even more significant was his insistence that clinical surgery be accompanied by parallel efforts in research, perfecting operative techniques in animal models before embarking on human trials, soon to characterize French surgical practice.

On a Tuesday morning, October 16, 1951 Professor Lortat-Jacob entered the operating room of the *Hôpital Broussais* and opened the abdomen of a 42 year old pianist whom his assistant Henry Robert had examined and found a palpable tumor in the right hypochondrium. Their suspicions were that this represented a hydatid cyst of the liver; their intent complete extirpation. Instead, upon entering the abdominal cavity, the surgeons found three tumors involving the right lobe of the liver, two of which were larger than grapefruits and the third the size of an orange. As far as Lortat-Jacob was aware, no one had attempted total removal of the right lobe of the liver, which, at the time, was defined topographically as the mass of liver to the right of the falciform ligament. The fear was that of exsanguinating hemorrhage or, perhaps, liver failure by leaving a too small amount of liver tissue behind. To date no European seemed to have a firm grasp on precisely how to split the liver in half without voluminous hemorrhage. It seemed reasonable to think, though, that some control of blood flow into the liver at the hilum and control of blood leaving the liver at the confluence of hepatic veins just above the liver might afford a more or less "regulated" attempt.

And on that day in October, 1951 Lortat-Jacob had exactly that in mind. His assault was rehearsed; his knowledge of the liver detailed. He was the consummate abdominal surgeon. Just as he had perfected in his surgery of gastric tumors, using a radical left *abdomino-thoracique* incision, Lortat-Jacob propped up his patient's right flank and sliced into the right chest, across the costal margin, and into the abdomen, dividing the diaphragm and laying bare the entire right lobe of the liver.[1] It was only then that the true nature of his patient's condition was unveiled: three tumors in the right lobe. It would take an entire right lobectomy to remove them all. For such a momentous operation Lortat-Jacob would entrust anesthesia only to his seasoned colleague and friend, the anesthetist Brunet d'Aubiac. Only then did he begin. And here would be what set Lortat-Jacob apart. Before invading liver substance, he would control blood flow. Contrary to the popular approach of liver surgeons before him who too often plunged into liver parenchyma and suffered the

[1] Lortat-Jacob's presented this case before the Société Nationale Française de Gastro-Entérologie which published the proceedings as "Hepatectomie Lobaire Droite Réglée Pour Tumeur Maligne Secondaire" [6]. The French medical journal *Presse Medicale* would soon publish the case in their April 16, 1952 issue [7].

wrath of torrential hemorrhage, Lortat-Jacob intended to stifle this tendency by interrupting blood borne pathways first. After securing hilar control of the vessels and ducts, Lortat-Jacob mobilized the bulbous right liver by dividing the peritoneal attachments, gaining access to the retrohepatic inferior vena cava. He then divided the minor hepatic veins to the inferior vena cava and then carefully encircled and divided the right hepatic vein. This completely freed the right lobe for removal. The parenchyma just to the right of the falciform ligament was transected—largely by finger-fracture—ligating intra-parenchymal branches in the process. Working steadily towards the inferior vena cave he and his assistant Robert included the *lobe carré* (quadrate lobe, Couinaud's segment IVa) and divided its delicate vascular attachments to the hilum. Lortat-Jacob then lifted the massive right lobe from the patient, having performed what, in later terminology, would be a trisectionectomy (five of Couinaud's eight segments). The left lobe, Couinaud segments I, II, and III, was no bigger than a fist ("*n'est pas plus gros que le poing*"). In his words, despite widespread fears, "*Il n'y a aucune hemorrhagie*"—there was no bleeding [7]. With regard to liver function, notwithstanding the alarmingly small liver remnant, there were few perturbations, and the patient was alive and well 3 months later. The tumors proved to be metastases from either a biliary or a pancreatic carcinoma.

Bravo! The feat was acclaimed as a major advance in visceral surgery. "I would like to stress the high level of interest of this exceptional communication by my friend Lortat-Jacob. As far as I know, this is an original observation, not only in France, but also in all the medical literature", so exclaimed his mentor, Professor d'Allaines, commenting on Lortat-Jacob's presentation before the *Société Nationale Française de Gastro-Entérologie* which met on March 31, 1952 [6]. Fifty years later the feat was still celebrated. Jacques Belghiti declared in 2003 (perhaps a bit effusively) that "[t]he first anatomical right resection" by Lortat-Jacob forecast the eventual application of his technique to transplantation and, specifically, split-liver transplantation: "Lortat-Jacob conceived the evolution of liver surgery announcing one of the most important advancements in liver transplantation over 50 years ago [split-liver transplantation to ease the donor shortage]" [8].

Indeed, it was a widely publicized affair, and for good reason. Lortat-Jacob had ushered in new dimensions of visceral surgery, an era that had begun almost 100 years prior. The abdomen had been successfully broached since the time of Christian Albert Theodor BIllroth (1829–1894) and his famous *Chirurgischen Klinik* (Surgical Clinic) at the *Allgemeine Krankenhaus* (General Hospital) in Vienna. All was possible now that the patients were blissfully anesthetized by the new inhalation agent ether and its cousin, chloroform. And Lister's observations on antisepsis could even prevent disastrous postoperative infections. As a result, by the close of the nineteenth century esophagus and stomach and colon were well within the grasp of still frock-coated, cigar-smoking surgeons. Yet one organ paled the enthusiasts of the *fin de siècle.* Uncontrolled hemorrhage was still the unwelcome outcome of explorations into the depths of the liver, hemorrhage so persistent that death was a familiar visitor, much to the vexation of the emboldened surgeon. This organ and its seeming morass of aimless and flimsy blood vessels defied control, and gave pause to even the most ambitious operator.