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The Rise and Fall of the Thoracoabdominal Incision in Urological Oncology

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Introduction: The thoraco-abdominal incision (TAI) has been used to provide maximal surgical exposure in the management of combined supra- and infra-diaphragmatic pathologic processes such as levels III or IV thrombi of the IVC. The TAI was once a cornerstone of urological oncology but is becoming increasingly uncommon in the era of robotic approaches to the renal hilum, suprahilar lymph node chain, and minimal access chest surgery to the supradiaphragmatic IVC. We wished to explore the complete history of the TAI, from first description to its height of popularity and its current utilization by contemporary urologic oncologists.

Sources and Methods: Primary source material included an interview with Donald Skinner, an early proponent of the TAI. We conducted a novel survey of active urologists in contemporary practice to investigate the usage of the TAI in practice. We reviewed documents from the Second Auxiliary Surgical Group (SASG) from 1941-1944; reports by military surgeon DF Marshall, recognized as performing the first TAI for a genitourinary indication during World War II; and records of the 8055th US Army (MASH) Unit in Korea, credited with improving the battlefield usage of the TAI; and secondary sources from the AUA's WP Didusch Archive, PubMed, and Googlescholar.

Results: The thoraco-abdominal incision (TAI) can originally be traced back to French civilian usage in the latter 19th century, but the TAI was not adopted for battlefield trauma surgery until the Second World War. The safety and effectivness of the TAI increased greatly during the Korean War with teaching, organized outcomes analyses, and improvement efforts. Trauma indications during these conflicts allowed for later adoption in the field of urologic oncology due to the incision's excellent exposure and became the hallmark of at least one fellowship in urologic oncology. Fewer than 15% of surveyed urologists in the contemporary era have used the TAI in the past 5 years.

Conclusions: The thoracoabdominal incision's later adoption by the civilian population is a testament to the ingenuity and resourcefulness of military surgeons in the former part of the twentieth century. Their contributions should not be forgotten as urological surgery moves towards minimally invasive approach.

Keywords: thoracoabdominal incision, inferior vena cava, military history

"Positioning the patient for [a] thoraco-abdominal incision," said the eminent urologic oncologist Donald Skinner, "was the major prerequisite for completing my fellowship in Urologic Oncology at USC."(1) For this article, Skinner spoke to the importance of the thoracoabdominal incision (TAI) to his practice in the twentieth century. What was once a standard approach in the arsenal of some urologic oncologists, however, is now employed by few surgeons in the United States. The TAI originated in the late 19th century, was refined in field trauma hospitals of World War II and the Korean War, and widened in clinical use in the latter half of the 20th century before falling out of favor at the start of the 21st century. The thoracoabdominal incision is unsurpassed in its ability to provide wide surgical exposure of the major abdominal vessels and renal units. On the left, the incision provides easy access to the heart, aorta, hemidiaphragm, esophagus, stomach, spleen, left adrenal gland and left kidney. From the right side, the inferior vena cava, liver, and right adrenal and kidney are equally accessible. Skinner et al., in their report of 64 patients with IVC thrombi, performed a right thoraco-abdominal incision with 7th or 8th rib

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incision "regardless of from which side the tumor arises".(2) Thoracoabdominal approaches are versatile in treating conditions such as esophageal and gastric cancers, aortic aneurysms, renal malignancies associated with vena cava tumor thrombus, retroperitoneal lymph node dissections, amongst others. We wished to explore the rich history and innovation that led to the development of the TAI and how the approach was taught to generations of urologic surgeons in both times of war and peace (Figure 1).

SOURCES AND METHODS

We performed a novel survey of active urologists on the their usage of the TAI in their practice. We conducted an interview with Donald Skinner on his use of the TAI in fellowship at USC and in his practice over a 40 year career. For military use of the TAI, we reviewed documents from the US Army's Second Auxiliary Surgical Group (SASG) from 1941-1944; reports by military surgeon DF Marshall; and records of the 8055th US Army (MASH) Unit in Korea, credited with improving the battlefield usage of the TAI. Secondary source materials were obtained from the AUA's WP Didusch Archive (Linthicum, Maryland), the National Library of Medicine digital archives (Bethesda, Maryland), PubMed, and Google Scholar.

RESULTS

Intial Description

The first mention of a thoracoabdominal incision was in the latter portion of the 19th century. French surgeon Dr. Odilon Lannelongue (1840–1911) described the resection of a right hepatic lobe initially with an abdominal incision. He then extended his incision with removal of the eighth through eleventh ribs and cartilage to enhance exposure of the chest. The postoperative course is unknown and, as with any novel surgical innovation, subsequent surgeons refined the approach. In 1909, Dr. Max Tiegel (1875–1951) employed a two-stage procedure that began with an abdominal exploration that was closed and followed by a separate thoracotomy as the second half of the incision. The patient died shortly after the operation.(3)

Wartime Applications

As the nature of the wounds and the wounded changed from the first to the second world war, surgical care required rapid advances, including adoption of the TAI. Allied surgeons adopted the thoracoabdominal incision as a method to address acute polytrauma of the chest and abdomen. World War I surgeons, in contrast, struggled with infection and the delays, from 18-24 hours, in getting the acutely injured to the operating room table.(4)

Figure 1. (Left) Odilon Lannenlogue (1840-1911) who first described the TAI in practice and (Right) Richard Chute (1900–1978), AUA President 1964-1965, was an early advocate of the TAI in urology as early as 1949.(9)

Thoracic injuries fared poorly and never saw the OR. Trauma surgeons in World War II, however, benefited from enhanced evacuation logistics, perioperative advances including access to whole blood, sulfanilamide, and penicillin, and the training to incorporate the TAI into surgical practice (Figure 2). As a result, mortality from high velocity missiles dropped precipitously during the second world war compared to the first.

The Second Auxiliary Surgical Group, for example, kept records of patients seen and their specific injuries from 1942-1945 in the Mediterranean Theater.(5) This outstanding medical organization reported to the Surgeon General on 8801 severely wounded soldiers in a 921-page report with 550 tables. The SASG recorded that of 903 patients with thoracoabdominal trauma, 247 fatalities were documented, with another 141 without record of whether they survived their injuries. A variety of incisions were used in these instances and, while mortality resulted in 27.3% of soldiers undergoing a formal thoracoabdominal incision, morbidities were also common with 292/903 (32.34%) reporting a complication while another 165 went without any postoperative records (See Table 1).(6)

Medical care during the Korean War (1953–1955) was associated with further reductions in perioperative mortality with the thoracoabdominal incision. The Mobile Army Surgical Hospital 8055 Army Unit in Korea between June 1, 1952, and March 31, 1953, managed 73 thoracic and thoracoabdominal wounds (Figure 3). While only four patients underwent a formal thoracoabdominal incision, they experienced a 0% mortality rate. Wounds

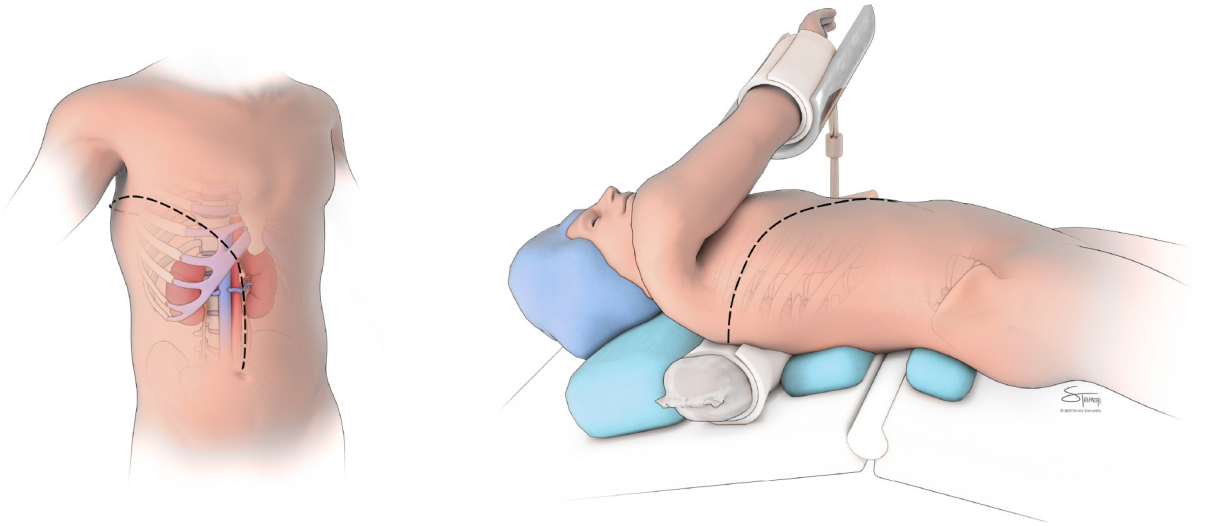

Figure 2. (Left) Right sided thoracoabdominal incision (TAI) coursing in the 7th or 8th intercostal interspace to the paramedian or median line affording simultaneous access to the chest and all abdominal contents. (Right) Intraoperative position for the TAI, positioning which Donald Skinner was necessary to learn to complete a fellowship in GU oncology at USC.

involving both the abdominal and thoracic cavities were again managed through various incisions; however, only 2 of the 73 patients expired, indicating a 3% mortality rate across all incision types (table 2). Methods of injury however also differed greatly from World War II as, instead of high impact missiles causing the polytrauma, the major cause of thoracoabdominal trauma was shell fragments.(7)

The first reported cases of urologic trauma managed with a thoracoabdominal incision were recorded by Donald Forbes Marshall, reflecting on his work in the field in 1944. Marshall described how "a transdiaphragmatic approach proved very satisfactory… (The incision) was successfully used in 4 cases…and in 2 more cases not included in (this) report." Marshall employed an incision not unlike that which is still performed today, coursing between the 8th and 9th (or higher) intercostal space to reach the paramedian line or midline and then coursing to below the umbilicus. While Marshall did not discuss his mortality rates, he concluded that "it has been demonstrated that patients with complicated thoraco-renal-abdominal wounds tolerate nephrectomy or repair extremely well by the trans-diaphragmatic approach."(8)

Incision	Total	Deaths	Percent Mortality (%)
Thoracotomy Only with Transdiaphragmatic Laparotomy	488	91	20.3
Laparotomy Only	202	77	38.1
Thoracotomy, then Laparotomy	144	36	25.0
Laparotomy, then Thoracotomy	74	26	35.1
Thoracotomy with Transdiaphragmatic Procedure followed by Laparotomy	20	7	35.0
Thoracolaparotomy Traversing the Chondral Arch	6	3	50.0
Non-Operated	3	1	33.3
Died before End of Operation	6		

Table 1. Second Auxiliary Surgical Group, Thoracic Surgical Experience in the Mediterranean Theater, 1942-1945, one of the earliest attempts to assess quality of outcomes with detailed operative record keeping.

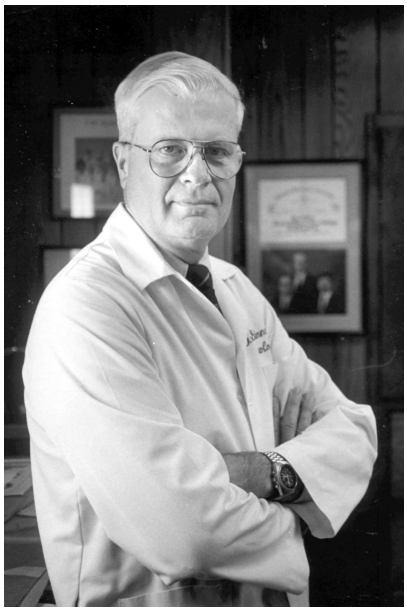

Figure 3. (Left) The Mobile Army Surgical Hospital (MASH) 8055 Army Unit in Korea operated between June 1, 1952, and March 31, 1953, and were a major innovator of surgical approaches to ballistic trauma. Their records of 73 known thoracic and thoracoabdominal wounds managed with the TAI helped transform the use of the TAI for subsequent civilian use. (Courtesy, TogetherWeServed.com) (Right) Donald Skinner, MD who believed positioning a patient for a TAI was a requisite for graduation from his fellowship in urologic oncology at USC. (Courtesy, the William P. Didusch Center for Urologic Hisory, Lithicum, Md)

Widespread Clinical Utilization

Military surgeons returned home from World War II and the Korean War, bringing their operative skills to the civilian population. General surgeons began utilizing the incision for esophageal and gastric cancers in the mid to late 20th century, and urologists incorporated the thoracoabdominal approach for aggressive treatment of renal tumor thrombi into the inferior vena cava. Richard Chute (1900–1978) of Massachusetts General Hospital advocated for thoracoabdominal incisions in radical nephrectomies as early as 1949.(9) The incision provided wide exposure to large kidney tumors while providing access to the intraabdominal vena cava and the cavo-atrial junction allowing intrapericardial suprahepatic vascular control. Skinner and colleagues were the first to demonstrate a survival advantage with aggressive resection of all tumor thrombi in patients with renal cell carcinoma in their 1989 *Annals of Surgery* publication "Vena Caval Involvement by Renal Cell Carcinoma Surgical Resection Provides Meaningful Long-Term Survival"(Figure 3).(2) Skinner believed strongly that a firm base of training in general surgery was paramount when attempting the thoracoabdominal incision as familiarity with the chest anatomy allowed for better surgical outcomes. Dr. Skinner said his familiarity came from both his two years of General Surgery Training at Massachusetts General Hospital and his two years as a surgeon in the Vietnam War.(1)

Contemporary Perspectives

The thoracoabdominal incision was a keystone of urological oncology for advanced retroperitoneal tumors for much of the 20th century. Matured through the crucible of World War II and the Korean War, this incision treated a multitude of conditions with safety and efficacy. A large series of 243 thoracoabdominal incisions for renal cell carcinoma published in 2016 showed an impressive early (30-day) mortality of 8%, an improvement over numbers published in the early half of the twentieth century as well as 43% of patients being free of disease at a 15-month follow-up.(10)

As surgery shifts to an ever more minimally invasive approach, previous tools such as the thoracoabdominal incision are fading into obscurity.(11) In a poll conducted for this manuscript of 24 urologists at a major US academic medical center in 2021, 14/19 (73%) had been taught the thoracoabdominal incision during their training; however, only 3/19 (15%) stated they used the TAI once in the past 5 years. Fewer than half of the respondents (42%) said they would advocate for the teaching of a TAI to a trainee. One potential contribution to this shift is the development of new surgical retractors that provide improved exposure, such as the Liver/Oncology system

retractor by Thompson Surgical Instruments (Traverse City, MI, USA). Such retractors may improve several operative metrics, including operative time, and decrease the inherent morbidity associated with entering the thorax, the pain of rib resection, and management of thoracostomy drainage. The thoracoabdominal incision is still used at some select centers in the United States, but it appears that most urology trainees have little exposure to or familiarity with TAIs, suggesting the incision fading into surgical obscurity.

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