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The role of multiorgan procurement for abdominal transplant in general surgery resident education

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ABSTRACT

Background: To assess the impact of participation of multiorgan procurement (MP) by general surgery (GS) residents on surgical knowledge and skills, a prospective cohort study of GS residents during transplant surgery rotation was performed.
Methods: Before and after participation in MPs, assessment of knowledge was performed by written pre and post tests and surgical skills by modified Objective Structured Assessment of Technical Skill (OSATS) score. Thirty-nine residents performed 84 MPs.
Results: Significant improvement was noted in the written test scores (63.3% vs 76.7%; $P < 0.001$). Better surgical score was associated with female gender (15.4 vs 13.3, $P = <0.01$), prior MP experience (16.2 vs 13.7, $P = 0.03$), and senior level resident (15.1 vs 13.0, $P = 0.03$). Supraceliac aortic dissection ($P = 0.0017$) and instrument handling ($P = 0.041$) improved with more MP operations.
Conclusions: Participation in MP improves residents' knowledge of abdominal anatomy and surgical technique.

1. Introduction

Open surgery experience for the general surgery trainees have seen a decline in the recent past. Many of what used to be common open general surgery operations have been replaced by minimally invasive operations. [1–3] More frequent use of non-operative management in trauma and the change from open vascular operations to endovascular approaches have also contributed to the decreased exposure to open surgical experience for the general surgery trainees.[4,5] Also, the change in the general surgery paradigm with the duty hour restrictions may have further contributed to this trend.[6, 7] This relationship may not be a universal phenomenon in that the modifications to the surgical training programs may be made to maintain the operative experience in the climate of restrictive duty hours.[8,9] However, the trainee's concern of negative impact that the duty hour restrictions can have on his or her operative experience continues to exist.[10]

These concerns about the operative experience of residents were highlighted in a survey of general surgery (GS) residency program directors where only 15% of the procedures the residents were expected to be competent in had been performed by the residents more than 10 times during their training.[11] Furthermore, GS residents were uncomfortable with open bile duct explorations, pancreaticoduodenectomies, and hepatic resections and this study suggested that the GS residency no longer provides adequate training in hepatopancreatobiliary surgery.[12] Attempts have been made to improve resident experience with the use of skill labs and virtual skill trainers, but they cannot completely replace real-life experience in the operating room.

Multiorgan procurement (MP) is a common procedure performed in abdominal transplantation surgery with the potential to address the decrease in the open operative experience.[13] It is a composite of many common and uncommon operations performed in GS (Table 1). It provides an excellent exposure to a wide range of complex anatomy that is applicable to general, vascular,

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Abbreviations

BUMC	Baylor University Medical Center
GS	general surgery
MP	multiorgan procurement
OSATS	Objective Structured Assessment of Technical Skill
PGY	post graduate year
SS	specific steps

hepatopancreatobiliary and trauma surgery, such as exposure of the diaphragmatic hiatus, complete visceral rotation, aortic exposure, and dissection of porta hepatis.[13] The fact that MP operations are performed in patients with unaltered and uninjured anatomy (e.g., absence of large tumors or trauma) in a semi elective setting also makes it an ideal learning opportunity. Ahmed et al. suggested that MP is a useful tool for improving familiarity with anatomy and teaching operative techniques for major vascular control.[14] We hypothesized that by performing MP operations, GS residents would learn knowledge and technical skills directly applicable to many common and uncommon GS operations. The aim of this study was to assess the impact of participation in MP operations on residents' knowledge and surgical skills.

2. Materials and methods

2.1. Study population and site

GS residents from postgraduate year (PGY) 2–4 rotating on the transplant surgery service at Baylor University Medical Center (BUMC), Dallas, Texas, voluntarily participated in this study. Four visiting residents from another residency program were also included in the study. BUMC is a community-based accredited GS residency program with 9 graduating residents per year. The residents underwent a standard consent process. The study was approved by the institutional ethics board.

2.2. Multiorgan procurement operation

The abdominal MP operation was performed according to the techniques initially described by Starzl with the modification of the dissection of the porta hepatis.[15] In brief, a standard sternotomy and laparotomy were performed. Medial visceral rotation was performed and the inferior mesenteric vein was isolated and cannulated. The infrarenal and supraceliac aorta was dissected and encircled. The porta hepatis dissection was completed by dividing the common bile duct, incising the gallbladder, and dissecting the right gastric, gastroduodenal, and common hepatic arteries. Any aberrant hepatic arterial anatomy was identified and preserved.[16] Intravenous heparin was given (500 units/kg). The infrarenal aorta was cannulated and the suprahepatic vena cava was divided. Once the abdominal organs (liver, kidney, and pancreas) were flushed with preservation solution, individual organs were retrieved.

2.3. Study design

The study was conducted prospectively. At the start of the 1-month transplant surgery rotation, the residents completed a written pretest (Supplemental Digital Content 1) with 30 questions specifically designed to assess their knowledge of the anatomy and the surgical techniques in MP. At the end of their rotation, the residents completed the same test as a posttest. As an internal control, the test contained 4 questions, the answers to which the residents would not have learned during the MP. The written test was used to gauge improvement in the residents' knowledge of MP operations. Aside from participation in MP operations, no didactic teaching on the MP operation was performed during the rotation.

At BUMC, the residents are an integral part of the transplant service which is comprised of two transplant surgery fellows. The residents participate in most of the multiorgan procurements with the transplant surgery attendings. There is rarely an overlap of cases between the residents and the fellows.

Table 1
Steps of multiorgan procurement and corresponding surgical skills and general/vascular surgery operations.

Steps of the organ procurement	Applicable general surgery skills	Surgical subspecialties
Pre cannulation steps		
Laparotomy	Laparotomy	General, trauma surgery
Sternotomy	Sternotomy	Cardiothoracic, trauma surgery
Pericardiotomy	Emergency thoracotomy for pericardial tamponade	Trauma surgery
Mobilization of the liver	Liver resection, liver trauma	HPB, trauma surgery
Kocher maneuver	Pancreaticoduodenectomy	HPB surgery
Medial visceral rotation	Colon resection, retroperitoneal trauma	Colorectal, trauma surgery
Isolation of the infrarenal aorta, iliac arteries	Abdominal aortic surgery, retroperitoneal trauma	Vascular, trauma surgery
Isolation of IMA	Colon resection	Colorectal surgery
Inferior mesenteric vein IMV dissection	Left colectomy	General, colorectal surgery
Dissection and division of right gastric artery	Gastrectomy	General surgery
Dissection of porta hepatis	Pancreaticoduodenectomy, liver resection	HPB surgery
Dissection and division of common bile duct	Pancreaticoduodenectomy, biliary surgery, avoiding bile duct injury	HPB, general surgery
Dissection of supraceliac aorta	Control of aorta during trauma, Nissen fundoplication	Trauma, vascular, foregut surgery
Cannulation of the infrarenal aorta, IMV	Abdominal aortic aneurysm repair, aortic trauma	Trauma, vascular surgery
Splenectomy dissection (ligation and division of short gastrics, mobilization of the spleen)	Splenectomy	Trauma surgery
Mobilization of the body and tail of the pancreas	Pancreatic resection	HPB surgery
Post cannulation steps		
Liver explant	Liver resection	HPB surgery
Dissection of the SMA and the celiac artery	Pancreatic resection	HPB surgery
Kidney explant: identification of the ureters, mobilization of the kidneys	Colon surgery, nephrectomy	Colorectal surgery, urology, surgical oncology
Iliac vessel harvest	Iliac vascular repair, iliac vascular trauma	Vascular, trauma surgery

HPB indicates hepatopancreatobiliary; IMA, inferior mesenteric artery; IMV, inferior mesenteric vein.

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