Mesh Hood Fascial Closure Is a Safe Alternative to Prevent Renal Allograft Compartment Syndrome During Kidney Transplantation

L.N. Wood, W. Yang, and A. Annamalai*

Cedars-Sinai Medical Center, Los Angeles, California

ABSTRACT

Background. Renal allograft compartment syndrome (RACS) is an under recognized yet important complication of kidney transplantation that can lead to early graft dysfunction and loss. The use of mesh for prevention and treatment of RACS in very selective circumstances has been documented previously in small case reports. However, it is unknown whether patient and graft survival rates are similar in patients undergoing renal transplantation with mesh placement for the prevention or treatment of RACS. The purpose of our study was to examine the risk factors, indications, and outcomes of mesh hood fascial closure (MHFC) use in the context of RACS prevention.

Methods. All patients who underwent kidney transplantation in our center between 2009 and 2013 were reviewed. Patients with mesh placed at the time of initial transplantation and secondarily at the time of reoperation were identified. Patient characteristics, Doppler ultrasound findings, and overall patient and graft survival rates were compared among patients with and without mesh placement.

Results. Of 600 patients who received a kidney transplant, 134 patients underwent mesh placement, 123 primarily and 11 secondarily. Our overall 1-year patient and graft survival rates compared between those with and without MHFC were, respectively, 97.5% and 94.8% compared to 98.5% and 95.5% with $P > .05$. Our mesh removal rate was 6% (8/134), and the rate of mesh infection was 1.6% (2/134).

Conclusions. We are the first to report the outcomes of MHFC for the prevention of RACS in patients undergoing renal transplantation. We found that MHFC in select circumstances has minimal risks and similar overall patient and graft survival rates when mesh is not used. Prospective studies to better understand the pathophysiology of RACS will aid in determining objective clinical indications for MHFC to improve allograft survival.

EARLY renal allograft dysfunction is a complication that infrequently occurs after kidney transplantation. Possible causes of this dysfunction are kinking and obstruction of the ureter or vasculature, as well as compartment syndrome in the retroperitoneal space [1]. Renal allograft compartment syndrome (RACS), a relatively uncommon term used in transplantation surgery, has been coined from the more well-known and accepted abdominal compartment syndrome in general surgery [2]. It has been defined as early allograft dysfunction due to pressure in the retroperitoneal space leading to transplant ischemia [1]. The exact pathophysiology of RACS is unclear but is suspected to be from extrinsic parenchymal compression due to space and anatomical limitations, venous outflow obstruction due to vascular "kinking," or both [1]. It is imperative to prevent and treat RACS, as it can lead to compromised graft function or even loss of the graft if undetected [3]. However, if readily diagnosed and promptly treated, RACS is reversible and graft loss can be prevented [4]. The original descriptions of RACS were in pediatric transplantations, where there was a size mismatch between a large allograft positioned in a small, artificially created, retroperitoneal space in the recipient [5]. Intraoperatively, the diagnosis of RACS is based on clinical findings of

*Address correspondence to Alagappan Annamalai, MD, 8700 Beverly Blvd, Suite 262, Los Angeles, California 90048. E-mail: alagappan.annamalai@cshs.org

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Table 1. Patient Demographics

Demographics	Total MHFC (n = 134)	Primary MHFC (n = 123)	Secondary MHFC (n = 11)
Average age, y	43 (range, 2–76)	43 (range, 5–76)	49 (range, 2–73)
Gender	62 females (100%)	58 females (94%)	4 females (6%)
	72 males (100%)	65 males (90%)	7 males (10%)
Average BMI, kg/m^2	23.5	23.5	24.5

Abbreviations: MHFC, mesh hood fascial closure; BMI, body mass index.

minimal urine output and poor allograft perfusion as evidenced by poor color, temperature, and turgor [6]. Postoperatively, early allograft dysfunction, post-transplantation Duplex vascular imaging showing decreased, absent, or reversed diastolic blow flood and a high degree of clinical suspicion can assist in diagnosis of RACS [5,6]. Risk factors include weight discrepancy between donors and recipients and noncompliant retroperitoneal spaces secondary to previous peritonitis [1]. Multiple treatment options for RACS have been suggested including mesh hood fascial closure (MHFC), intraperitonealization of the graft, and subcutaneous placement with the fascia left open [1,6,7]. There has been no consensus on which method is superior, but the use of each has been shown in case reports with successful outcomes leading to improved renal allograft perfusion and urine output [1–4].

In our institution, RACS has been an accepted transplantation complication for years and hence its prevention has been a primary goal. We present a study including 6 times as many patients as compared to any other published reports of the use of MHFC after kidney transplantation. The primary objective of our study was to assess the safety of MHFC by comparing patient and graft survival rates between those with and without MHFC and the incidence of mesh removal. Our secondary objectives were to compare perfusion studies, graft and patient survival rates, and incidence of mesh removal between primary and secondary MHFC.

METHODS

After institutional review board approval was obtained, a retrospective review of all renal transplantations performed at Cedars-Sinai Medical Center between March 2009 and January 2013 was conducted and all patients who had an MHFC, either primary or secondary, were identified. Primary MHFC, defined as having a MHFC at the time of transplantation, was performed based on clinical experience and suspicion for the development of RACS secondary to a large allograft, small retroperitoneal space, or a tight fascial closure. Suspicion was based on intraoperative clinical signs or ultrasound evidence of graft ischemia with poor allograft color, turgor, or kinking of renal vasculature. Doppler examination showing poor perfusion, high resistive indices (RIs) from diminished, absent, or reversed diastolic arterial blood flow typically in conjunction with reversed venous flow was an indication for the surgeon to perform an MHFC. Secondary MHFC, defined as having an MHFC during a second operation within 30 days after transplantation, was performed if early allograft dysfunction was suspected postoperatively with a combination of clinical findings of poor graft function and/or Doppler examination. RACS was confirmed on reoperation and was considered to be the cause if graft function and perfusion improved both clinically and sonographically after fascial opening.

The kidney transplantation database is prospectively collected and updated on a daily basis to include overall patient and graft survival. For the purposes of this study our database was collected retrospectively using the transplantation database and electronic medical records at a single center. All kidney transplantation patients with MHFC had complete follow-up for the study period. Variables identified included patient age, gender, body mass index (BMI), primary versus secondary MHFC, if mesh was placed due to clinical findings or suspicion, Doppler perfusion, and RI immediately post-transplantation, RI pre- and post-transplantation if secondary MHFC was performed, 1-year graft survival, and 1-year patient survival. Doppler perfusion was poor, moderate, or well and measured using power Doppler sonography assessing the cortical gray-scale level based on standardized cutoffs for each level of perfusion. Clinical findings that were considered indications for primary MHFC were based on reviewed operative reports. For example, surgeons commented on intraoperative evidence of vascular kinking, increased graft turgor, visual appearance of graft ischemia, or Doppler evidence of graft ischemia. Clinical suspicion for primary MHFC was determined based on operative notes suggesting risk of graft ischemia from tight fascial closure and risk of compartment syndrome.

We compared 1-year graft and patient survival rates between patients with MHFC and all renal transplantations at our center during the same period, MHFC usage compared to patient BMI, total number of mesh removals, and graft and patient survival rates in mesh removal cases. On subgroup analysis between patients with primary versus secondary MHFC we compared age, gender, BMI, 1-year patient and graft survival rates, removal of mesh, patient and graft survival if mesh was removed, and Doppler results. We used a χ^2 analysis to determine if there was statistical significance between the groups and considered our results to be statistically significant if the P value was less than .05.

RESULTS

During a 5-year period, there were a total of 134 patients who underwent MHFC after kidney transplantation of which 122 were performed by a single surgeon. One hundred twenty-three patients had primary MHFC and 11 had secondary MHFC using Prolene mesh. There were 62 females and 72 males included in the study. Fifty-eight (94%) females had a primary MHFC and 4 (6%) had a secondary MHFC. Sixty-five (90%) males had a primary MHFC and 7 (10%) had a secondary MHFC. The mean age in the overall, primary, and secondary closure group was 43 years, 43 years, and 49 years, respectively. Patient mean BMI was 23.5 kg/m^2 overall, 23.5 kg/m^2 in the primary MHFC group, and 24.5 kg/m^2 in the secondary MHFC group. There were 33 patients with BMI $<$ 20 kg/m^2, 50 patients with a BMI of 20 kg/m^2 to 24 kg/m^2, and 51 patients