Appendix:

Supplemental Table I: Billing codes for peripheral arterial disease (PAD) revascularization procedures and amputations.

CPT codes for vascular procedures

35331, 35351, 35355, 35361, 35363, 35521, 35533, 35537, 35538, 35539, 35540, 35558, 35563, 35565, 35621, 35623, 35637, 35638, 35646, 35647, 35654, 35661, 35663, 35665, 35651, 35548, 35549, 35551, 35546, 37220, 37221, 37222, 37223, 35452, 35454, 35472, 35473, 35481, 35482, 35491, 35492, 35556, 35566, 35570, 35571, 35583, 35585, 35587, 35656, 35666, 35671, 35302, 35303, 35304, 35305, 35306, 35371, 35372, 35582, 35641, 35456, 35459, 35470, 35474, 35483, 35485, 35493, 35495, 37205, 37206, 37207, 37208, 37224, 37225, 37226, 37227, 37228, 37229, 37230, 37231, 37232, 37233, 37234, 37235

CPT codes for amputations
27290, 27295, 27590, 27591, 27592, 27598, 27880, 27881, 27882, 27888, 27889, 28800, 28805

ICD9 procedure codes for amputations
84.10, 84.12, 84.13, 84.14, 84.15, 84.16, 84.17, 84.18, 84.19

Supplemental Table II: Life table analysis for unadjusted amputation free survival and modified major adverse limb event (mMALE) free survival by HbA1c levels (≤7 or >7.0%) and preoperative knowledge of diabetes diagnosis (PreopDM) as well as incremental HbA1c levels (≤6.0%, 6.1-7.0%, 7.1-8.0% or >8.0%)

	Amputation free survival			
	<=7.0%/ No PreopDM	**>7.0% No PreopDM**	**<=7.0%/ PreopDM**	**>7.0%/ PreopDM**
30-day	97.5	95.2	92.7	92.5
1 -year	93.6	86.9	84.6	82.2
3-year	91	81.7	80.9	76.2
5-year	89.3	77.8	78.2	72.4
	mMALE free survival			
	<=7.0%/ No PreopDM	**>7.0% No PreopDM**	**<=7.0%/ PreopDM**	**>7.0%/ PreopDM**
30-day	92.7	90.3	87.2	86
1 -year	76.6	68.8	66.9	64.1
3-year	67.5	57.4	58.9	53.5
5-year	62.7	51.2	53.1	46.6
	Amputation free survival			
	<=6.0%	**6.1-7.0%**	**7.1-8.0%**	**>8.0%**
30-day	96.6	95.5	94.8	93.5
1 -year	91.8	89.5	86.9	82.7
3-year	89.2	86.4	82.5	75.9
5-year	87	84.6	79.4	71.4
	mMALE free survival			
	<=6.0%	**6.1-7.0%**	**7.1-8.0%**	**>8.0%**
30-day	91.5	90.7	89.4	87.8
1 -year	74.2	72.8	68.5	64.5
3-year	65.8	64.3	58.5	52.5
5-year	60.7	59.4	52.8	45.5

Scientific Session IV - Friday, January 20, 2017
Discussant: Christopher Carsten, MD – Greenville, SC

15. <u>High Hemoglobin A1c Associated With Increased Adverse Limb Events In Peripheral Arterial Disease Patients Undergoing Revascularization</u>

Shipra Arya[1], Zachary O. Binney[2], Anjali Khakharia[1], Luke P. Brewster[1], Peter W. Wilson[1], William D. Jordan, Jr. [1], Yazan Duwayri[1]
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Discussion:

In this paper Dr. Arya and her colleagues at Emory performed a retrospective evaluation utilizing the VA database of patients who required lower extremity intervention between 2003 and 2014. Patients were included if were identified as being diabetic and had received testing for HgA1c within 6 months before or after their lower extremity intervention. They compared outcomes of patients with HgA1c levels <7 to those with HgA1c level >7. The authors found that the patients with levels <7 experienced fewer amputations and MALE. They conclude that screening and management for DM may impact the long-term outcomes for this patient population.

I have several questions.

1. How do we know that poor HgA1c control is not simply a surrogate for access to care or lack thereof rather than a direct marker of poor physiology? And as a corollary to that
2. Was there any attempt to correlate the number of follow-up visits that patients had within the system with their HgA1c control?
3. Nearly half of the total patients undergoing revascularization during this time frame within the VA were excluded from analysis because of lack of a HgA1c. Was there any attempt to identify how many of these 26,076 patients were identified as diabetic but were not receiving the standard of care in diabetic management and how they fared?
4. Finally how does this information translate into how I as the vascular surgeon need to change my management these patients? Your data shows that those who faired the worse by far where those who presented with ulceration or gangrene and PAD necessitating urgent intervention. This group however would have limited opportunity to benefit from improved diabetic care prior to intervention? How can I impact that situation?

I would like to thank the society for the opportunity to discuss this paper and the authors for adding to the literature that supports that poorly managed diabetics have poor outcomes. I look forward to the authors' response.

Response:

Thank you Dr. Carsten for the thoughtful discussion of the manuscript.

1. HbA1c could very well be a marker of quality of care or access to care. To better get at the causality of the HbA1c we chose to look at the exposure in a graded fashion instead of simply elevated versus normal HbA1c. The dose response relationship of the levels of HbA1c and increasing risk of amputation is evidence that this truly may be a causal effect rather than a surrogate. We also adjusted for other markers of quality of care such as use of medications as well as access to care by adjusting for race and severity of PAD at presentation.
2. We did not specifically look at follow up visits for these patients postoperatively. However, the median follow-up for patients with and without elevated HbA1c was not different. Given the nature of single payer care provided at the VA regardless of secondary insurance or socio-economic status, we believe that access to care may not be as big a player in this patient population. However, in a non-VA setting, access to care may play a bigger role in HbA1c control.
3. We focused our analysis to our hypothesis that "high HbA1c is associated with worse limb related outcomes for PAD patients, regardless of diabetic status". We did not do a comparison to the group without available HbA1c. It is something we could look at in the future. Patients without HbA1c levels either never had diabetes, or developed diabetes much later than their PAD revascularization or they were diabetics with very poor care or their diabetes was managed by non-VA care. The challenge would be to define the exposure period in such a cohort and how to make it comparable to those with HbA1c levels.
4. That's a great question. I think for a start, we as vascular surgeons should routinely check HbA1c and include that in our risk-benefit discussion with the patient on possible outcomes. We should screen for diabetes using HbA1c based on our data. Early engagement of endocrinologists and hospitalists in management of diabetes can be done. If possible, we should optimize their diabetic control before embarking on a non-emergent procedure. SVS and Association pf podiatry medicine pointed to such measures in their recent guidelines for management of diabetic foot ulcers.
   The role of perioperative glycemic control is tricky. From critical care and cardiac surgery randomized clinical trials we now know that too stringent control of glucose can also be detrimental. Further study will be needed in a prospective fashion to define what is the best regimen and what targets to use for diabetic control for PAD patients. As a personal belief, I think all patients should get vascular rehabilitation, much like cardiac rehabilitation around coronary percutaneous and open procedures. Nutrition, smoking cessation, diabetic control, medication adherence and exercise are all components of that program. The specifics of glycemic control will need to be defined in future studies.