Management of Post-transplant diabetes mellitus (PTDM)

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5/5/23

I have no potential conflicts of interest to report
Introduction

- Several terms are used in the literature to describe the presence of diabetes following organ transplantation
  - “New-onset diabetes after transplantation” (NODAT): The new-onset of diabetes following transplant
  - “Post Transplant diabetes mellitus” (PTDM): Presence of diabetes in the posttransplant setting irrespective of the timing of diabetes onset
  - Hyperglycemia is very common during the early posttransplant period
    - Estimated 90% of kidney transplant recipients exhibit hyperglycemia (in most cases, steroid- or stress-induced) in the first few weeks following transplant

- PTDM is a common and important complication after solid organ transplantation
- PTDM is an established risk factor for cardiovascular disease after transplantation, a major cause of morbidity and mortality in this population
- Transplant patients with PTDM have higher rates of rejection, infection, and rehospitalization
- Hyperglycemia in PTDM is associated with a distinct dysfunction of β cells as well as decrease in insulin sensitivity
- Most of our knowledge on PTDM treatment strategies derives from studies that have included kidney transplant recipients
Diagnosis of PTDM

- A formal diagnosis of PTDM is optimally made once the patient is stable on maintenance immunosuppression and in the absence of acute infection/stress
  - Recommend waiting until the patient is on a stable glucocorticoid dose equivalent to ≤10 mg per day of prednisone before making the diagnosis of PTDM
- Based on ADA guidelines, the OGTT is considered the gold-standard test for the diagnosis of PTDM (1 year posttransplant)
- Screening people with fasting glucose and/or A1C can identify high risk individuals requiring further assessment
  - A1c can be affected by anemia, a history of recent blood transfusion, and renal failure
  - A regular review of glucose levels, both fasting and random, should occur by the providers
• In a study of 152 patients who underwent heart, the incidence of PTDM was 38% by the 1-year follow-up.
Effect of Immunosuppressive Drugs on PTDM

- **Corticosteroids**
  - Used as induction therapy, for maintenance, and for treatment of rejection
  - Suggested mechanisms for hyperglycemia include increased insulin resistance, increased hepatic gluconeogenesis, and decreased insulin secretion

- **Calcineurin inhibitors**
  - Tacrolimus and cyclosporine are commonly the cornerstone of the immunosuppression used after solid organ transplantation
  - Calcineurin inhibitors impair insulin secretion and sensitivity, inhibit insulin gene transcription, and cause direct damage to pancreatic islet cells
  - Tacrolimus use is associated with a much higher risk of PTDM when compared with cyclosporine

- **mTOR inhibitors:**
  - Sirolimus and Everolimus
  - Can lead to islet cell toxicity

Management of PTDM- immediate post-op period

- **Hospital setting:**
  - Insulin therapy is the agent of choice for the management of hyperglycemia, PTDM, and preexisting diabetes in the hospital setting
  - When transitioning from insulin drip to SQ insulin: usually between 40% and 80%, depending on renal function, steroid dose, and time away from surgery

- **After discharge:**
  - For patients without a previous history of DM who are still requiring insulin therapy on the day of discharge, the health care team must decide whether to send the patient home on insulin therapy, on an oral hypoglycemic medication, or on no diabetic medication
  - It is important to discharge the patient on a flexible regimen that can be changed as the clinical status changes
  - Those with persistent hyperglycemia should continue insulin with frequent home glucose monitoring to determine when insulin dose reductions may be needed and when it may be appropriate to switch to noninsulin agents
Management of PTDM- Chronic

- No studies to date have established which noninsulin agents are safest or most efficacious in PTDM
- The choice of agent is usually made based on the side effect profile of the medication and possible interactions with the patient’s immunosuppression regimen
- Drug dose adjustments may be required because of decreases in the GFR, a relatively common complication in transplant patients

PTDM Management- Metformin

- Small short-term studies report that metformin is safe to use in renal transplant recipients; limited data in other types of organ transplant
- Metformin increases insulin sensitivity and decreases hepatic gluconeogenesis

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>It does not cause hypoglycemia</td>
<td>Need to monitor renal function</td>
</tr>
<tr>
<td>No drug-drug interactions with</td>
<td>gastrointestinal side effects</td>
</tr>
<tr>
<td>immunosuppressive agents</td>
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</tbody>
</table>
### PTDM Management - Metformin

<table>
<thead>
<tr>
<th>Medication Class</th>
<th>Renal function</th>
<th>Use in Transplant patients</th>
</tr>
</thead>
</table>
| Metformin        | • eGFR ≥60; use caution; no dosage adjustment necessary, follow renal function  
                   • eGFR 45–59: use caution, follow renal function every 3–6 mo  
                   • eGFR 30–44: maximum dose 1000 mg/d, follow renal function every 3–6 mo. Do not start as new therapy  
                   • eGFR <30: avoid use | GI side effects  
                   Lactose acidosis is rare with impaired kidney function |

### PTDM Management - Sulfonylureas

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relatively well tolerated</td>
<td>Can cause hypoglycemia</td>
</tr>
<tr>
<td>Need dosage adjustments in renal impairment</td>
<td>Weight gain</td>
</tr>
<tr>
<td>Glyburide and glimepiride interfere with cyclosporine metabolism</td>
<td></td>
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</tbody>
</table>

Use with caution
PTDM Management- Sulfonylureas

<table>
<thead>
<tr>
<th>Medication</th>
<th>Renal functions</th>
<th>Use in transplant patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glipizide</td>
<td>eGFR &lt;30: use with caution</td>
<td>Acceptable</td>
</tr>
<tr>
<td>Glimepiride</td>
<td>eGFR &lt;60: use with caution, &lt;30 avoid use</td>
<td>Acceptable</td>
</tr>
<tr>
<td>Glyburide</td>
<td>eGFR &lt;60: avoid use</td>
<td>Avoid use</td>
</tr>
</tbody>
</table>

PTDM Management- Thiazolidinediones (TZDs)

- TZDs have been used successfully in people with liver and kidney transplants, but side effects include fluid retention, heart failure, and bone loss
- Use in patients with underlying bone disease (such as renal or hepatic osteodystrophy) could be potentially problematic

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typically, do not cause hypoglycemia</td>
<td>Fluid Retention</td>
</tr>
<tr>
<td>Increase insulin sensitivity</td>
<td>Heart failure</td>
</tr>
<tr>
<td>Hepatically metabolized</td>
<td>Bone loss</td>
</tr>
</tbody>
</table>
PTDM Management- Thiazolidinediones (TZDs)

<table>
<thead>
<tr>
<th>Medication Class</th>
<th>Renal Function</th>
<th>Use in Transplant Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thiazolidinediones</td>
<td>No dose adjustment needed</td>
<td>Well tolerated. Concern regarding fluid retention, CHF, and bone fractures.</td>
</tr>
</tbody>
</table>

Pioglitazone

PTDM Management- Dipeptidyl peptidase 4 (DPP-4s) inhibitors

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do not interact with immunosuppressant drugs</td>
<td>Contraindicated in patients with history of pancreatitis</td>
</tr>
<tr>
<td>Have demonstrated safety in small clinical trials</td>
<td>Mild-moderate reduction in A1C</td>
</tr>
<tr>
<td>Do not cause hypoglycemia</td>
<td>Doses adjustments needed depending on eGFR (except for Linagliptin)</td>
</tr>
<tr>
<td>Few adverse effects</td>
<td></td>
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</tbody>
</table>
## PTDM Management- Dipeptidyl peptidase 4 (DPP-4) inhibitors

<table>
<thead>
<tr>
<th>Medication Class</th>
<th>Renal Function</th>
<th>Use in Transplant Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>DPP-4 inhibitors</td>
<td></td>
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</tr>
<tr>
<td>Sitagliptin</td>
<td>eGFR ≥50: 100 mg daily</td>
<td>Several small studies show that it is well tolerated in transplant patients</td>
</tr>
<tr>
<td></td>
<td>eGFR 30–49: 50 mg daily</td>
<td></td>
</tr>
<tr>
<td></td>
<td>eGFR &lt;30: 25 mg daily</td>
<td></td>
</tr>
<tr>
<td>Saxagliptin</td>
<td>eGFR &gt;50: 2.5 or 5 mg daily</td>
<td>Metabolized by CYP3A4; reduce dose if cyclosporine/tacrolimus used but does not affect cyclosporine/tacrolimus levels</td>
</tr>
<tr>
<td></td>
<td>eGFR ≤50: 2.5 mg daily</td>
<td></td>
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<tr>
<td>Alogliptin</td>
<td>eGFR &gt;60: 25 mg daily</td>
<td></td>
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<tr>
<td></td>
<td>eGFR 30–59: 12.5 mg daily</td>
<td></td>
</tr>
<tr>
<td></td>
<td>eGFR &lt;30: 6.25 mg daily</td>
<td></td>
</tr>
<tr>
<td>Linagliptin</td>
<td>No dose adjustment needed</td>
<td>Has been used in transplant patients</td>
</tr>
</tbody>
</table>

### Published studies with DPP-4i use in kidney transplant

- Lane et al. [36]
  - Study design: Case series, n = 15
  - Follow-up: 3 months
  - Population: KT recipients with eGFR >30 ml/min/1.73 m² and diagnosis of PTDM
  - Intervention/s: All patients treated with sitagliptin
  - Outcome: Reduction in HbA1c from 7.2 ± 0.1% to 6.7 ± 0.3% (P = 0.037)
  - No patient discontinuation because of side effects
  - No symptomatic hypoglycaemia
  - Decrease in FPG of 22.21 mg/dL and decrease in postprandial plasma glucose of 40.07 mg/dL (P < 0.01)
  - Decrease of HbA1c 0.8% in 24 weeks

- Sanyal et al. [37]
  - Case series, n = 21
  - Follow-up: 6 months
  - Population: KT recipients with diabetes and stable renal function
  - Intervention/s: All patients received linagliptin monotherapy (5 mg/day)
  - Outcome: Metformin + sitagliptin versus metformin + insulin
  - Rescue therapy: pioglitazone

- Soliman et al. [38]
  - RCT, n = 62
  - Follow-up: 3 months
  - Population: KT recipients with PTDM receiving metformin and inadequate glycemic control
  - Intervention/s: Meetformin + sitagliptin versus metformin + insulin
  - Outcome: Similar reduction in HbA1c in both groups (−0.6% with sitagliptin and −0.6% in insulin group)
  - Small weight loss in sitagliptin group (−0.4 kg) and weight gain in insulin group (0.8 kg); P = 0.05
  - No severe adverse events

- Bouner et al. [39]
  - Case series, n = 22
  - Follow-up: 32.5 ± 17.8 months
  - Population: KT recipients with diagnosis of PTDM treated with sitagliptin alone
  - Intervention/s: All patients treated with sitagliptin monotherapy
  - Outcome: Mean HbA1c 6 ± 0.5%
  - No episodes of pancreatitis
  - Rare transplant-specific adverse events

- Holderer et al. [40]
  - Phase 2 RCT, n = 33
  - Follow-up: 4 months
  - Population: KT recipients (≥6 months post KT) with stable renal function and diagnosis of PTDM
  - Intervention/s: Vildagliptin 50 mg/day versus placebo during 3 months
  - Outcome: Reduced HbA1c (6.1% versus 6.5%, P = 0.03) and 2HGG (217.7 versus 231.2 mg/dL, P = 0.06) in the vildagliptin group versus placebo
  - Mild adverse events, similar rates in both groups

- Stem Rauben et al. [41]
  - RCT cross-over, n = 19
  - Follow-up: 8 weeks
  - Population: KT recipients (≥14) with PTDM and stable renal function
  - Intervention/s: 4 weeks with sitagliptin followed by 4 weeks with no sitagliptin, versus vice versa
  - Outcome: Significant increase of insulin secretion with sitagliptin
  - Decrease in FPG (0.9 [0.5–1.7] mmol/L, P = 0.005) and 2HGG (2.9 [0.5–6.4] mmol/L, P = 0.006)

- Guardado-Mendoza et al. [42]
  - Prospective cohort study, n = 28
  - Follow-up: 12 months
  - Population: KT recipients with fasting hyperglycaemia during the first 24 h post surgery
  - Intervention/s: Linagliptin 5 mg/day plus insulin versus insulin alone
  - Outcome: Lower glucose levels (151.0 ± 15.1 versus 191.4 ± 22.5 mg/dL) and insulin doses (0.5 ± 0.5 versus 242.6 ± 61.0 in the linagliptin + insulin group; P = 0.05)
  - Less severe hyperglycaemia in linagliptin + insulin group (65.1 ± 2.2 versus 54.2 ± 3.3 mg/dL; P = 0.06)
PTDM Management—GLP-1 receptor agonists

- There is limited data on GLP-1RA use in transplantation
- No dose adjustment is indicated in those with renal impairment, including end-stage renal disease, although data in this population are limited
- Nausea (and other GI side effects) is a common side effect of all drugs
  - Use caution in patients with history of autonomic neuropathy with delayed gastric emptying

### Pros

<table>
<thead>
<tr>
<th>Appetite suppression and weight loss</th>
<th>Nausea (and other GI side effects) is a common side effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do not cause hypoglycemia</td>
<td>Contraindicated in patients with history of pancreatitis/MTC/MEN-2</td>
</tr>
<tr>
<td>No dose adjustment is indicated in those with renal impairment</td>
<td></td>
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</table>

## Published studies with GLP-1 RA Use in Kidney Transplant

<table>
<thead>
<tr>
<th>Study id</th>
<th>Study design, follow-up</th>
<th>Population</th>
<th>Intervention/s</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pinelli et al. [17]</td>
<td>Case series, n = 5, Follow-up: 3 weeks</td>
<td>KT recipients with or without previous DM or PTDM, with stable renal function receiving tacrolimus</td>
<td>All patients received liraglutide in monotherapy</td>
<td>Reduction of postprandial blood glucose levels at 60 (7.3 ± 1.2 versus 5.9 ± 0.5 mmol/L) and 120 min (7.1 ± 0.8 versus 6.0 ± 0.4 mmol/L); no decrease of FBS</td>
</tr>
<tr>
<td>Halden et al. [18]</td>
<td>RCT, n = 24 (PTDM n = 12, without PTDM n = 12)</td>
<td>KT with and without PTDM</td>
<td>Intravenous infusion of GLP-1 versus saline (placebo)</td>
<td>GLP-1 improves glucose-induced insulin secretion and glucagon suppression in PTDM patients</td>
</tr>
<tr>
<td>Liu et al. [19]</td>
<td>Retrospective case series, n = 7, Mean follow-up: 19.4 ± 7.6 months</td>
<td>KT recipients with PTDM treated with liraglutide</td>
<td>All patients received liraglutide</td>
<td>Decrease of FBS from 228.6 ± 39.1 to 166.0 ± 26.6 mg/dL (P = 0.103)</td>
</tr>
<tr>
<td>Singh et al. [20]</td>
<td>Retrospective case series, n = 63, Follow-up: 24 months</td>
<td>SOT recipients with DM using dulaglutide, Includes both type-2 DM (43 patients) and PTDM (20 patients)</td>
<td>All patients received dulaglutide</td>
<td>Statistically significant weight reduction: mean paired difference at 6, 12 and 24 months of 2.07 (P &lt; 0.001), 4.007 (P &lt; 0.001) and 5.23 (P &lt; 0.034) kg</td>
</tr>
<tr>
<td>Singh et al. [21]</td>
<td>Retrospective cohort, n = 88 (dulaglutide n = 63, liraglutide n = 25), Follow-up: 24 months</td>
<td>SOT patients with DM treated with dulaglutide or liraglutide, Includes both type-2 DM (43 patients) and PTDM (20 patients)</td>
<td>All patients received dulaglutide or liraglutide</td>
<td>Significant weight decrease with dulaglutide compared with liraglutide (2% versus 0.09%, P = 0.003)</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td>Reduction in insulin use with dulaglutide compared with liraglutide (26% versus 3.6%, P = 0.01)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>No statistical differences between groups in HbA1c changes</td>
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</table>
A retrospective chart review of solid organ transplant recipients (mostly kidney) with diabetes who were using dulaglutide (0.75 and 1.5 mg weekly)

- Included recipients with T2DM regardless of the time of onset of diabetes with respect to a transplant
- A total of 59, 50 and 13 recipients were followed during 6, 12 and 24 months

There was a sustained, statistically significant reduction in the primary endpoints of weight, BMI, and insulin requirement at 6, 12 and 24 months, respectively

- There was no increased risk of malignancy, cardiovascular morbidity, graft-failure or all-cause mortality
- Gastrointestinal manifestations were rare, even in patients with advanced CKD, and required no change in immunosuppressive agents
- Concluded dulaglutide may be considered an important option for diabetes management in solid organ transplant
A retrospective study to assess the safety and effectiveness of dulaglutide (0.75 or 1.5 mg weekly) and liraglutide (0.6-1.8 mg daily) in management of diabetes in solid organ transplant at 6, 12 and 24 months.

- 88 transplant recipients (mostly kidney)
- There was a sustained reduction in weight and insulin requirement with dulaglutide when compared to liraglutide
- There was no episode of severe hypoglycemia requiring hospitalization in either group
- Rates of GI side effects were higher in the liraglutide group than in the dulaglutide group
- There was a 10% reduction in creatinine and a 15% increase in eGFR at the end of 24 months with dulaglutide. However, there was an increase in creatinine by 7% and an 8% decrease in eGFR at the end of 24 months with liraglutide

Retrorespective review of 14 kidney transplant recipients who were on Liraglutide (0.6-1.8 mg daily) and Dulaglutide (0.75 mg weekly) for at least approximately 12 months.
Results

• No significant impact on weight loss, but was associated with a significant reduction in the total daily insulin dose and reduction in the risk of hypoglycemia.
• Kidney function remained stable and none of the recipients experienced acute rejection.
• Tacrolimus dose was not significantly changed.
• Five patients (29%) discontinued GLP1RA therapy—4 due to side effects and 1 due to uncontrolled hyperglycemia.

PTDM Management—Sodium-glucose cotransporters 2 (SGLT2) inhibitors

• The benefits related to SGLT2i use in terms of kidney function have been widely reported in T2DM. Five relevant clinical trials in T2DM population (EMPA-REG, CANVAS, DECLARE, CREDENCE and DAPA-CKD) have shown that treatment with SGLT2i can slow the progression of CKD and the appearance of renal events.
• In terms of adverse effects, there can be an initial increase in creatinine. There is also concern for UTIs, genital mycotic infections, and necrotizing fasciitis.
  • This is especially relevant in the kidney transplant population, who are more vulnerable because of chronic immunosuppression and genitourinary structural or functional abnormalities after the surgery.
  • UTI can lead to a deterioration of renal function and, in the worst cases, graft loss.
  • Genital mycotic infections and necrotizing fasciitis can be particularly harmful in immunosuppressed transplant recipients.
• Limited data in transplant recipients.
**Pros**

- Associated with weight loss
- Do not cause hypoglycemia
- No major GI side effects
- Few known drug interactions with immunosuppressants

**Cons**

- Risk for euglycemic DKA
- Need to monitor renal function/(initial) decrease in eGFR
- Risk of urinary or mycotic infection

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**PTDM Management—SGLT2-i**

- An increase of serum creatinine and a decrease of eGFR are seen with the initiation of SGLT2i also in recipients with PTDM.
  - This effect has been reported in two studies using empagliflozin: in a study including 14 recipients treated with this agent a reduction of eGFR from 55.6 to 47.5 at 4 weeks and in another contemporary eight case-series report, similar increases in creatinine were seen after 4 weeks.
  - A stabilization of eGFR after this initial increase at 12 months has been confirmed in three studies.
- In studies focused on a few number of kidney transplant recipients, there were no more UTIs with SGLT2i use (incidences between 20% and 25%)
Published studies with SGLT2i use in kidney transplant

EMPTRA-DM study: 14 stable kidney transplant patients were transitioned from insulin (<40 U/d) to empagliflozin 10 mg monotherapy

OGTT before and after the 4-week empagliflozin monotherapy, as well as the evaluated glucose profiles showed that empagliflozin monotherapy yielded inferior glucose control

After the 4-week empagliflozin monotherapy, the study was continued for 11 months further, but 6 participants withdrew, due to poor glycemic control, urinary tract infections, and worsened eGFR. Of the 8 participants remaining in the study, 3 had to be placed back on insulin therapy
• From baseline to 4 weeks, eGFR decreased from 55.6 ± 20.3 to 47.5 ± 15.1 mL/min per 1.73 m² (P = .008)
• Kidney function at 3, 6, and 12 months was unchanged in comparison to baseline
• Risk of DKA: During the 4 weeks of empagliflozin treatment, there was a minimal ketone body excretion without any signs of ketoacidosis in 1 participant. Throughout the subsequent follow-up of the remaining 8 participants no DKA occurred.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Baseline</th>
<th>2 weeks</th>
<th>4 weeks</th>
<th>3 months</th>
<th>6 months</th>
<th>12 months</th>
<th>P (baseline vs 4 weeks)</th>
<th>P (baseline vs 12 months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creatinine mg/dL, mean (SD)</td>
<td>1.4 (0.3)</td>
<td>1.5 (0.3)</td>
<td>1.5 (0.4)</td>
<td>1.4 (0.3)</td>
<td>1.4 (0.3)</td>
<td>1.4 (0.3)</td>
<td>.06</td>
<td>.99</td>
</tr>
<tr>
<td>eGFR mL/min 1.73 m², mean (SD)</td>
<td>54.0 (23.8)</td>
<td>47.6 (18.1)</td>
<td>45.6 (19.7)</td>
<td>49.8 (16.8)</td>
<td>54.1 (19.6)</td>
<td>53.5 (13.3)</td>
<td>.01</td>
<td>.93</td>
</tr>
</tbody>
</table>

Kaplan–Meier curves for the study population (SP) vs the matched reference population (RP)
• EMPA-Renal Tx study: Single-center, prospective, double-blind study
• 49 patients with kidney transplanted >1 year ago, diagnosed with PTDM, with stable renal function (eGFR >30 mL/min/1.73 m²), and with stable immunosuppressive therapy were randomized to receive either 10 mg empagliflozin or placebo once daily for 24 weeks
• Median change in HbA1c was significantly reduced with empagliflozin compared with placebo (P = 0.025)
• The magnitude of glucose reduction was dependent on GFR and baseline HbA1c.
• The treatment also resulted in a significant reduction in body weight compared with the placebo group (P = 0.014)
• There were no significant differences between the groups in adverse events, immunosuppressive drug levels, or eGFR

Median change from baseline to week 24 in HbA₁c (P = 0.018) (A), FPG (P = 0.27) (B), and 2-h glucose after an OGTT (P = 1) (C) in the two intervention groups
The relationship between baseline eGFR and change in HbA\textsubscript{1c} (A) and renal glucose excretion (B) from baseline to week 24

<table>
<thead>
<tr>
<th>Medication Class</th>
<th>Renal Function for glycemic control use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canagliflozin</td>
<td>eGFR 30–60: maximum dose 100 mg daily</td>
</tr>
<tr>
<td></td>
<td>eGFR &lt;30: avoid use</td>
</tr>
<tr>
<td>Dapagliflozin</td>
<td>eGFR &lt;45: avoid use</td>
</tr>
<tr>
<td>Empagliflozin</td>
<td>eGFR &lt;30: Avoid use</td>
</tr>
</tbody>
</table>
- Metformin: Treat kidney transplant recipients with T2DM and an eGFR ≥30 with metformin according to recommendations for patients with T2D and CKD
- GLP-1RA: The same recommendation for treatment of T2DM in patients with CKD applies to kidney transplant recipients, as there is no evidence to indicate different outcomes in this population
- SGLT2i have not been adequately studied in kidney transplant recipients, who may benefit from SGLT2i treatment, but are immunosuppressed and potentially at increased risk for infections; therefore, the recommendation to use SGLT2i does not apply to kidney transplant recipients

Conclusions
- PTDM is a common condition after solid-organ transplantation and is associated with increased morbidity, mortality, and health care costs
- SGLT2i and GLP1-RA have been recommended for individuals with type 2 diabetes and established ASCVD and CKD as part of the glucose-lowering regimen. Guideline-directed medical therapy for heart failure includes SGLT2i therapy.
- Individuals with PTDM are particularly affected by CKD and ASCVD
- There is currently limited data in efficacy and safety of non-insulin antihyperglycemic agents in people with PTDM
- Much more data (including Prospective randomized studies) are needed regarding the types of treatment and their implementation given the complexity of care in this population
THANK YOU