Insulin Pump Therapy Management
The Collaborative Art and Science of Supporting an Adult “Pumper”
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Learning Objectives
- Describe advantages & disadvantages of pump therapy
- Describe the process of initiating pump therapy
- Use a collaborative approach with an adult pumper to:
  a. Maximize the benefits of insulin pump therapy.
  b. Analyze data and identify patterns
  c. Set realistic goals with psychological support

History of Pumps
What the Pump Can Do
- Adjustable basal
- Address dawn phenomena
- Bolus calculator, prevents stacking, provides precision of dose
- Unique bolus deliveries

Insulin Pumps & CGMS today
Why Insulin Pump Therapy
Clinical Significance
- Overall better control
- Less frequent and less severe hypoglycemia
- Prevention of lows can help patient regain hypoglycemic unawareness
Why Insulin Pump Therapy

*Pumper Satisfaction*

- Ease and discreetness of giving bolus
- Less fear of lows
- More flexible lifestyle
- Overall improved quality of life

Disadvantages of Insulin Pump Therapy

- Mechanical device attached to your body
- Infusion site issues: infections etc.
- Weight gain: *not necessarily so*
- Increased risk of DKA

Disadvantages of Insulin pump therapy

- **Cost of pump with insurance coverage**
  1. Tubing Pump: 10-20% of $5000-$6000 = $500-$1200
  2. PDM for pods: 10-20% of $900 = $90-$180

Retail Cost Comparison per Month
30 Units of Insulin per Day on average

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
<th>PDM</th>
<th>USD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulin vials (50)</td>
<td>$400</td>
<td>$400</td>
<td>$400</td>
</tr>
<tr>
<td>2 vials rapid</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 vials rapid</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 vial rapid</td>
<td>$450</td>
<td>$450</td>
<td></td>
</tr>
<tr>
<td>1 vial Long</td>
<td>$100</td>
<td>$100</td>
<td></td>
</tr>
<tr>
<td>Insulin Pens</td>
<td>$400</td>
<td>$400</td>
<td></td>
</tr>
<tr>
<td>Needles or syringes</td>
<td>$25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pods (500)</td>
<td>$300</td>
<td>$300</td>
<td></td>
</tr>
<tr>
<td>Reservoirs (100)</td>
<td>$15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infusion set (1000)</td>
<td>$150</td>
<td>$150</td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL =** $750

Potential DKA

Trouble Shooting Pump Problems

Phone call: 2:45pm Triage Nurse answers

"My glucoses have been high since I changed my pod yesterday"

Potential DKA

Trouble Shooting Pump Problems

What would be the next steps:

a. Keep pod in for basal and give a shot
b. Change pod and give a shot
c. Test ketones and restrict fluids
d. b and c
e. a and c
What are the Next Steps?

* Change Pod again
* Check Ketones
* Push Fluids
* Give shot

Follow Up Call #1

CDE # 1 left a message of the following questions:

Is she coming down with something or currently sick/infection?
Has the problem started with the use of a new box of pods?
Is her insulin good? (not using greater than 28 days?)
Does she have any scar tissue that she might be inserting the pod into?
Has she had this problem in the past?

Pumper Status from Triage Nurse

Can change pod
No ketone strips
Gave shot 2 hours ago
Drinking water
Needs call back about dosing

Follow Up Call #2

CDE # 2 called at 6:30pm
Got more info.
Pumper has been using a temporary basal that is almost double her basal (+95%) all day
180 before lunch gave bolus with Pod,
@ 2:30 BG 400 gave injection 5 units
@ 4pm BG 289

Is This a Pump Problem?

CDE : states “You seem to have a lot of insulin resistance”
Pt: “Well I did have a cortisone shot a few days ago”

Now we need a different plan.

Next Steps

What Should You Advise Patient to do:

a. Adjust basal rate
b. Adjust correction factor
c. Adjust carb ratio
d. All of the above
Trouble Shooting Pump Problems

<table>
<thead>
<tr>
<th>PUMP SETTINGS</th>
<th>Bolus Ratio</th>
<th>Target 120 mg/dl</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basal 12a 0.90 units/hr</td>
<td>12a 1 unit 13 grams</td>
<td>1 unit 60 mg/dl</td>
</tr>
<tr>
<td>4a 0.75 units/hr</td>
<td>12p 1 unit 10 grams</td>
<td>1 unit 30 mg/dl</td>
</tr>
<tr>
<td>2p 0.70 units/hr</td>
<td>10p 1 unit 12 grams</td>
<td></td>
</tr>
<tr>
<td>6p 0.90 units/hr</td>
<td>9p 1.10 units/hr</td>
<td></td>
</tr>
</tbody>
</table>

Correction Factor: 1 unit 60 mg/dl

The Potential Pumper

1. Pre pump visit: pick pump, assess readiness
2. Protocol: Set realistic expectations
   a. Carb counting: food logs, reading labels, APPs
   b. BG testing: minimum 4 times per day
   c. Visit schedule
   d. Basal testing
   e. Data collection and access

Riding the Cortisone Wave

<table>
<thead>
<tr>
<th>Basal 150%</th>
<th>Bolus ratio:</th>
</tr>
</thead>
<tbody>
<tr>
<td>12a 1 unit 13 grams</td>
<td>10 grams</td>
</tr>
<tr>
<td>12p 1 unit 10 grams</td>
<td>7 grams</td>
</tr>
<tr>
<td>10p 1 unit 12 grams</td>
<td>9 grams</td>
</tr>
</tbody>
</table>

Correction factor: 1 unit 60 mg/dl → 1 unit 30 mg/dl

Poor Candidate

• Not motivated
• Only wants it to make diabetes easier
• A1c > 9-10% ?? “It Depends”
• History of DKA in the past 1-2 years

The 2 Most Critical Factors for Success??

Frequency of Monitoring

Sufficient Ongoing support
Infusion Site Selection

- BMI and body locations available
- Activities
- Dexterity
- Duration of diabetes: scar tissue

Options for Infusion Sets

- 90 degree 6mm or 9mm teflon cannula
- 90 degree steel needle 6-8 mm

More Options

- 30-45 degree 13mm-17mm teflon
- Pod (patch pump)
  - 6.5 mm 60 degree

Newest Infusion Set

“The Achilles Heel of Continuous Subcutaneous Insulin Infusion (CSII)”

- Silent occlusions
- Increased pressure against flow of insulin
- But not detected by the pump

Clinical Solutions

- Steel needle
- Change site more frequently
- Avoid auto insertion devices
- Ask pump companies to (investigate)
- Flow smart??

Data Collection-The Log Book

Continuous Glucose Monitor Data

Pump Download

Continuous Glucose Monitor Data

Basal Rate Adjustment

Before Adjustment
• 12a 0.85 units/hr
• 7a 1.25 units/hr
• 1p 1.15 units/hr
• 6:30pm 0.85 units/hr

After Adjustment
• 12a 0.85 units/hr
• 5:30a 1.25 units/hr
• 1p 1.00 units/hr
• 6:30pm 0.85 units/hr

Dawn Phenomena

• Ben is a 38 year old with type 1 for 26 years
• Current lantus dose 17 units
• Fixed doses at meals
• Extreme dawn phenomena
• Many years pump recommended
• Came back and asked about pumps
• Current A1c 7.1%
**Pre Pump Tasks**
- Is patient willing to do CGMS?
- What are patients expectations
- Pre pump visit for pump selection
- Carb counting training
- Set up visit schedule for starting pump and subsequent visits

**Calculating Basal Rate**
- Method 1: Use 80-90% of long acting dose and divide by 24 = units/hr
- Method 2: given 48% of TDD = basal insulin
- 2% of TDD each hour = units/hr

**MDI with Dawn Phenomena**

**Basal Rate Calculations**
- 17 units of lantus
- TDD of 32 units
- Method #1 80% of 17 = 13.6 / 24 = .55 units/hr
- Method #2 2% of 32 = 0.65 units/hr

**Day Time Lows**

**Initial Basal rates**

<table>
<thead>
<tr>
<th>TIME</th>
<th>RATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>12a</td>
<td>0.5 units/hr</td>
</tr>
<tr>
<td>3a</td>
<td>0.6 units/hr</td>
</tr>
<tr>
<td>7a</td>
<td>0.55 units/hr</td>
</tr>
</tbody>
</table>
Basal Testing
- Period of fasting starts 5 hours after last bolus or Food
  OVERNIGHT TEST.
- Dinner at 7pm no correction or food after that
- After 12a Test every 2-3 hours or have CGM data
  Stop test if > 250 or < 70

Basal Test
- 7pm 118mg/dl (pre dinner last bolus, last food)
- 12a 125mg/dl test begins
- 3a 166mg/dl (41 point rise)
- 6a 210mg/dl (44 point rise)
- 8a 248mg/dl (38 point rise)

Basal Testing
- 7pm 128mg/dl (pre dinner last bolus, last food)
- 12a 155mg/dl test begins
- 3a 121mg/dl (30 point drop)
- 6a 198mg/dl (77 point rise)
- 8a 251mg/dl (53 point rise)

More Adjustments

Basal Rates After Several Adjustments

<table>
<thead>
<tr>
<th>TIME</th>
<th>RATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>12am</td>
<td>0.70 units/hr</td>
</tr>
<tr>
<td>3am</td>
<td>1.10 units/hr</td>
</tr>
<tr>
<td>8a</td>
<td>0.45 units/hr</td>
</tr>
<tr>
<td>12p</td>
<td>0.55 units/hr</td>
</tr>
</tbody>
</table>
TOTAL BASAL INSULIN = 16 units
Soft Data
- Relationship with diabetes educator
- How can we make this collaborative?
- What does a pumper find helpful?

Collaborative Process
- Questionnaire to 95 pumpers from our practice
- 37 responses (39%)
- Common themes:
  1. Accessibility
  2. Approach to teaching
  3. Attitude of the educator
  4. Psychological support

Approach to Teaching
- “Not dictatorial but collaborative and with instruction”
- “Give me a chance to ask questions”
- “Makes me part of the process”
- “In depth discussion of the download and sharing data”

Attitude of the Educator
- “Compassionate”
- “Not judgmental”
- “Talk about what matters to me”

Psychological Support
- “Atta Girl keep up the good work”
- “Sympathy when I screwed up”
- “Talk about things that bother me”
- “Work with me whatever place I am”
Hypoglycemia Risks

- Susan 70 y/o female type 1 diabetes >50 years
- A1c before coming to our clinic: 6.1-6.5%
- Patient wants tight control: wants her A1c to be below 6.0%
- Frequent hypoglycemia with paramedics 2 times in past year
- Severe hypoglycemic unawareness
- Pump setting for insulin on board 3 hours

What would be helpful

- a. Tell patient the lows are bad for her
- b. Share stories about patients who have died from lows
- c. Show patient current guidelines for modifying goals
- d. Tell her she has a great A1c
- e. All of the above

Modifying Glucose Targets

- ADA: less stringent (A1c <8%)
  1. History of severe hypoglycemia
  2. Hypoglycemia unawareness

- ACE: less stringent fasting, post meal & A1c
  1. Hypoglycemic risk
How the Pump is Used

Average Looks Good but…

Standard Deviation lower is better
Her Standard deviation 87

Stacking Insulin

Stacking Insulin/Easy Bolus

Hypoglycemia

Less Stacking Less Lows
### Outcome
- Patient beginning to see benefits of less lows
- Patient using easy bolus less
- November 2015 A1c 7.0
- March 2016 A1c 7.1%

### Progress not Perfection
Danielle 58 year old patient with type 1 diabetes since age 27
Widowed
Active with grandchildren
Works in retail

History of A1c:
- Nov 2014 10.7%
- March 2015 8.8%
- Sept 2015 10.2%
- Jan 2016 11.2%

### Better Average Less Lows
- Average BG (mg/dL) 146 ± 56
- BG Readings 132
- Readings Above Target 60 (47%)
- Standard Deviation currently 50 dropped 37 points

### Less Lows

### Over all Picture

### Avg 219mg/dl Not Entering Carbs
- Average BG (mg/dL) 219 ± 64
- Readings Above Target 116 (41.6%)
- Readings Below Target
- Standard Deviation
- Average BG (mg/dL) 219
- Total Enters Carbs
- Carbs/Total Enters (mg/dL) 1.9

### Summary
- Patient improving with less lows
- A1c progression showing improvement
Going High Overnight

Set Realistic Goals
Focus on evening snacking: only one snack
Enter all carbs
Test blood sugar at bedtime

Not Using Features

Using Features: month 1

What would you say
a. What the obstacles to taking care of your diabetes?
b. You aren’t testing enough.
c. You are eating too much at night.
d. All of the above.

Improvement During Day
Better Average Entering Carbs

<table>
<thead>
<tr>
<th>Statistic</th>
<th>April 2016</th>
<th>Target</th>
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</thead>
<tbody>
<tr>
<td>Avg BG (mg/dL)</td>
<td>69.4</td>
<td>80</td>
</tr>
<tr>
<td>BG Readings</td>
<td>76.2</td>
<td>75</td>
</tr>
<tr>
<td>Readings Above Target</td>
<td>64</td>
<td></td>
</tr>
<tr>
<td>Readings Below Target</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Sensor Avg (mg/dL)</td>
<td>66.9</td>
<td>74</td>
</tr>
<tr>
<td>Avg A1c ≤ 480 (mg/dL)</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Avg A1c ≤ 79 (mg/dL)</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Avg Daily Carbs (g)</td>
<td>14.2</td>
<td>15</td>
</tr>
</tbody>
</table>

Learning Objectives

- Describe advantages & disadvantages of pump therapy
- Describe the process of initiating pump therapy
- Use a collaborative approach with an adult pumper to:
  a. Maximize the benefits of insulin pump therapy.
  b. Analyze data and identify patterns
  c. Set realistic goals with psychological support

Art with Science combined

Patient readiness and patient engagement
Provide encouragement for basal tests
Modify A1c goals
Support in using pump to decrease hypoglycemia
Use of pump features while setting realistic goals

Outcome

April 2016
Lost 7 lbs
A1c 8.0%
Walking more
Continues to struggle with evening snacking
But entering in pump has helped her
Take Away

Collaborative Support for Insulin Pump Therapy Management is An Art and a Science

References