ERAS for Cardiac Surgery !
Really ?
Really!

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Goals

- What is ERAS? Or Fast track surgery
- Implementing “ On table Extubation” for patients undergoing isolated CABG

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What is ERAS

- First described by H. Kehlet 1999 Br J Anesth- a multidisciplinary approach to surgical procedures with the aim of **reducing postoperative length** of stay, **perioperative morbidity/mortality**, and **attenuating the stress response to surgery**.
- Targeted surgical population – **colorectal surgery**
- Emphasized **multimodal non-opioid analgesics** and the use of regional **anesthetics** to accomplish this goal

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The state of colorectal surgery prior to ERAS

- Standard colorectal surgery complication rate = 20-30%
  - Ileus
  - Pulmonary dysfunction
  - pain
- Postoperative length of stay (LOS) 8-12 days

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Standardization of care: Impact on enhanced recovery protocol on length of stay, complications and direct costs after colorectal surgery.Thiele. Journal of American college of surgery 2015

- Implemented standardized enhanced recovery pathway
- Re-evaluated the following:
  - Fasting in preoperative period
  - Intra-operative liberal fluid administration
  - Liberal use of nasogastric tubes
  - Opioid-centric pain management strategies

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From Theile: Preop/intraop/ postop pathway prior to ERAS protocol implementation

- Night before surgery mechanical bowel prep (4 l Golytely, erythromycin (1g x 3), neomycin (1g x 3), and metoclopramide (10mgx 3)
- Clear liquids day before surgery
- NPO past midnight
- Liberal intra-operative opioid use
- Low thoracic epidural (bupivacaine and hydromorphone) for open procedures.
- No regional for laparoscopic procedures

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Prior to ERAS- postop pathway

- Postoperative fluid NSS or lactated ringers at 125 cc/hr until patient tolerated a diet
  - Clear liquid 1st postop day
- Postoperative pain- PCA fentanyl, morphine, or hydromorphone. PO pain med once tolerate diet
- d/c criteria regular diet, flatus, and pain control

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Theile: ERAS protocol

- Expectations reviewed in preoperative visit
- ERAS denoted in EMR
- Night before MBP - Regular diet until 6 pm- clear liquids until 2 hrs before surgery- 20 oz gatorade 2 hrs before anesthesia induction
- Preop - 200 mg Celecoxib, 600 mg Gabapentin, and 975 oral Acetaminophen

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Theile: ERAS anesthesia protocol

- Intrathecal morphine (100 µg)
- Subcutaneous unfractionated heparin 5,000 sub cutaneous after spinal
- N-methyl-D-aspartate (Mg^{++} 30 mg/kg, ketamine 0.5 mg/kg) ketamine infusion 10 µg/kg/min- opioid sparing effects
- IV lidocaine infusion (40 µg/kg/hr) and 48 hrs postop (1mg/hr)
- Intraop fluid management goal directed

Theile: Postop ERAS

- Pt get out of bed in PACU to be weighed and are out of bed and in chair night of surgery
- Clear liquids given in PACU and night of surgery
- D/c Iv morning after surgery
- Soft diet 1st postoperative day
- Scheduled doses of acetaminophen and celecoxib (q 4h day of surgery, or 6:00 am 1st postop day for open)

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Thiele 2015 JACS

Table 3

Compliance with Protocol Elements

Protocol elements	Before ER protocol (n = 98)	After ER protocol (n = 109)	p Value
Intraoperative morphine equivalents, mg, mean ± SD	21.7 ± 10.7	0.5 ± 1.1	0.0001
Total morphine equivalents, mg, mean ± SD	280.9 ± 395.7	63.7 ± 130.0	0.0001
Intraoperative net fluid balance, mL, mean ± SD	2,733 ± 1,464	848 ± 953	0.0001
Total net fluid balance, mL, mean ± SD	4,409 ± 5,496	−182 ± 3,933	0.0001
Gatorade, n (%)	—	90 (83)	NA
Ambulate DOS, n (%)	0	84 (77)	0.0001
Ambulate by POD 1, n (%)	79 (81)	96 (88)	0.178

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Table 4

Clinical Outcomes before and after ER Protocol Implementation

Outcomes	Before ER protocol (n = 98)	After ER protocol (n = 109)	p Value
Length of stay, d, mean ± SD (median)	6.8 ± 4.7 (5)	4.6 ± 3.6 (3)	0.0002
Open	7.5 ± 5.3 (6)	5.2 ± 4.4 (4)	0.007
Laparoscopic	5.5 ± 2.6 (5)	3.8 ± 2.1 (3)	0.003
Readmission	17 (17)	10 (9)	0.1
Ileus	27 (28)	18 (17)	0.06
Unplanned intubation	2 (2)	1 (1)	0.60
Death	0	0	1.0
Superficial/deep SSI	10 (10)	4 (4)	0.09
Organ space SSI	10 (10)	4 (4)	0.09
Any SSI	20 (20)	8 (7)	0.008
Thromboembolic event	4 (4)	3 (3)	0.71
Progressive renal insufficiency	0	0	1.0
Acute renal failure	0	0	1.0
Urinary tract infection	3 (3)	1 (1)	0.35
Myocardial infarction	1 (1)	1 (1)	1.0
Postoperative bleeding	12 (12)	6 (6)	0.13
Sepsis	1 (1)	2 (2)	1.0
Pneumonia	1 (1)	3 (3)	0.62
Unplanned return to OR	7 (7)	5 (5)	0.56
Any complication	30 (30)	16 (15)	0.007
Mean 30-d direct cost, mean ± SD	20,435 ± 12,857	13,306 ± 9,263	0.001

Elements of ERAS

- No bowel prep
- Limit premedication
- No preoperative fasting
- Clear carbohydrates 2-4 hours prior to surgery
- Standard anesthetic technique
- Thoracic Epidural or TAP or IT narcotic
- High FIO2 (80%)
- Avoid perioperative fluid overload
- Maintain normothermia
- Small transverse incision
- Multimodal Non-opioid analgesia
- Early removal of bladder catheters
- Early postoperative feeding and mobilization

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Enhanced recovery for Isolated CABG: Initiating an on table extubation (OTE) program and reducing postoperative length of stay. Abst STS 2019 San Diego California

- Despite the enormity of undergoing cardiac surgery, patients primarily fear postoperative mechanical ventilation
- As of 2018, the Society of Thoracic Surgeons national database reports an On Table Extubation rate of 2.9%
- Only 57% of CABG patients achieve postoperative extubation < 6hrs after ICU arrival
- In 2014 at PAH, we achieved an OTE in 48% of isolated CABG- ICU Postop BiPAP= 50% of OTE patients

PAH CABG: 2014

- **Non-standardized Anesthetic for OTE**
  - Anesthetic 2-4 mg midazolam, 15-20 IV fentanyl, rocuronium or vecuronium
  - Reversal with neostigmine/glyco
  - Some patients received preop intrathecal narcotic
- **ICU concern over the benefit of OTE**
  - Patients over sedated
  - Patients under sedated
- **Non-standardized opioid administration** intraoperative and postoperative
- **No standardized perioperative pain management strategy**

PAH CABG: 2015

- Preoperative Clinic surgical team set patient pain expectations
- 1/3 of patients received intrathecal duramorph (0.25 mg, with 5 ug of fentanyl)
- 2015 piloted the use of 1 gm of IV acetaminophen after separation from CPB, and limit dose of Intravenous fentanyl 10-15 cc
- Avoid IV opioids post CPB separation

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PAH CABG: 2016-2019

- 2016- 2018 increased use of preoperative Intrathecal narcotic administration
- 2016-2018 increased use of preoperative oral gabapentin (300mg) – attempt to limit intraoperative opioids
- 2018 (April)- piloted after induction of general anesthesia - bilateral serratus anterior blocks (0.5% bupivacaine with 1:200,000 epi)
- 2019 (January) scheduled dose of gabapentin for 24 hrs postoperative (100mg), along with 3 doses IV acetaminophen
- 2019 (February)- standard use of Ketamine (0.1 mg/kg/hr) and dexametatomidine (0.1 μg/kg/hr). Limit intraoperative IV opioid to 5 cc or less of IV fentanyl.

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PAH CABG: Post CPB

- After protamine administration- 1 gm acetaminophen
- Ketamine infusion turned off
- With chest wires dexametetomidine off
- After chest closure reversal with sugammadex
- After chest closure convert spontaneous respiration

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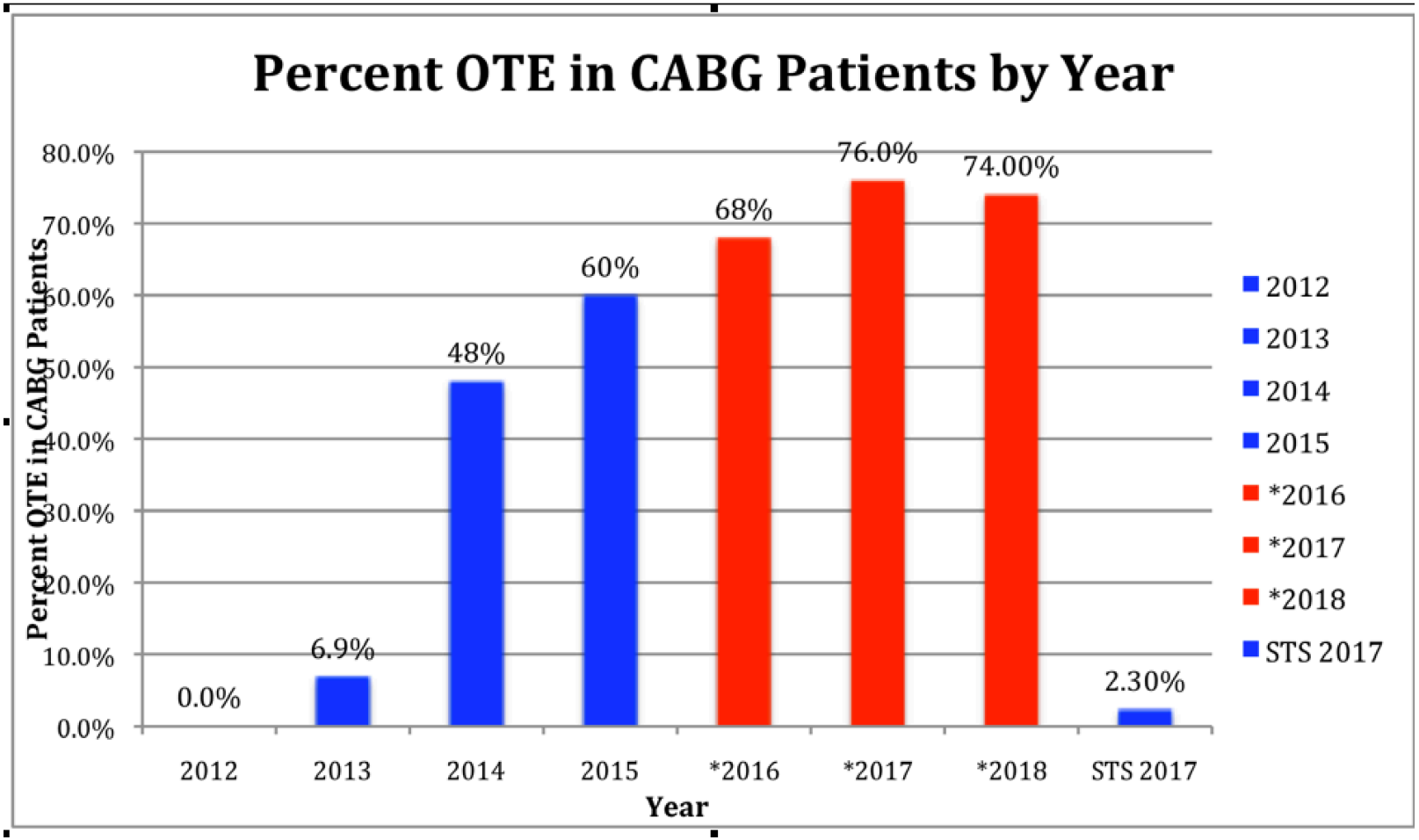
Surgical Technique

- Proximal anastomosis prior to CPB
- CPB - warm beating heart – maintain normothermia
  - Distal anastomosis on cpb with cardiac stabilizer
- LV vent placed
- No Aortic cross clamp i.e. no ischemic arrest
- Low use of post CPB inotropes

OTE by year



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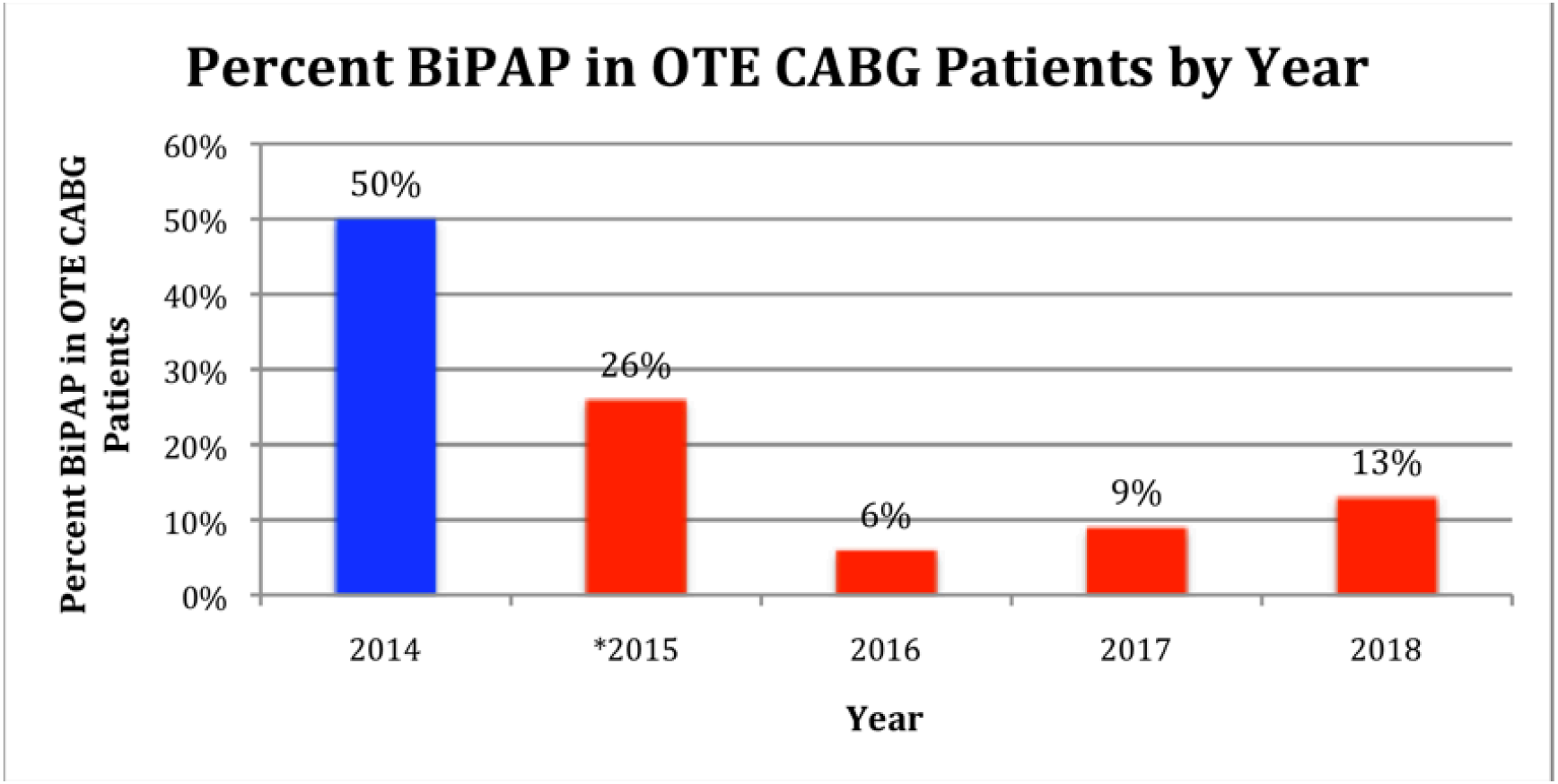
Post OTE use of BiPAP by year



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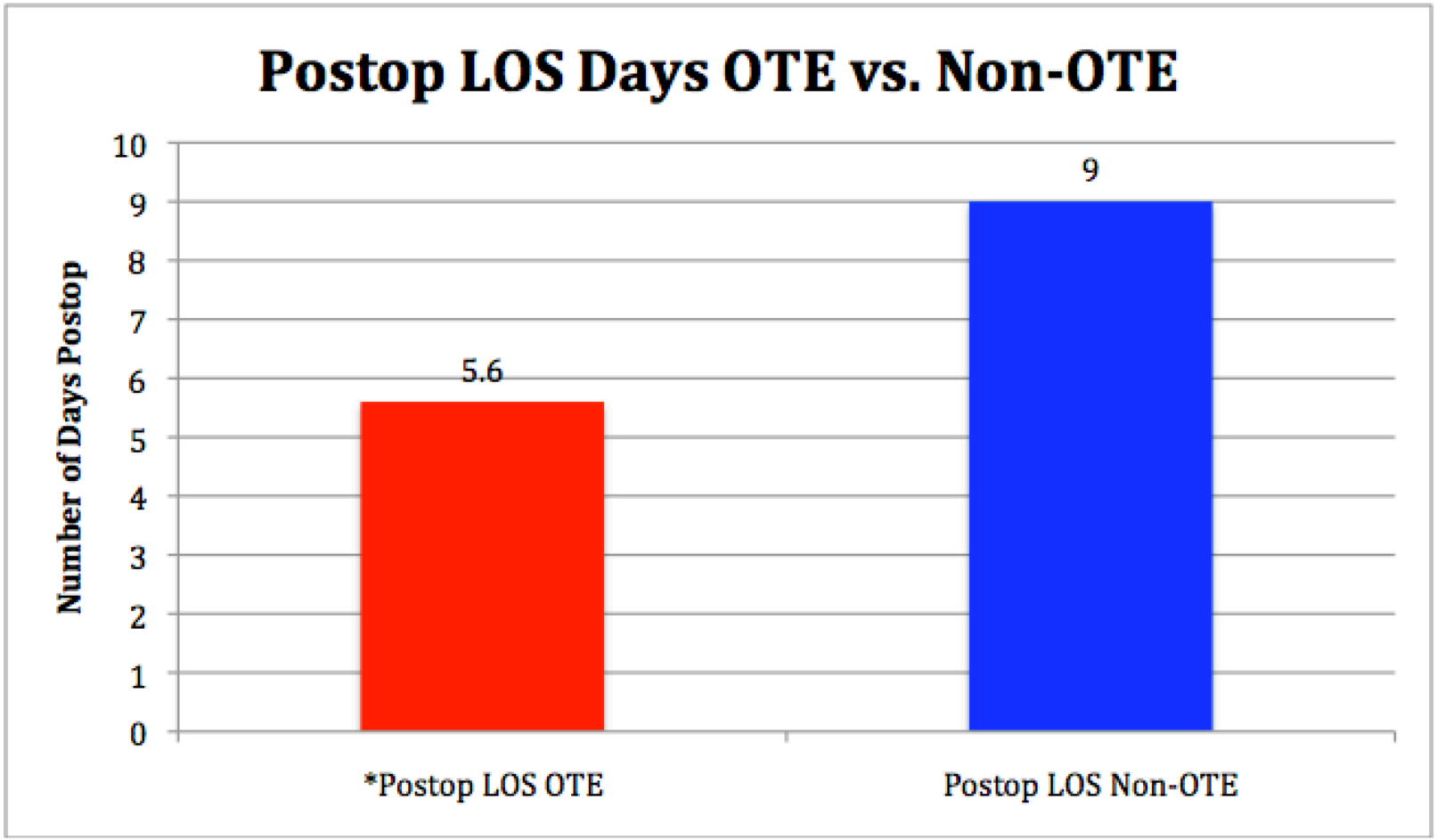
Post op LOS OTE vs Non OTE



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Establishing a standardized multimodal analgesic Protocol

- Preoperative IT narcotic (n= 157)
  - 2015- 26%
  - 2016- 58%
  - 2017- 76%
  - 2018- 74%
- Preoperative GABA (n=143)
  - 2016- 46%
  - 2017- 88%
  - 2018- 88 %
- Post CPB IV acetaminophen (n= 183)
  - 2015- 63%
  - 2016 - 78 %
  - 2017- 76%
  - 2018 – 85 %

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24 hour postoperative Fentanyl requirements at PAH

- *Intrathecal Narc vs No Intrathecal Narc
  - 67.55 μg vs 138 μg, p=0.004
- Preop Gaba vs No preop Gaba
  - 85 μg vs 112.5 μg p= 0.3
- *Preop Gaba/ Intrathecal Narc vs No Preop Gaba Nointrathecal Narc
  - 52 μg vs 123μg , p= 0.0019

24 hr Fentanyl requirements by year at PAH in CABG

- 2015 = 115 μg
- 2016 = 89.18 μg
- 2017 = 98 μg
- **2018 = 172 μg ***
- 2019 = 60 μg

Intraoperative IV Fentanyl administration from 2015-2019 at PAH

- 2013 – 750- 1000 µg **20** cc
- 2014- 750- 1000 µg **20** cc
- 2015 – 611.19 µg **12** cc
- 2016 – 554.88 µg **11**cc
- 2017 – 594.7 µg **12**cc
- 2018 – 486.62 µg **9** cc
- January 2019- 350 µg **7** cc
- February – April 2019- 223.33 µg **4.5** cc

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ERACS Postoperative Standardized Pain Management at PAH

- Gaba/ Acetaminophen 3 doses postop
- Rescue pain medication- IV dilaudid, po oxycontin, some cases Ketoralac
- > 50 % of CABG patients are now out of bed to chair day of surgery (10% within 1 hr of ICU arrival)
- 10 % of CABG patients ambulate the night of surgery with 50% Ambulating the next day
- LOS 4-5 days with the goal of decreasing to 3 day LOS (STS CABG LOS = 6.9 days)

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GABA and ERAS/ERACS Opioid Sparring Anesthesia

- Gaba/ acetaminophen the night prior to surgery
- Gaba preop and acetaminophen po - 2 hrs prior to arrival in the hospital
- Scheduled dosing of Gaba/Aceta for 48 hrs in the postoperative period
- Meta-analysis support an opioid sparring effect of perioperative Gaba (pre and postop)

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Benefits of Opioid Sparring

- Reduce PONV
- Reduce ileus
- Reduce urinary retention
- ? Postoperative delirium (Leung J. Anesthesiology 2017; 127:633-44)
- Reduce postoperative opioid administration (Tiippana E. Anesth & Analg 2007;104:1545-56)
- Reduce % of patients that develop postoperative opioid dependence (JAMA April 2018)

Conclusion

- Developing ERACS takes time
- It takes a multispecialty team to effectively implement ERACS and reduce postop LOS
- Institutional culture remains an impediment but can be overcome
- OTE is associated with reducing Postop LOS
  - STS still rates programs on the < 6 hr benchmark
- If more programs adopt OTE/ ERACS significant reduction in health cost for isolated CABG can occur

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Thank you

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