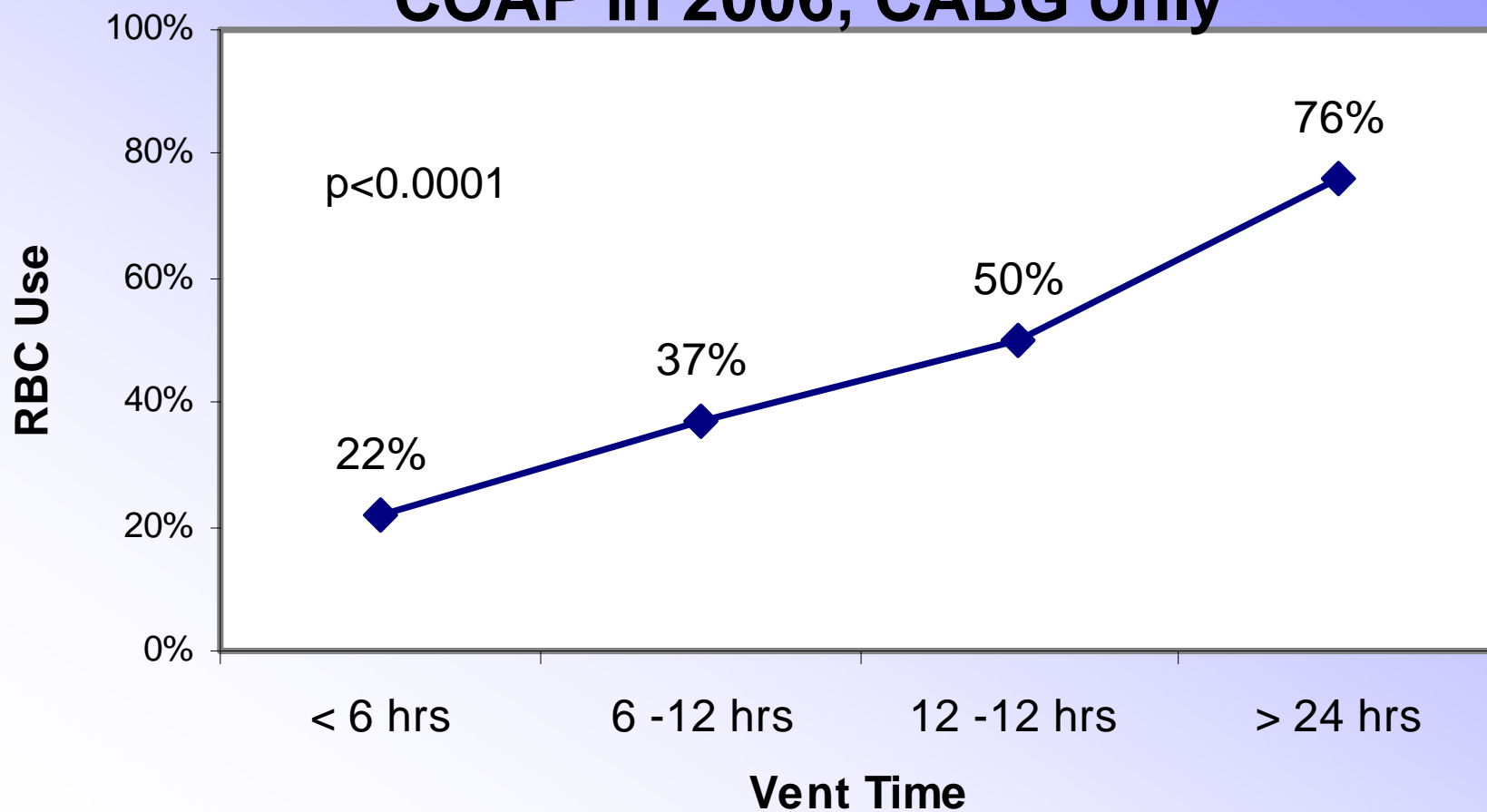
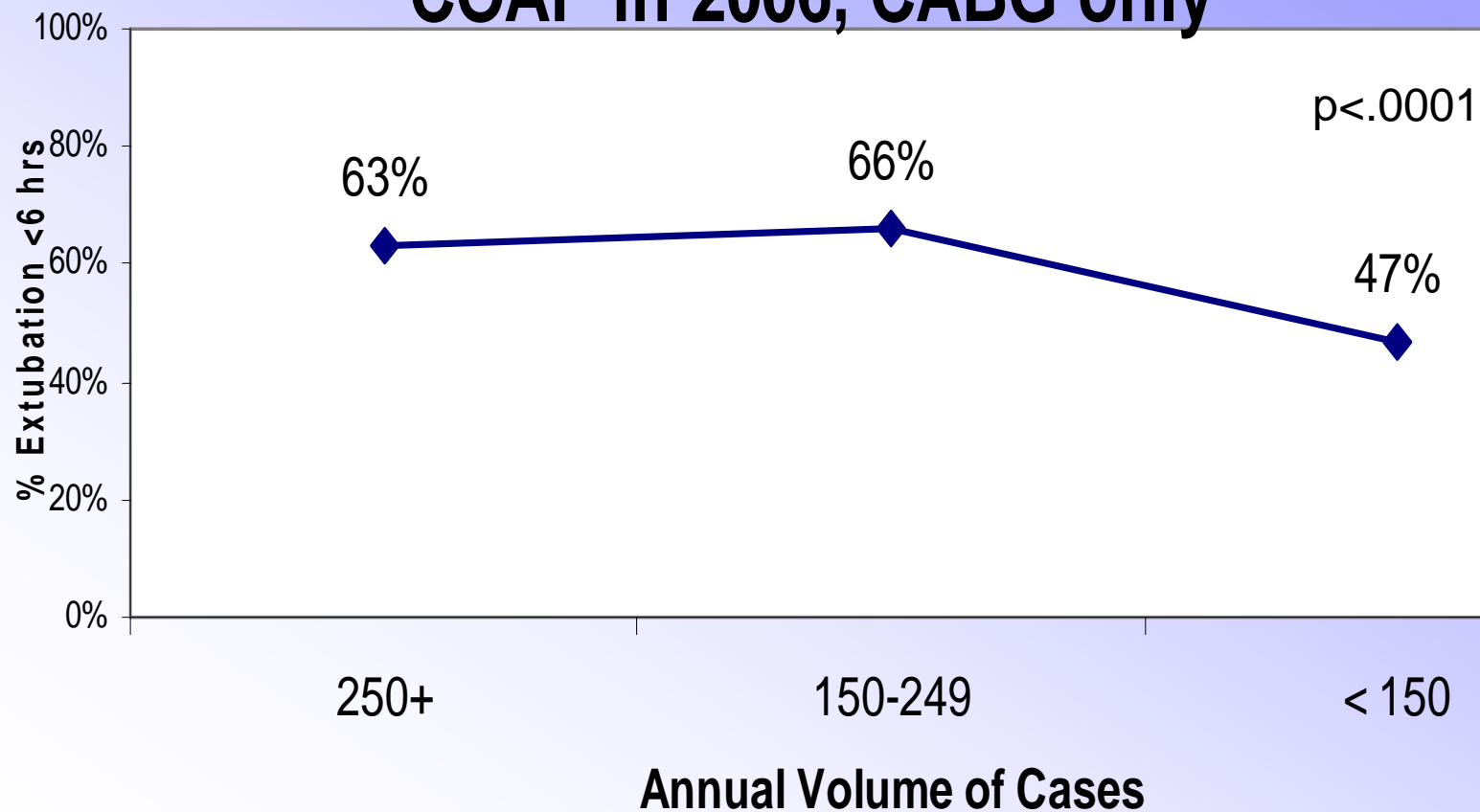


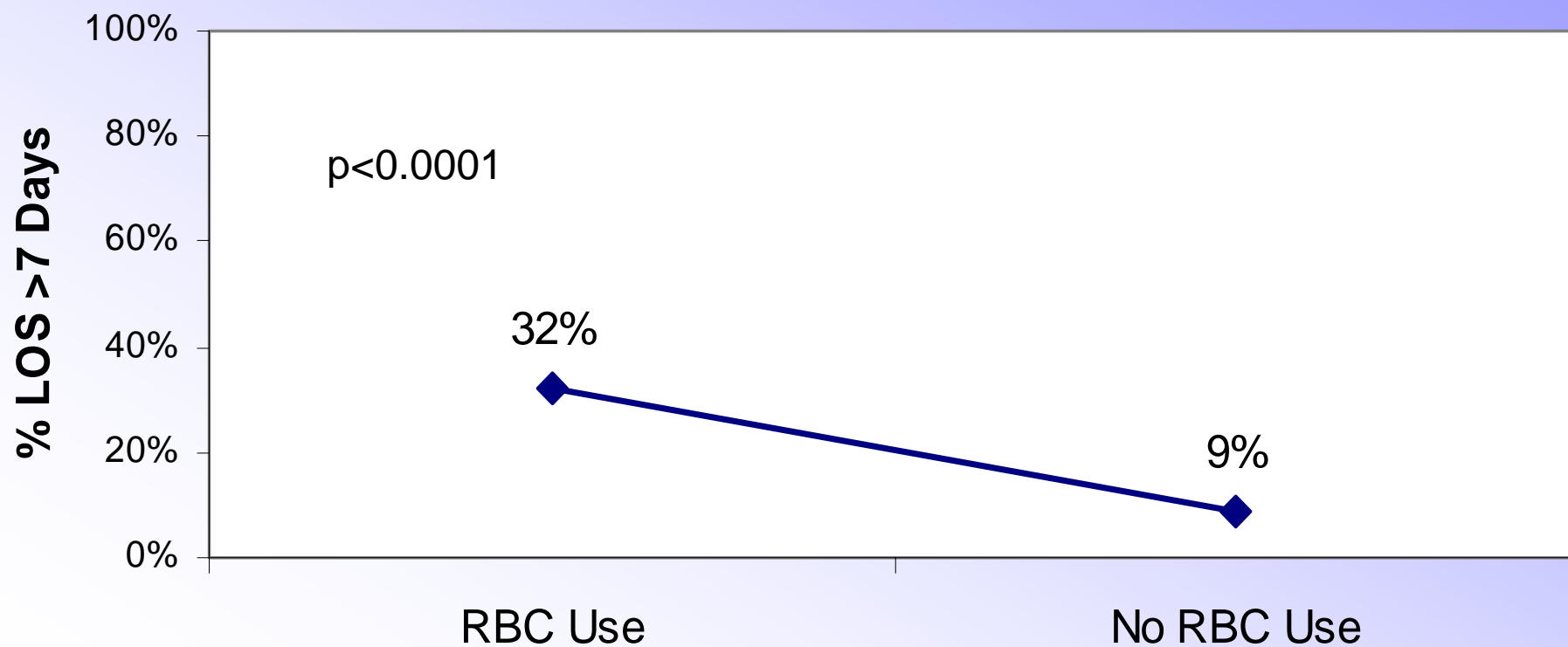
## Red Blood Cell Use and Vent Time COAP in 2006, CABG only



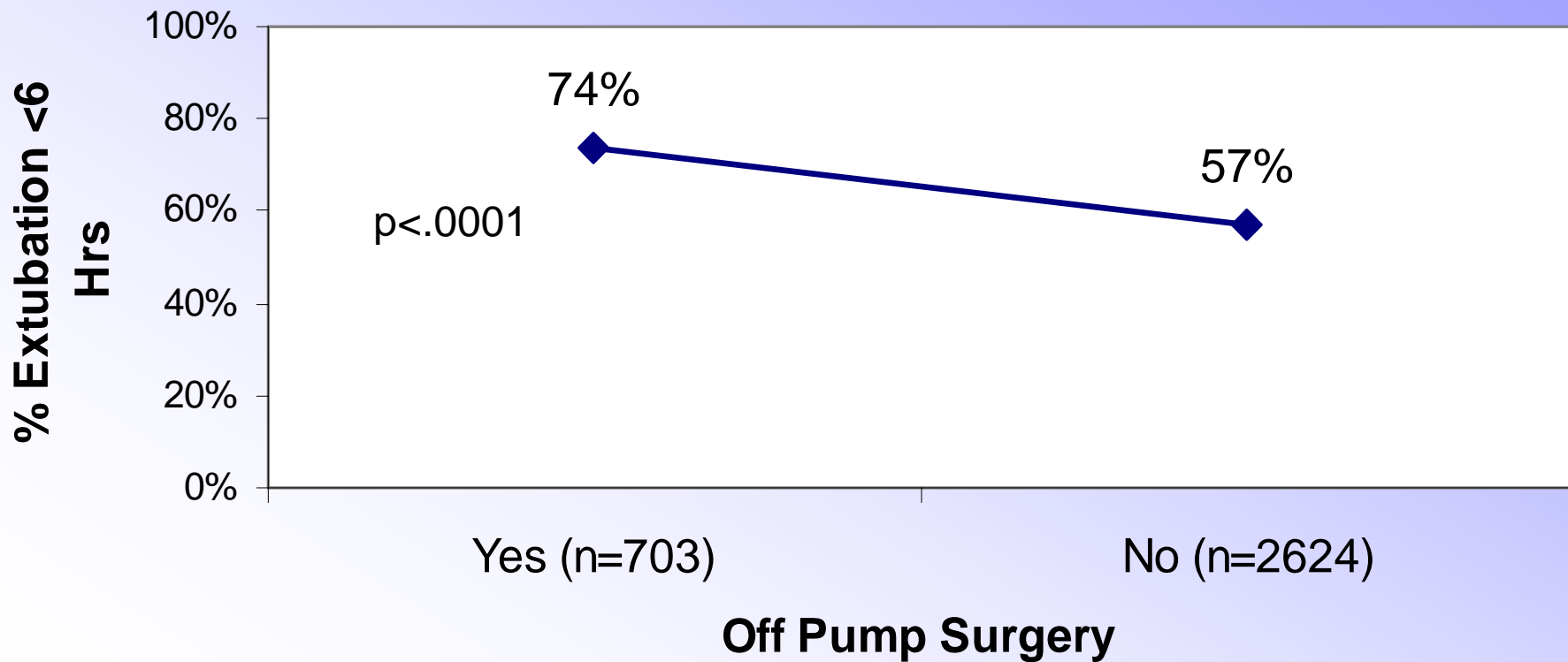
## Extubation < 6 hours and Hospital Size COAP in 2006, CABG only



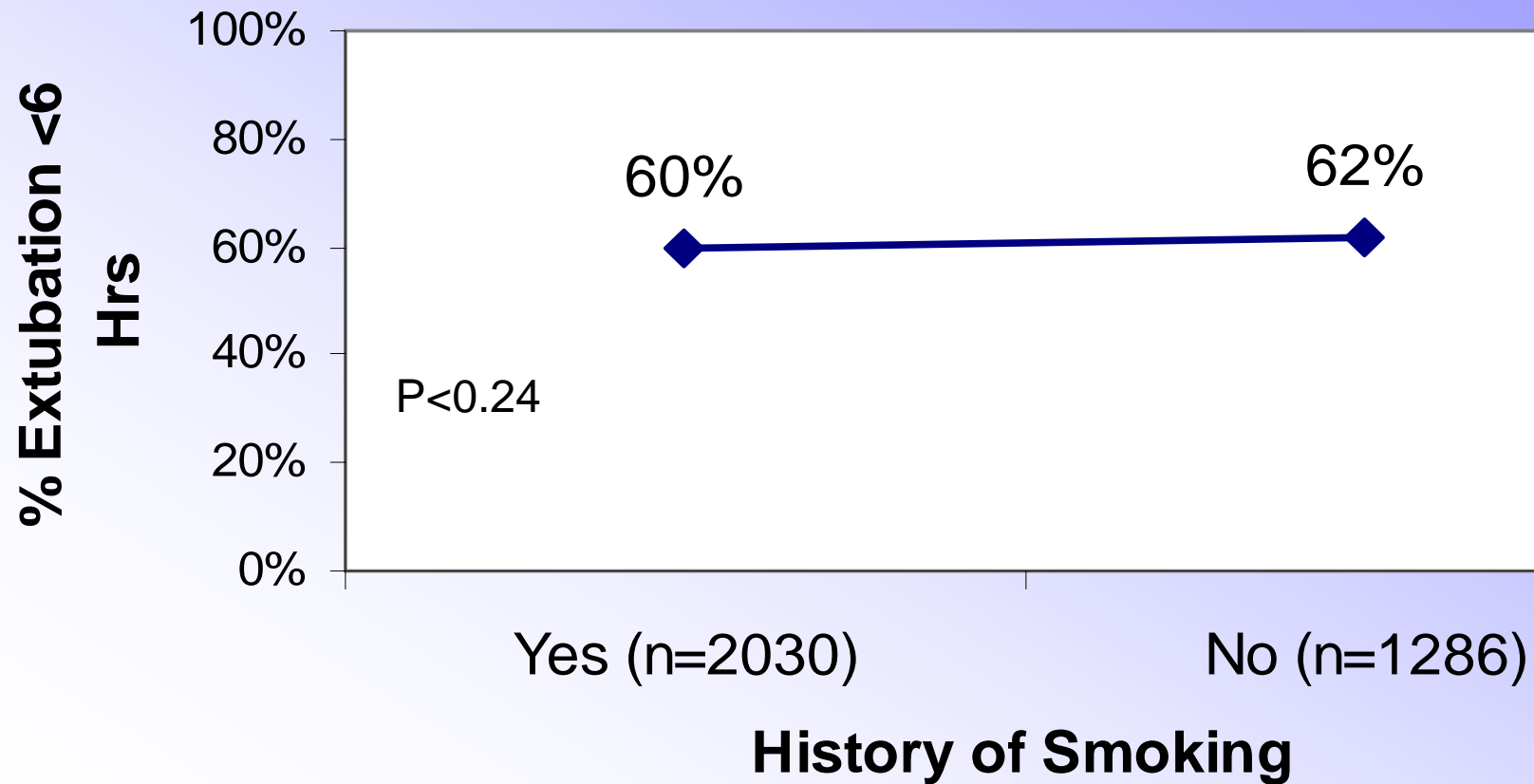
## RBC Use vs. LOS > 7 days COAP in 2006, CABG only



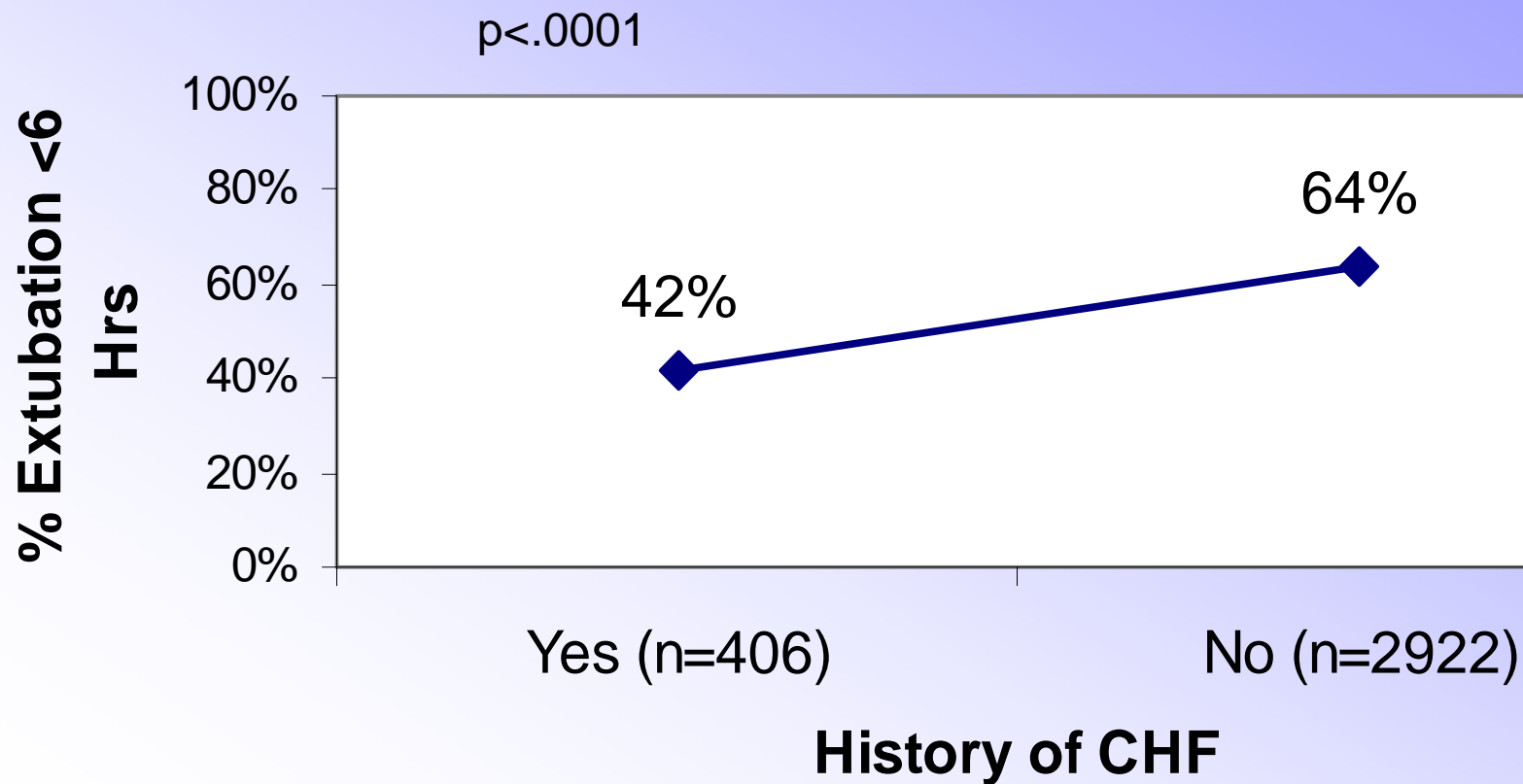
## Off Pump Surgery vs. Early Extubation COAP in 2006, CABG only



## Smoking vs. Early Extubation COAP in 2006, CABG only



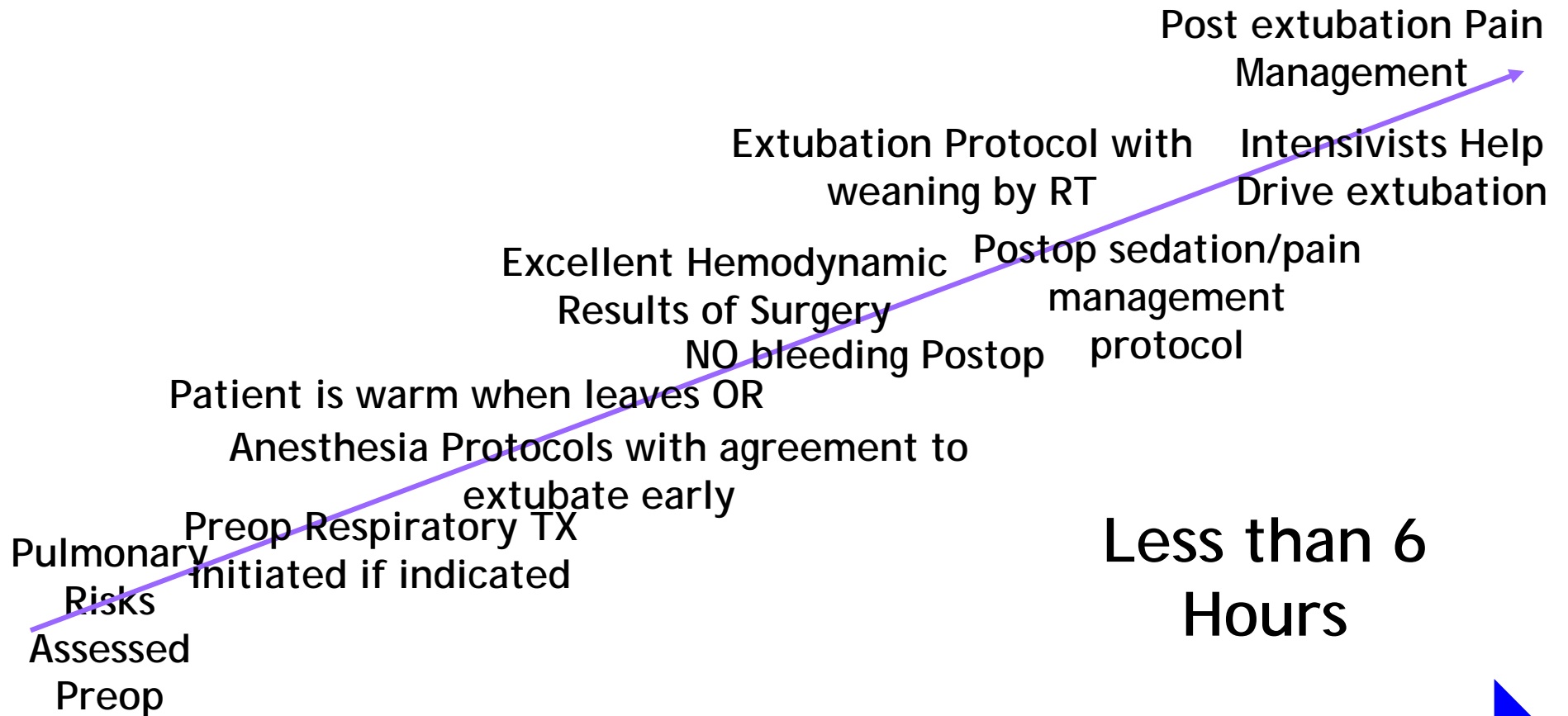
## CHF and Early Extubation COAP in 2006, CABG only



## Process Improvement

- ▲ **Process Improvement as a measure of the quality of clinical processes of an institution**
- ▲ **What processes are in place to allow the institution to be successful in attaining excellent outcome results?**
- ▲ **Examples of processes include:**
  - Early extubation
  - Blood utilization
  - Door to Balloon time

## Early Extubation



Time Elapsed

COAP IN 2007



## ▲ Fast-track Extubation Criteria and Protocol

**Heart rate <110**

**Mean arterial pressure 65mm**

**Hg Cardiac index 2.0 L/min/m<sup>2</sup>**

**Temperature 36°C**

**No significant bleeding**

**No unstable ventricular  
arrhythmias**

**Respiratory rate <30/min**

**Tidal volume 5 mL/kg**

**Negative inspiratory force  
at least 25 cmH<sub>2</sub>O**

**Vital capacity 10 mL/kg**

**Lifts head off bed**

## Early extubation-Key Assumptions

Postoperative complications that may prolong intubation:

- Excessive bleeding and tamponade
- myocardial ischemia
- Low cardiac output state
- arrhythmias
- sepsis
- stroke
- acute renal failure

*Seminars in Cardiothoracic and Vascular Anesthesia, Vol 9, No 1 (March), 2005: pp 5-16*

## Patients Extubated After Heart Surgery

### ▲ Extubation in operating room

- The experience with fast-tracking has led some centers to extubate selected patients in the operating room. This practice does not appear to be problematic, since patients extubated before leaving, compared with those extubated within 6 to 8 hours of leaving the operating room, did not have any differences in oxygenation, lung volumes, or chest radiograph evidence of atelectasis up to 4 days after surgery.

### ▲ Extubation within 6 hours

### ▲ Prolonged ventilation

- Patients extubated only after 24 hours had longer hospital stays and more postoperative complications. This delayed extubation was associated with poor left ventricular, renal, and pulmonary function, as well as the longer duration and greater urgency of surgery,

## Mechanical Ventilation after Cardiac Surgery: Truths or Myths?

### **FACT: Cardiac Surgery is steeped in tradition**

#### ▲ Traditional practice:

- Mechanically ventilate patients for up to 24 hours after cardiac surgery allowing patients to rewarm, emerge from anesthesia, stabilize hemodynamically, and ascertain if there was excessive bleeding.
- Rationale?? continued mechanical ventilation would insure control over ventilation, reduce metabolic demands, and negate the need to induce anesthesia and/or reintubate in case of return to the operating room for bleeding.
- Really just intuitive thinking and not supported by published studies.

## Mechanical Ventilation after Cardiac Surgery: Truths or Myths?

### FACT:

- ▲ Cardiac surgery patients can be extubated in less than 6 hours
- ▲ Cardiac surgery patients are extubated by nursing staff and respiratory therapists in the middle of the night without an MD at the bedside... with low re-intubation rates
- ▲ Cardiac surgery patients can leave the ICU in less than 24 hours and be safely discharged within 3-4 days

## Rationale for early extubation: Pulmonary issues

### ▲ Early extubation results in earlier ambulation and cough

- Earlier constitution of cough reflex via earlier restoration of ciliary functions, quicker improvement of intrapulmonary shunts, reduction of atelectasis rates, and preservation of cardiac output

### ▲ Reduces the incidence of respiratory complications

- Patients extubated early after surgery had significantly less atelectasis than those extubated later and on postoperative day 5, VC and FEV/FVC were higher in the group of patients extubated early after surgery.
- Two consecutive cohorts of patients- the fast-track patients had a 7.3% nosocomial pneumonia rate versus a 14.7% rate in nonfast track patients
- Study of fast-tracked patients showed lower pneumonia rates: 3.4% of those less than 70 years of age and 4.4% of those older than 70 years developed pneumonia

## Should we extubate in the operating room?

- ▲ **Some centers have extubated selected patients in the operating room.**
- ▲ **Small studies have shown that patients extubated before leaving, compared with those extubated within 6 to 8 hours of leaving the operating room, did not have any differences in oxygenation, lung volumes, or atelectasis by CXR up to 4 days after surgery.**

## **Prolonged ventilation greater than 24 hours**

**▲ Patients extubated only after 24 hours had longer hospital stays and more postoperative complications. This delayed extubation was associated with poor left ventricular, renal, and pulmonary function, as well as the longer duration and greater urgency of surgery**



## Off Pump Surgery

- ▲ The time to extubation was shorter in off-pump than in on pump CABG patients (3.4 vs 8.3 hours).
- ▲ In a series of 160 patients extubated in the operating room, the 5 subsequent reintubations were for reoperation for mediastinal bleeding and not respiratory failure. Among 64 MIDCAB patients, 85% were extubated in the operating room without complications.

*Journal of Cardiothoracic and Vascular Anesthesia*, Vol 19, No 1 (February), 2005: pp 26-31

## Handout

***Seminars in Cardiothoracic and Vascular Anesthesia, Vol 9,  
No 1 (March), 2005: pp 5-16***

**Fast-Track Cardiac Anesthesia: Choice of  
Anesthetic Agents and Techniques**

***Paul S. Myles, MBBS, MPH, MD,<sup>^</sup> and David McIlroy, MBBS<sup>^</sup>***

## Throughput Considerations

### Present economic conditions:

#### ▲ Efficient use of limited resources

- The restricted number of patient beds and OR's

▲ Prolonged mechanical ventilation and ICU stay contribute greatly to the overall cost of cardiac surgery.

▲ High number of patients awaiting operation are increasing the popularity of fast track protocols.

Of note....the practice of these protocols requires firm cooperation and concordance between the physiotherapists, intensive care nurses, and anesthesiologists working in the cardiac surgery unit.

## Is Fast-Track Cardiac Anesthesia Cost-Effective?

Delayed extubation can slow patient throughput (in the operating room and ICU) and thus reduce opportunity for increasing caseload.

"ICU block" may also result in a greater number of cancellations and a waste of operating room resources.

Reducing ICU length of stay is one way to reduce costs.

Use of a protocol directed toward early extubation results in a substantial shortening of the total ICU and hospital stay of low-risk CABG patients

▲ *Seminars in Cardiothoracic and Vascular Anesthesia, Vol 9, No 1 (March), 2005*

▲ *Crit Care Med 2006 Vol. 34, No. 6*

## ***Early Tracheal Extubation after Coronary Artery Bypass Graft Surgery Reduces Costs and Improves Resource Use***

*A Prospective, Randomized, Controlled Trial*

- ▲ Randomized trial comparing costs of early versus late tracheal extubation in 100 patients after cardiac surgery.
- ▲ Reduced ICU costs by 53% ( $P < .026$ ) and surgical costs by 25% ( $P < .019$ ) when compared with late extubation.
- ▲ The total hospital cost savings were 13% per patient ( $P < 001$ ) and reduced elective case cancellations ( $P < .002$ ).

*Seminars in Cardiothoracic and Vascular Anesthesia, Vol 9, No 1 (March), 2005:  
pp 5-16*

## Cost Analysis of On Pump vs. Off Pump- Is there a difference?

- ▲ OPCAB surgery costs are 14% to 20% less than the on-pump CABG
- ▲ The on-pump patients stayed on average a day longer in the hospital.
- ▲ This average additional day was a result of an increase in the ICU as well as the overall increase in LOS
- ▲ The cost of this extra day for the on-pump patients is probably a hybrid of the cost of a day in the ICU and the cost of a day in the step down unit/general room. However, this is a significant additional cost that occurs on average by performing on-pump versus off-pump coronary surgery

*Journal of Cardiothoracic and Vascular Anesthesia*, Vol 19, No 1 (February), 2005: pp 26-31

## Early Extubation

### Preoperative Evaluation:

Identification of the patient with pulmonary disease

High risk patients for prolonged intubation

▲ Constantinides VA, Tekkis PP, Fazil A, et al: Fast-track failure after cardiac surgery: Development of a prediction model.

▲ *Crit Care Med* 2006; 34:2875–2882

## Early Extubation-Anesthesia

### Intraoperative strategies for early extubation:

- ▲ Analgesia and sedation
  - Heavy sedation of patients may lead to prolonged ventilation and an extended stay in the intensive care unit (ICU). Hemodynamic effects of the sedatives and analgesics also may affect the period of ICU stay
  - Low- to medium-dose opioids

Journal of Clinical Anesthesia (2006) 18, 605–610



## Hospital Focus on Early Extubation

- 1. Goal is at least the WA State average of 65% are extubated within 6 hours and less than x remain intubated after 24 hours**
- 2. Multidisciplinary team agrees to focus on this process**
- 3. Review current protocol for extubation and everyone agrees to work with it**
- 4. On daily rounds, review ICU extubation times and possible barriers to success**
- 5. Review re-intubation cases in order to improve processes**