

Patient Safety Tip of the Week

October 13, 2020 Night-Time Surgery

Some studies have shown that morbidity and mortality rates are higher for “after-hours” surgery or “night” surgery. It’s easy to think “that should be obvious since patients having surgery at night are sicker and need emergency surgery”. But is that the case? In fact, many surgeries done at “night” or “after-hours” were actually elective cases that just got scheduled or pushed to later times. Do those cases also have higher morbidity and mortality rates?

A recent study ([Althoff 2020](#)) analyzed data on over 300,000 patients undergoing non-cardiac surgery at 2 tertiary care hospital networks, 8% of whom underwent night surgery. Night surgery was defined as a surgical incision time between 17:00 and 07:00 hours. They found that, indeed, night surgery was associated with an increased risk of postoperative mortality and morbidity and that the effect was independent of case acuity. Moreover, at least some of the effect was mediated by potentially preventable factors: higher blood transfusion rates and more frequent anesthesia handovers.

The 30-day mortality rate was 0.9% after day surgery and 3.4% after night surgery (adjusted odds ratio for increased risk of mortality after night surgery = 1.26, $p < 0.001$). In secondary analyses, night surgery was also associated with increased 30-day morbidity, defined as a composite outcome including renal, cardiovascular, bleeding, infection, intestinal/digestive, and pulmonary complications (adjusted odds ratio 1.41, $p < 0.001$).

Among patients undergoing non-emergency surgery, night surgery was associated with 1.35-fold higher adjusted odds for 30-day mortality compared with day surgery. For patients undergoing emergency surgery, morbidity and mortality were higher for those undergoing night surgery but did not reach statistical significance. These findings suggest that the increased risk of mortality and morbidity after night surgery was not driven by a higher case acuity.

They also extended their analyses to examine whether transfusion rates and handovers were associated with the outcomes of 30-day mortality and morbidity. The proportion of patients receiving intraoperative blood transfusions was 5.5% during night surgeries and 2.8% during day surgeries. Night surgery was significantly associated with higher transfusion rates after adjustment (adjusted odds ratio 1.25) and the association remained robust in a subgroup of cases where data on intraoperative estimated blood loss and preoperative hemoglobin levels were available, after additional adjustment for blood loss,

mild anemia, and moderate to severe anemia within 30 days prior to surgery. They estimated that the higher intraoperative transfusion rates mediated about 5% of the effect on morbidity and mortality.

Anesthesia handovers occurred in 22.6% of night surgeries, compared to 8.8% in day surgeries. Anesthesia handovers were significantly associated with an increased risk of morbidity (adjusted odds ratio 1.10) They estimated that the higher rate of anesthesia handovers mediated about 4.1% of the effect of night surgery on morbidity.

In our October 4, 2016 Patient Safety Tip of the Week “[More on After-Hours Surgery](#)” we noted a Canadian study which showed that surgical mortality does vary by time of day ([WFSA 2016](#)). They evaluated all surgical procedures for the past 5 years, including all elective and emergent surgical cases except ophthalmic and local anesthesia cases. After adjustment for age and ASA scores, patients operated at night (11:30 PM-7:29 AM) were **2.17 times more likely to die** within 30 days than those operating on during regular daytime working hours (7:30 AM-3:29 PM). Those operated on in the late day (3:30 PM-11:29 PM) were 1.43 times more likely to die than those operated on during regular daytime working hours.

Of course, it is logical that patients operated on after-hours are likely to be sicker and thus have a higher mortality. The Canadian authors tried to adjust for that using age and ASA scores but those likely are imperfect adjusters. Other potential factors contributing to the higher after-hours mortality as noted by the authors include provider fatigue during anesthesia and surgery, overnight hospital staffing issues, delays in treatment, or the patient being too sick to be postponed prior to treatment.

We’ve done several prior columns pointing out some of the downsides of after-hours surgery. In our What’s New in the Patient Safety World columns for September 2009 “[After-Hours Surgery – Is There a Downside?](#)” and October 2014 “[What Time of Day Do You Want Your Surgery?](#)” we discussed studies that showed for certain types of orthopedic surgery after hours there was an increased need for reoperations for removal of painful fracture hardware ([Ricci 2009](#)) and laparoscopic cholecystectomies done at night compared to daytime were associated with a higher conversion rate to open cholecystectomy (11% vs 6%) ([Wu 2014](#)). We also noted previous studies by Kelz and colleagues that showed increased morbidity in non-emergent surgical cases done “after hours”, one in the VA system ([Kelz 2008](#)) and another in a private hospital setting ([Kelz 2009](#)). And our January 2015 What’s New in the Patient Safety World column “[Emergency Surgery Also Very Costly](#)” suggested, in addition to the human costs of after-hours surgery there may also be financial costs.

Why should “after hours” surgery be more prone to adverse outcomes than regularly scheduled elective surgery? There are many reasons aside from the fact that patients needing emergency and after-hours surgery are generally sicker. For surgery, in particular, the **impact of time of day on teamwork** is important. You are often operating with a team that is likely different from your daytime team. All members of that team (physicians, nurses, anesthesiologists, techs, etc.) may not have the same level of

expertise or experience as your regular daytime team (because many hospitals have “seniority” policies, you may have less experienced personnel on your OR “on-call” teams) and the team dynamics between members is likely to be different. The **post-surgery recovery unit is likely to be staffed much differently after-hours as well**. The staff may be more likely to be unfamiliar with things like location of equipment. And some of the **other hospital support services** (eg. radiology, laboratory, sterile processing, etc.) may have lesser staffing after-hours. Just as importantly, many or all of the “on-call” staff that make up the after-hours surgical team have likely worked a full daytime shift that day, so **fatigue** enters as a potential contributory factor. And there are always **time pressures** after hours as well. In addition, one of the most compelling reasons surgery is done at night rather than deferred to the next morning is the **schedule of the surgeon** or other physician for that next morning (either in surgery or the cath lab or his/her office). Because the surgeon does not want to disrupt that next day schedule, he/she often prefers to go ahead with the current case at night. Similarly, many hospitals run very tight OR schedules and adding a case from the previous night can disrupt the schedule of many other cases.

In our October 24, 2017 Patient Safety Tip of the Week “[Neurosurgery and Time of Day](#)” we highlighted a study which looked at neurosurgical procedures at the University of Michigan Health System ([Linzey 2017](#)). Noting that reported outcomes are worse at night for things like coronary angioplasty, orthopedic surgery, and colorectal surgery, Linzey and colleagues reviewed their own experience in neurosurgery. There was a higher percentage of more minor procedures late in the day. As you’d expect, complications were more frequent in those cases done as “emergent” and in those patients with more comorbidities (likelihood of complications increasing 10% for each comorbidity). But after adjusting for all patient and procedure characteristics, the **odds of a complication were increased by more than 50% for start times between 21:01 and 07:00** (OR 1.53). The odds ratio was even higher when severe complications were considered (OR 1.61).

Linzey and colleagues have some thoughtful comments on why a “night effect” might not have been seen in some reported series of transplant surgery. They noted that transplant surgery is done by teams who are used to working together and who frequently perform surgery at night. Transplant teams are also less reliant on housestaff. And transplant teams are typically doing one type of surgery, compared to other specialties which may be performing multiple different types of surgery at night.

The current Althoff study would seem to add to the concept of the importance of team continuity in that it showed how anesthesia handovers contributed to the higher morbidity and mortality of night surgery. The Althoff study is important in that it found the “night effect” applies even more to non-emergency surgery and identified both the anesthesia handover issue and transfusion issue as contributory factors. Althoff et al. also speculated that prolonged fasting might be a factor contributing to the higher mortality and morbidity in patients having night surgery.

Clearly, there are multiple factors that likely contribute to worse outcomes when surgery is done at night or after-hours. As in our several prior columns, we highly recommend hospitals take a hard look at surgical cases done “after-hours”. You need to look at the morbidity and mortality statistics of such cases. You especially need to look at issues like team continuity and intraoperative handovers. In particular, you need to determine which cases truly needed to be done after hours and, perhaps more importantly, which ones could have and should have been done during “regular hours”. If the latter are significant, you need to consider system changes such as reserving some “regular hours” for such cases to be done the following morning. You may have to alter the scheduling of cases for individual surgeons as well. For example, perhaps the surgeon on-call tonight should not have elective cases scheduled tomorrow morning. That way, if a case comes in tonight that should be done tomorrow morning you will have both a “free” OR room and a “free” surgeon. And you would need to develop a list of criteria to help you triage cases into “regular” or “after-hours” time slots.

Some of our previous columns on “after-hours” surgery:

- September 2009 [“After-Hours Surgery – Is There a Downside?”](#)
- October 2014 [“What Time of Day Do You Want Your Surgery?”](#)
- January 2015 [“Emergency Surgery Also Very Costly”](#)
- September 2015 [“Surgery Previous Night Does Not Impact Attending Surgeon Next Day”](#)
- October 4, 2016 [“More on After-Hours Surgery”](#)
- August 15, 2017 [“Delayed Emergency Surgery and Mortality Risk”](#)
- October 24, 2017 [“Neurosurgery and Time of Day”](#)
- December 2019 [“Surgeon On-Call Shifts”](#)

References:

Althoff FC, Wachtendorf LJ, Rostin P, et al. Effects of night surgery on postoperative mortality and morbidity: a multicentre cohort study. *BMJ Quality & Safety* 2020; Published Online First: 07 October 2020
<https://qualitysafety.bmj.com/content/early/2020/10/07/bmjqs-2020-011684>

WFSA (World Federation of Societies of Anaesthesiologists). Five-year study reveals patients operated on at night twice as likely to die as patients who have daytime operations. *Science Daily* 2016; August 29, 2016

Regarding:

Wang N, et al. Retrospective analysis of time of day of surgery and its 30 day in-hospital postoperative mortality rate at a single Canadian institution. Poster presentation 601. World Congress of Anaesthesiologists 2016

<https://www.sciencedaily.com/releases/2016/08/160829192642.htm>

Ricci WM, Gallagher B, Brandt A, Schwappach J, Tucker M, Leighton R. Is After-Hours Orthopaedic Surgery Associated with Adverse Outcomes? A Prospective Comparative Study. J Bone Joint Surg Am. 2009; 91: 2067-2072
<http://www.ejbs.org/cgi/content/abstract/91/9/2067>

Wu JX, Nguyen AT, de Virgilio C, et al. Can it wait until morning? A comparison of nighttime versus daytime cholecystectomy for acute cholecystitis. Amer J Surg 2014; published online first September 20, 2014
<http://www.americanjournalofsurgery.com/article/S0002-9610%2814%2900438-3/abstract>

Kelz, R.R., Freeman, K.M., Hosokawa, P.W. et al. Time of day is associated with postoperative morbidity: an analysis of the national surgical quality improvement program data. Annals of Surgery 2008; 247: 544–552
<http://www.ncbi.nlm.nih.gov/pubmed/18376202?dopt=Abstract>

Kelz RR, Tran TT, Hosokawa P, et al. Time-of-day effects on surgical outcomes in the private sector: a retrospective cohort study. J Am Coll Surg 2009; 209(4): 434-445.e2.
<http://www.journalacs.org/article/S1072-7515%2809%2900507-9/abstract>

Linzey JR, Burke JF, Sabbagh A, et al. The Effect of Surgical Start Time on Complications Associated With Neurological Surgeries. Neurosurgery 2017; Published online 13 October 2017
<https://academic.oup.com/neurosurgery/article/4430328/The-Effect-of-Surgical-Start-Time-on-Complications>



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