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Are Chest Radiographs Needed Prior to an Elective, Non-Cardiac Surgery?

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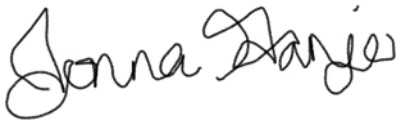
Signature 

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Abstract

Patients are usually required to have a preoperative exam thirty days prior to a surgical procedure at the request of surgeons. Many of the elective, non-cardiac preoperative exams are performed by the patient's primary care providers (PCPs). The PCP assesses the patient's history, performs a comprehensive physical, and many times orders diagnostic imaging, and laboratory exams. In the past, most providers would order a chest radiograph (chest x-ray/CXR) during the preoperative examination. Through examination of current guidelines and literature review, it has been concluded that routine CXR are not needed for a majority of asymptomatic patients presenting for a preoperative exam for an elective, non-cardiac surgery. Even in patients with known cardiovascular, or pulmonary comorbidities, a routine preoperative CXR did not change the perioperative management, or postoperative outcome for most patients (Kirkham et al., 2015). Clinicians should use their developed skills to perform a thorough history and physical (H&P) assessment, which in many cases, will provide the correct clinical diagnosis, (Sweitzer, 2019) and diagnostic testing will be ordered based on the H&P.

Background

Approximately 27 million Americans undergo surgical procedures every year (Arnold & Beer, 2016). The role of the primary care provider (PCP) is to assess the patient's cardiac and pulmonary function, to determine risks factors for a cardiac or pulmonary events peri/postoperatively (Arnold & Beer, 2016). The most critical elements to preoperative examinations are the history and physical (H&P) assessments (Sweitzer, 2019). The current guidelines for preoperative examinations recommend limited, patient specific use of laboratory and imagining diagnostic tests to accompany an H&P examination (Fleisher et al., 2014).

In the past, as technology advanced, clinicians believed that the increased use of available technology would benefit clinical diagnosis from an H&P assessment. This included the use of chest radiographs (chest x-rays/CXRs) to diagnose asymptomatic tuberculosis in the mid-20th century (McComb et al., 2016). It has been documented that as early as the 1970's, practitioners began to question the use CXRs during routine physical exams. Although practitioners questioned the routine use of CXRs to detect asymptomatic tuberculosis, the practice continued. Since the 1980's, numerous studies have examined the use of CXRs to assess asymptomatic patients (McComb et al., 2016). In recent decades, clinician have also inquired about the amount of ionizing radiation we are exposing our patients to with increased diagnostic imaging (Gargani & Picano, 2015).

The literature review will examine whether a chest radiograph is needed prior to an elective, non-cardiac surgery. The topics reviewed are the necessity of routine diagnostic tests, cardiac risk assessment guidelines, pulmonary risk assessment recommendations, and value-based healthcare goals. According to current guidelines and literature review routine CXRs should not be part of a preoperative examination for an elective, non-cardiac procedure.

Case Summary

A 76-yo female presents to her PCP for a preoperative examination prior to an arthroscopic right knee surgery. She is alone, but is a good historian. She reports no illnesses in the last 2 weeks, but was hospitalized approximately 1-2 months ago for diarrhea. The hospitalization was not due to a pathogen, and she has a follow-up appointment with gastroenterology. Her medical history includes; hypertension, obesity, Diabetes Mellitus type 2, hypothyroidism, squamous cell skin carcinoma and former smoker. Her current medication regimen is lisinopril, metformin, Rybelsus, Synthroid, aspirin. She takes Tylenol and ibuprofen as needed for pain.

The day of the office visit her BP was slightly elevated, 136/88, but she stated that her BP was usually well controlled with her medication. Her O2 saturation was 95%, but this was not unusual for her, and she did not appear in respiratory distress. Review of systems were within normal limits (WNL), with exception of diarrhea which she reports is not due to a pathogen. Her physical exam revealed bilateral hearing devices, umbilical hernia, and antalgic gait, otherwise WNL. See Appendix A to view full preoperative case clinic note

Literature Synthesis

A literature review in regards to the need for CXRs for elective, non-cardiac surgeries was decided upon as an interesting consideration for this case study for multiple factors. Although the patient is undergoing a low risk procedure (UCLA Anesthesiology & Perioperative Medicine, 2020), she has multiple comorbidities including her age, hypertension, obesity, Diabetes Mellitus type 2, hypothyroidism, smoking history, and need for general anesthesia during her procedure. The literature will examine what the current guidelines recommend for CXRs, and whether this patient should have received a CXR prior to her procedure.

Research Methods

Research for the literature review began with a book used by many primary care providers as a resource for preoperative assessments, Preoperative Assessment and Management (Sweitzer, 2019). Follow-up research was conducted in what is considered to be the top two data bases for healthcare research, CINHAL Complete and Medline (PubMed) (Mateo & Foreman, 2014). The search terms used were; preoperative, examination/assessment and chest radiograph/chest x-ray. The search parameters included; apply related words, Boolean/phrase, PDF full text available, peer reviewed, publication date of January 2015 through March 2020, clinical trials and human subjects. Continuing research was conducted with Google scholar, with the same search terms and date parameters.

The examination of Preoperative Assessment and Management (Sweitzer, 2019), led to the review of The American College of Cardiology/American Heart Association (ACC/AHA) Guidelines (Fleisher et al., 2014) and The Canadian Cardiovascular Society (CCS) Guidelines (Duceppe, 2017). Review of the previous guidelines resulted in evaluation of what is considered a third societal guideline (Fleisher, 2017), The European Society of Cardiology/European Society of Anaesthesiology Guidelines (ESC/ESA) (Kristensen, 2014). These three guidelines are for patients who undergo non-cardiac surgeries. The CINHAL complete search resulted in 9 outcomes, of which 2 articles were reviewed. The Medline search lead to in 162 results, of which 3 articles were reviewed. The Google scholar search resulted in 15,200 articles, 1 of which was further reviewed.

Routine Diagnostic Tests

Almost every patient undergoing surgery in the United States (U.S.) requires a preoperative exam prior to surgery. Whether this is done in advance by a PCP, or by an

anesthesiologist the day of the procedure, routine diagnostic tests are usually ordered (Sweitzer, 2019). Literature has shown that when a clinician performs a thorough history, the correct clinical diagnosis is made 56% of the time. With a corresponding physical exam, the correct diagnosis increases to 73%. Diagnostic tests, such as chest x-rays, and electrocardiograms only *confirmed* a suspected diagnosis 3% of the time (Sweitzer, 2019).

Diagnostic tests were once considered a routine portion of a preoperative exam, and were ordered regardless of the patient's assessment (Sweitzer, 2019). Today, routine preoperative diagnostic tests are suggested only if the results will alter a current medical regimen, influence peri/postoperative monitoring, and/or require delay of said surgical procedure until the current condition can be resolved or stabilized (Thanavaro, 2015). Routine preoperative CXRs prior to elective non-cardiac surgeries is considered to be low-value (Sigmund et al., 2015), and clinicians have discovered that these routine tests can often do more harm to patients. This harm results from further tests and procedures, a possible delay in the planned surgery, and anxiety for the patient (Sweitzer, 2019).

A routine chest x-ray in an asymptomatic patient is unlikely to reveal a pulmonary disease that would change the planned anesthetic course. The literature reviewed cites that routine CXRs have not been shown to predict "postoperative pulmonary complication" (Sweitzer, 2019, p. 30). Some clinicians continue to use CXRs to evaluate asymptomatic, uncomplicated patients, despite current literature and guideline recommendations. Studies have noted that most abnormalities observed on routine preoperative CXRs are minor (fibrosis, prior granulomatous, or tortuous aorta), and have no management value (McComb et al., 2016). Chest x-rays are indicated for patients presenting with signs and symptoms of cardiovascular, or pulmonary disease without explained reason or severity (Sweitzer, 2019; Thanavaro, 2015).

Cardiac Evaluation

An integral portion of the preoperative examination is assessing a patient's cardiovascular health, considering that worldwide, 42% of patients undergoing non-cardiac related surgical procedures experience cardiac related complications (Kristensen et al., 2017). Currently three guidelines exist for preoperative cardiovascular assessment of the non-cardiac surgery patient; The American College of Cardiology/American Heart Association (ACC/AHA) Guidelines (Fleisher et al., 2014), The European Society of Cardiology/European Society of Anaesthesiology (ESC/ESA) Guidelines (Kristensen et al., 2014) and The Canadian Cardiovascular Society (CCS) Guidelines (Duceppe et al., 2017) (Fleisher, 2017; Sweitzer, 2019). The clinician performing the preoperative examination may choose which guideline to follow, and base the cardiac assessment, and risk factor, on their own clinical knowledge and experience.

The ACC/AHA, and ESC/ESA guidelines were both published in 2014, and are still considered reputable guidelines to follow (Fleisher, 2017; Sweitzer, 2019). The guidelines are based on literature review, and were evaluated by said task forces (Fleisher et al., 2014; Kristensen et al., 2014). These two guidelines have similar recommendations regarding the assessment of cardiovascular health. Assessments include, but are not limited to, a thorough H&P, measurement of metabolic equivalents (METs), and a resting ECG for patients with known coronary heart disease, or structural cardiac abnormalities. Neither of the stated guidelines recommends a routine CXR for assessment of cardiovascular risk assessment (Fleisher et al., 2014; Kristensen et al., 2014). The ACC/AHA does write that a CXR may be considered for patients with signs and symptoms of Heart Failure (HF) to confirm "pulmonary vascular redistribution or pulmonary edema" (Fleisher et al., 2014).

The Canadian Cardiovascular Society (CCS) guidelines, released in 2017, are the newest guidelines for cardiac risk assessment prior to non-cardiac surgery (Duceppe et al.,2017). An interesting point from the CCS guidelines is that the panel would not make a recommendation on the use METs as a measurement of functional capacity to estimate peri/postoperative cardiac risk (Duceppe et al., 2017). Metabolic equivalents, or METs, is the patients self-reported functional cardiac capacity, or oxygen consumption. It is assessed from the patient's activities of daily living, including but not limited to the ability to walk a flight of stairs, play golf, or ballroom dancing. METs is measured from 1, which is the baseline oxygen consumption of a 40-yo male, to 10, which is considered excellent cardiac function (Fleisher et al., 2014).

The CCS guidelines also differ from the ACC/AHA & ESC/ESA guidelines in that they do recommend the measurement of a NT-proBNP or BNP, and troponin preoperatively to measure cardiac risk peri/postoperatively prior to non-cardiac surgery (Duceppe et al., 2017). The ACC/AHA & ESC/ESA guidelines both noted the current study of the use of BNP, and troponin biomarkers, but at the time did not recommend the routine use, as there was not enough evidence (Fleisher et al., 2014; Kristensen et al., 2014). The CCS guidelines, like the ACC/AHA & ESC/ESA guidelines, does not recommend a routine CXR as part of a cardiovascular risk assessment (Dueceppe et al., 2017).

It should be noted that The American College of Radiology (McComb et al., 2016) does recommend a routine CXR in patients with severe and/or uncontrolled hypertension, to screen for potential cardiogenic edema or aortic coarctation.

Pulmonary Evaluation

Postoperative pulmonary complications (PPCs) are defined as major, or minor pulmonary complications that occur peri/postoperatively in up to 30% of patient's requiring general

anesthesia (Diaz-Fuentes et al., 2016). The definition of a PPC includes, but is not limited to, respiratory failure, pneumonia, need for mechanical ventilation after the surgical procedure, significant atelectasis, purulent tracheobronchitis, and exacerbation of current chronic lung disease (Diaz-Fuentes et al., 2016). This enforces the need for a comprehensive pulmonary assessment during a preoperative examination. Although CXRs are often used to measure the risk for PPCs, the findings are often expected due to the comprehensive H&P performed (Diaz-Fuentes et al., 2016), and their sole ability to predict PPCs is low (McComb et al., 2016). This also holds true for patients with pulmonary conditions such as pulmonary hypertension, chronic obstructive airway disease (COPD), obstructive sleep apnea, and chronic hypoxic conditions (Diaz-Fuentes et al., 2016). Performing CXR's on asymptomatic healthy patients has been shown to have low diagnostic yield (McComb et al., 2016), and therefore, a routine CXR prior to an elective, non-cardiac surgery is not recommended (Diaz-Fuentes et al. 2016; McComb et at., 2016).

Patient's risk for PPCs consist of multiple non-modifiable risk factors including; age, HF, COPD, and/or functional limits. One modifiable risk factor that can be addressed by the PCP at a preoperative examination is smoking (Diaz-Fuentes et al., 2016). Smoking cessation within 2-4 weeks prior to surgery may decrease airway secretions, improve mucociliary transport, and improve the body's utilization of oxygen. Education regarding smoking cessation is one of the most beneficial interventions performed during a preoperative examination (Diaz-Fuentes et al., 2016).

Value-Based Care

In 2017, the U.S. spent approximately $3.5 trillion on health care, which represents a large portion of the American budget (Rama, 2019). Healthcare providers are being asked to help

reduce the cost of healthcare by following current guidelines, including the guidelines for ordering routine preoperative CXRs. Patient's outcomes are being examined by the federal government to determine a model known as value-based healthcare (Schwartz et al., 2014).

A retrospective cohort study from 2008-2013, n=1,546,223, found that patients undergoing low-risk surgical procedures, including ophthalmic and endoscopic procedures, often had routine CXRs. There were regional, and institutional variations, but the highest percentage of routine chest x-rays ordered was 51% (Kirkham et al., 2015). A similar study performed only for Medicare recipients found the 5.5% had routine CXRs ordered. Although this may seem a small percentage, it represents $75 million in spending (Schwartz et al., 2014). A third retrospective analysis found that although guidelines were published in 2002 that no longer recommend routine CXRs, no statistically significant data was noted in overall changes in the use of CXRs (Sigmund et al., 2015).

In an age of providing the best care to our patients while keeping costs low, when is it appropriate to order a CXR prior to a non-cardiac surgical procedure? The obvious answer is when a clinician suspects cardiovascular, or pulmonary risks after a thorough H&P. There are also some guidelines for asymptomatic patients. Patients undergoing an elective aortic aneurysm, upper abdominal, or thoracic surgery, who are older than 50, should have a CXR due to increased risk of surgical procedure, and patient's age, both of which increases the risk for PPCs (McComb et al., 2016). The ACC/AHA recommends that a patient with a Body Mass Index (BMI) greater than 40 kg/m2, due to possible undiagnosed HF, cardiac chamber enlargement or pulmonary hypertension (Fleisher et al., 2014). Lastly a patient with advanced age, greater than 70 who is an unreliable historian may be considered for a CXR (McComb et al., 2016).

Conclusion

Multiple guidelines and studies were reviewed for the question of, are chest radiographs needed prior to an elective, non-cardiac surgery? The overwhelming answer is a routine CXR should not be ordered for an asymptomatic patient presenting for a preoperative exam, prior to an elective, non-cardiac surgery. If a clinician does order a CXR, this should be done after a thorough H&P, and suspected clinical diagnosis. If a CXR is ordered, the clinician must consider whether this will change the course of current therapy, and what are the adverse effects of ordering said imaging? Adverse effects include radiation exposure, delay in surgery, anxiety from delay in procedure, and the potential for unnecessary tests due to incidental findings (McComb et al., 2016). Clinicians have developed, and honed their skills of performing a thorough and reliable H&P, and they should refer to these skills when order diagnostic imaging. For learning points see Appendix B

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Appendix A

Chief Complaint: Pre-Op Exam for Arthroscopic Right Knee surgery

History of Present Illness: Patient is a 76-yo Caucasian female presenting to the clinic today for a preoperative evaluation. She is here alone, and able to provide her personal history and her primary language is English. She is able to perform her ADL without assistance. She denies SOB, resting or with activity. She is scheduled for arthroscopic right knee surgery. She is unsure of the date of surgery, or the surgeon the surgery is scheduled with. Patient reports no current illness, or respiratory illness or fever in the last 2 weeks. Patient states that she was hospitalized 1-2 months ago for diarrhea. She states that she had an EKG and bloodwork done while in the hospital. She continues to have diarrhea, but was negative for C. Diff or any other bacterial or viral infection per stool culture. She has a follow-up with GI in 1-2 weeks. She has not changed anything in her diet. She has questions about how long the surgery will take and how long she will be in the hospital.

Patient currently takes lisinopril for blood pressure control, and she states that this has been well controlled. She takes metformin and Rybelsus for Type2 diabetes. She takes Synthroid for hypothyroidism. She also takes ASA 81 MG daily for prophylactic purposes. She is a former smoker with a 20-year smoking history. She quit smoking more than a decade ago.

Current Medications:
lisinopril 10 MG tablet daily.
metformin 1000 MG BID
Rybelsus 7 MG daily
Synthroid 125 MCG daily
ASA 81 MG daily
Tylenol per HPI
Ibuprofen per HPI

Allergies:
Amoxicillin
Morphine
Active Problem List:
Hypertension
Obesity
Diabetes Mellitus Type 2
Hypothyroidism
Squamous Cell skin carcinoma

Past Medical History:
Tobacco abuse disorder

Past Surgical History:
Patient reports several surgeries in the past.
Umbilical Hernia repair.

Unable to provide remainder of list.

Family History:
Hypertension
Cancer
Mother – Breast Cancer

Social History:
She is a former smoker.

Review of Systems:
Pre-operative Risk Assessment
History of significant transfusion antibody reaction: No
Diabetes Mellitus: Yes
Chronic Pain: Yes, of right knee.
Fever > 101 in past 2 weeks: No
Actively managed cancer: No
Pregnancy: No
Cardiac: Denies MI history. History of Hypertension requiring medication, well controlled.
Pulmonary: Denies Hx of asthma of COPD. Denies SOB.
Infection: Open wound with/without infection: No
Vascular: N0, Bleeding disorders: No
Renal: No history of renal disease.
Central Nervous System: no neurological deficit
History of anesthesia problems: No history of problems. No personal history of Malignant Hyperthermia
GI: diarrhea
All other systems reviewed and negative

Physical Examination:
BP: 136/88
Pulse: 78
Temp: 98.5 degrees F
SpO2: 95%
Weight: 211lb (95.71 kg)
Height: 5' 6"
BMI 34 kg/m²

GENERAL APPEARANCE: alert and orientated X3, in no distress, cooperative
SKIN: normal color, no rash or suspicious lesion
HEENT:
Head: atraumatic and normocephalic
Eyes: normal and pupils equally round, reactive to light and accommodation.
Ears: normal bilateral tympanic membranes, pearly grey, and external ear canals She wears bilateral assistive hearing devices
Nose: pink moist mucosa. Negative for rhinorrhea

Throat/mouth: normal appearing mucosa. No erythema or edema noted
NECK: No lymph node swelling and supple
LYMPHATIC: no supraclavicular, occipital or cervical node swelling
CHEST: clear in all lobes, no wheezing or crackles
CARDIOVASCULAR: regular rate and rhythm. normal heart sounds. +2 pulses bilateral brachial and posterior tibial. Capillary refill <3 bilateral feet. No peripheral edema.
ABDOMEN: no hepatosplenomegaly, nontender to palpation. Umbilical hernia noted at 12 o'clock position.
MUSKULOSKELETAL: Antalgic gait. Right knee swelling
NEUROLOGIC: Bilateral upper and lower strength equal and 5/5
PSYCHIATRIC: mood is pleasant

Laboratory/Diagnostic Tests:
CBC: WNL
CMP: WNL
EKG: Normal Sinus Rhythm
Chest x-ray: not indicated

Diagnosis/diagnoses:
Pre-operative Exam: Satisfactory. According to history and physical exam patient is optimized for anesthesia and surgery may continue as planned.

Management plan (therapeutic decision making):
RCRI risk: 0 which is a 3.9% risk of a major cardiac event
Pulmonary risk: increased due to patients 20-year smoking history
Infection risk: Increased due to DM Type 2
Meds: Avoid all NSAIDS (Aleve, ibuprofen, naproxen, aspirin) 7-10 days prior to surgery. Also avoid over the counter supplements if you are taking any not discussed during our visit, excluding multivitamin. The hospital will contact you in regards to taking your medications the day of surgery. Your surgery usually is on an out-patient basis. This means that in most cases you are able to go home the same day of surgery. You should plan for a ride to, and from the hospital, and if possible, someone to stay with you the night of the surgery.

Appendix B

Learning Points

- Routine chest x-rays are no longer recommended prior to elective non-cardiac surgeries.
- The most beneficial preoperative exam is a thorough history and physical assessment.
- For a majority of asymptomatic patients presenting for an elective non-cardiac preoperative exam, CXRs are a low-value unnecessary test, that is unlikely to reveal lung disease that would change the course of anesthesia.
- Watch for new research and guidelines in regard to the use of METs, and the use of preoperative BNP and troponin for cardiac risk.
- Unnecessary CXRs prior to elective, non-cardiac surgery cost Medicare $75 million dollars in 2009
- One of the most beneficial interventions during a preoperative examination can be education in regards to smoking cessation as cessation even 2-4 weeks prior to surgery can reduce secretions, improve mucociliary transport, and increase the body’s utilization of oxygen.