September 2012

Washington University Emergency Medicine Journal Club
Supplemental Oxygen in the Management of Acute Myocardial Infarction

Vignette

You are receiving a patient from EMS that is having chest pain and you notice that the patient is not on oxygen. Remembering from medical school that everyone gets ABCs and IV, O2, monitor (especially with chest pain), you ask the paramedics why they aren't on oxygen. In fact, they point out, that the patient's oxygen saturation is 96% and according to their protocols, written by their Medical Directors, they are not supposed to place a chest pain patient on oxygen when the SpO2 is greater than 92% (unless the patient appears to be in respiratory distress). Questioning this, you bring up the question to Dr. Svancerek who curses and turns to Dr. Levine, who handily supplies you with articles (which were thankfully saved on his iPad) given to him by Dr. Gilmore. However, still being leery of the reasoning behind this logic (and that of ACLS updates), you suggest performing a search on the literature to really find the answer.

PICO Question
Population: Prehospital or emergency department patients with acute myocardial infarction and oxygen saturation ≥ 92%.
Intervention: Supplemental oxygen administration
Comparison: Room air oxygen
Outcome: Mortality, length of stay, or functional status

Search Strategy

With the assistance of your Medical Librarian, you develop a pubmed search strategy and enter ((("Myocardial Infarction/therapy"[Mesh])) AND ("Oxygen Inhalation Therapy"[Mesh:noexp])) AND ((("Length of Stay"[Mesh])) OR ("Mortality"[Mesh] OR "mortality"[Subheading])) AND (Humans[Mesh] AND English[lang]) This search yields 14 citations, from which you choose 2 of the papers.

Hoping for two more relevant articles, you turn to the TRIP database and search "oxygen myocardial infarction," which results in 86 systematic reviews, from which you identify an appropriate systematic review and meta-analysis. One of the trials included in the meta-analysis (a Russian trial) was not identified on your initial search, and you decide to include this article as well.

Article 1: Rawles J, Kenmure ACF. Controlled trial of oxygen in uncomplicated myocardial infarction. British Medical Journal 1976;1:1121–3. Answer Key.

Article 2: Burls A, Cabello JB, Emparanza JI, Bayliss S, Quinn T. Oxygen therapy for acute myocardial infarction: a systematic review and metalanalysis. Emerg Med J. 2011 Nov;28(11):917-23. Answer Key.

Article 3: Ranchord AM, Argyle R, Beynon R, Perrin K, et al. High-concentration versus titrated oxygen therapy in ST-elevation myocardial infarction: A pilot randomized controlled trial. Am Heart J 2012; 163(2): 168-175. Answer Key.

Article 4: Ukholkina GB, Kostyanov IY, Kuchkina NV, et al. Oxygen therapy in combination with endovascular reperfusion during the first hours of acute myocardial infarction: clinical and laboratory findings. International Journal of Interventional Cardioangiology 2009;9:45-51. Answer Key.

Bottom Line

Current guidelines for the treatment of acute myocardial infarction (AMI) provide inconsistent recommendations regarding the use of supplemental oxygen (Kallstrom 2002, Antman 2004, Van de Werk 2008), likely due to a paucity of clear evidence of benefit or harm. There has been some indirect evidence that supplemental oxygen may cause harm, with proposed mechanisms including coronary artery vasoconstriction (Momen 2009), decreased coronary blood flow (McNulty 2005, Farquhar 2009), increased peripheral vascular resistance (Milone 1999), and oxygen free radial damage (Tatarkova 2012). One systematic review found no benefit from oxygen therapy in the management of myocardial ischemia (Nicholson 2004).

The current literature addressing the use of oxygen in AMI is sparse and it is difficult to draw firm conclusions. The earliest randomized controlled trial was blinded, but pre-dated many current management strategies, including routine revascularization, antithrombotic therapy, and glycoprotein iib/iiia inhibitor use. The two other clinical trials as well as well as a third trial identified in the meta-analysis, were non-blinded and of poor methodological quality. All the studies were small, thus limiting their statistical power.

Mortality

Two of the randomized controlled trials and the meta-analysis demonstrated a trend towards increased mortality with the routine use of supplemental oxygen in AMI, but none was sufficiently powered to show a statistically significant difference. Only the PGY-4 study demonstrated a decrease in mortality with oxygen use, though this was also statistically non-significant.

Secondary Outcomes

None of the studies demonstrated a difference in pain (measured by analgesic use). No clear benefit was seen in terms of cardiac function, whether evaluated by systolic time intervals (STIs), echocardiogram, or cardiac MRI. The effect on cardiac biomarkers was mixed, with one study showing a significant increase in maximum AST level with oxygen therapy, one showing a significant decrease in maximum MB-

CPK level, and one study showing no significant difference in troponin T or NT-proBNP levels.

Future Research

A slightly larger trial is currently underway (AVOID Study) with a primary outcome measure of myocardial infarct size assessed by measuring cardiac troponin I and creatine kinase (CK). Survival to hospital discharge is a secondary outcome, though the study will be underpowered to detect a statistically significant difference. The authors of the meta-analysis made the following calculation: assuming a relative risk of 0.67 and a baseline mortality of 1.7% (the pooled mortality in the meta-analysis), using a power and sample size calculator we find we would need approximately 10,000 subjects in each arm to achieve a 90% probability of detecting a statistically significant difference. Further research should also address long-term functional status as an outcome, using either the Kansas City Cardiomyopathy Questionnaire or Quality of Life after Myocardial Infarction (QLMI) instrument or another validated quality of life instrument.

Consensus

While there is currently no definitive evidence that the routine administration of supplemental oxygen in AMI improves patient-important outcomes, there is also no definitive data that it causes harm. While it is reasonable to withhold supplemental oxygen in AMI patients with normal oxygen saturation (typically $Sp0_2 \geq 92\%$), it is also reasonable to provide supplemental oxygen in these patients, particularly in those with subjective shortness of breath.