

Influence of Air Pollution on Perioperative Outcomes & Potential for Big Data Driven Discoveries

Presenting Author: Roman Kovtun, BS, University of Utah School of Medicine

Co-Authors: Roman Kovtun, BS, University of Utah School of Medicine. Larry Ha, MD University of Utah, School of Medicine. Daniel Mendoza, PhD, MS, Department of Atmospheric Sciences, Department of City & Metropolitan Planning, University of Utah. John Pearson, MD, Department of Anesthesiology, University of Utah School of Medicine.

Background: Mounting evidence demonstrates that short-term and long-term exposure to air pollution increases the risk of cardiovascular mortality and reduces life expectancy.¹ These effects are especially pronounced in populations with chronic medical conditions, the elderly, and patients with low socioeconomic status.¹ While surgical populations, especially those with cardiovascular comorbidities, could constitute another population vulnerable to air pollution, to date this relationship has not been widely studied. Therefore, we performed a literature review aimed to understand the extent of current research that examines the influence of air pollution on perioperative outcomes.

Methods: Air pollution was used as a broad term or defined as any of the six principal air pollutants regulated by the EPA as part of the National Ambient Air Quality Standards (NAAQS). These included carbon monoxide, lead, ozone, nitrogen dioxide, sulfur dioxide, and particulate matter. Studies were identified by electronic database searches in PubMed and Scopus from 1960 to the present. Principal PubMed medical subject heading (MeSH) terms used were air pollution, carbon monoxide, ozone, particulate matter, lead, nitrogen dioxide, sulfur dioxide, perioperative period, postoperative complications, intraoperative complications, surgical procedures. This search yield over 2,000 results, so the MeSH terms were modified to include more relevant subheadings like adverse effects, toxicity, complications, and epidemiology. This search yielded n=80 results in the English language. Out of these articles, we manually identified the relevant ones, and performed citation chaining for each via Scopus. A total of n=12 studies were included in this review.

Conclusions: Based on the current literature review there seems to be a relationship between air pollution and increased adverse perioperative outcomes, however, a large gap in research still exists. The majority of studies examined the impact of residential air pollution levels on outcomes of organ transplants. Spencer-Hwang et al² found that in kidney transplant patients for each 10-ppb increase in ozone, the risk of fatal coronary heart disease increased by 35%. Moreover, studies of lung transplant recipients correlated residential proximity to major roads with increased risk of chronic lung allograft dysfunction and mortality.^{3,4,5,6} However other data suggests that macrolide use likely ameliorated some of these effects.^{6,7,8} In addition, recent data from Al-Kindi et al⁹ identified that every 10-ppb increase in particulate matter was associated with a 26% increased risk of mortality among heart transplant patients.

Beyond organ transplantation, Li et al¹⁰ found that increased levels of air pollution were associated with decreased clinical pregnancy rates among IVF patients, while increased ozone levels had a beneficial role.¹¹ Studies also shows that increased short-term air pollution may also be deleterious. Che et al¹² identified that the incidence of delirium in the surgical population increased with rising levels of air pollution in the hospital area. Moreover, Männistö et al found that increased ambient levels of nitric oxides prior to delivery were associated with a higher incidence of cardiovascular events especially in those delivering via caesarian section.¹³

This data suggests that there is a link between ambient air pollution and perioperative outcomes. However, the degree to which this relationship impacts the surgical population is well studied with only n=12 studies to date. Recent technological advances, including the decreasing cost of air quality equipment, public atmospheric pollution models, ubiquitous GPS in patient smartphones, and the advent of large scale electronic health records in the past decade, make it possible to better study the influence of air pollution on perioperative and other health outcomes both in acute and chronic timescales. Using these Big Data sources could elucidate the impact of air pollution on the surgical population and help us assess the health and financial burden placed on the system by poor air quality.

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