



The clinical and economic burden of perioperative complications of radical cystectomy

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Radical cystectomy (RC) is the gold standard treatment and most effective method for local control of muscle invasive and high risk, non-invasive bladder cancer (1,2). RC is, unfortunately, a major surgery with significant attendant morbidity. Notwithstanding improvements in surgical technique and pre-, peri-, and postoperative care, 27–64% of patients experience at least one complication with a 26–43% 90-day readmission rate and a 1.5–3% 30-day mortality rate (3–6). These numbers also bespeak the relative frailty and poor baseline physiologic reserve of patients frequently in consideration for RC. Thus, the decision to proceed with surgery should involve a careful and thoughtful weighing of risks to benefits as well as a thorough discussion with the patient on their individualized risks.

The economic burden of RC is equally worthy of examination. Relying on the Medicare resource-based relative value scale, one group (7) calculated the per case cost of RC at a single tertiary care institution to be \$21,815 to \$22,974, depending on the surgical approach employed. The authors found that total costs were primarily driven by the length of stay. By comparison, Leow *et al.* estimated the average 90-day direct hospital costs per RC in the United States between 2003 and 2015 to be \$39,657 with index hospitalization and readmission accounting for 88% (\$34,803) and 12% (\$4,847), respectively (8). The vast majority of variations in total costs were due to the type of postoperative complications (8). In fact, an index complication has been shown to increase costs by more

than \$9,000 and each readmission complication increases costs by more than \$20,000, likely driven by the resultant increase in length of hospital stay (9).

Mossanen and colleagues (10) evaluated the relationship between perioperative complications and 90-day mortality following RC. Using Premier Healthcare Database, they rigorously examined more than 57,000 patients (based on survey weighting) across 360 hospitals. Overall outcomes were congruent with prior studies, including a 68.3% total complication rate and perioperative and 90-day mortality of 2.2% and 3.4%, respectively. Not surprisingly, there was a direct relationship between mortality and number of complications, but the probability for postoperative mortality rose dramatically with each additional complication with a steep inflection point at four or more complications. This relationship was even more pronounced in the setting of hospital readmission, conferring a near doubling of mortality risk. More complications also bore higher readmission rates. This observed influence of timing of complications on mortality may be explained by a greater susceptibility to complications in patients with poor baseline reserve and/or the cumulative effect of complications to successively weaken a patient (10).

The relationship between timing of complications and mortality was of particular interest to us. On the surface, this finding suggests that failure to recognize a developing complication or to escalate care consequently leads to worse outcomes—be it the deficiencies in surgeon experience or

the multidisciplinary system in place to support patients through all phases of care. As noted by the authors, previous studies in various medical specialties have associated higher mortality rates with lower institutional volume (11-16); one study specifically examining RC found that improved mortality was seen with high volume surgeons and especially high-volume hospitals (17). Mossanen *et al.* go on to discuss the concept of failure to rescue (FTR), attributing delays in care to possible geographical or systematic constraints on patients in the face of a trend toward greater centralization of care. By this logic, delays in care portend worse outcomes owing to either advancing severity of a complication or the additive effects of numerous complications, further increasing susceptibility to subsequent morbidity (18,19). Ultimately, these complications become progressively costlier, both on a clinical patient level and an economic level.

Though rational explanations with which we agree, we would also like to stress that this issue is likely much more complex than is otherwise explained by available literature. For one, the causal relationship between patient outcomes and FTR cannot be definitively proven on the basis of observational and retrospective studies. Further, while Mossanen *et al.* confirmed that complication type influences the probability of postoperative mortality, this is only part of the equation. Though not captured in the current study, the relative severity of such complications is associated with mortality risk (20-22). It has also been observed that that minor complications (Clavien grade 1 or 2), nonfatal major complications (Clavien grade 3 or 4), and mortality (Clavien grade 5) are associated with significantly increasing costs (8).

The Mossanen study provides value to the surgical risk stratification and patient counseling processes as it quantifies the prognostic significance of complications on patient survival following RC. This discussion is of critical importance as perioperative complications have both clinical and economic implications. Moreover, they currently serve as major indices of safety and quality by which hospitals and providers are measured. Certainly, efforts to reduce the number and probability of surgical complications should be paramount. While some complications are unavoidable, patient outcomes following RC can be improved with earlier recognition and management of postoperative complications and more widespread adoption of multimodal care systems that support patients from diagnosis through long-term follow up (16,22-25). Ultimately, future investigations are needed to better characterize the mechanisms responsible for complications and their differential influences on patient outcome and healthcare costs.

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Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

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