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ALARA (As Low As Reasonably Achievable): Evaluating Causes of Excessive Radiation for Routine Interventional Radiology Procedures

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Introduction/Background

Radiation safety is essential for patients, providers, and oversight. A recent modeling study projected that CT imaging may contribute to 5% of future cancers, raising public concern. In interventional radiology (IR), radiation monitoring emphasizes threshold-based reporting, with interventions triggered at 5 Gy and 10 Gy. Routine procedures like central venous access or tube exchanges typically fall below these thresholds and are not actively monitored for outliers. This study examines the causes of excess radiation exposure and evaluates the feasibility of using air kerma and fluoroscopy time as quality measures for routine IR procedures.

Methods/Intervention

We analyzed 15,578 IR procedures at a large academic center. Procedure types were reviewed by 3 IRs and classified as routine based on technical complexity and anticipated procedure time. These included tube checks and exchanges (nephrostomy, gastrostomy, GJ tubes, venous access). For each procedure, plots of air kerma versus fluoroscopy time were made for four BMI categories. A total of 329 (2.1%) outliers were identified when fluoroscopy time exceeded 10 minutes or if the air kerma rate exceeded 22 mGy/min to 49 mGy/min based on the exposure kV. Manual chart review classified reasons for extended time as: uncomplicated (unknown cause), technically challenging, intraprocedural complication, and complex anatomy (transplant, post-surgical anatomy, malignant obstruction).

Results/Outcome

The most common cause of excess fluoroscopy time was intraprocedural technical challenges (54%). However, 28% of cases were uncomplicated as noted despite excess fluoroscopy time. Complex patient anatomy contributed to 13% of cases. Intraprocedural complications, such as loss of wire access and fractured catheters, accounted for 5% of outliers.

Conclusion

Fluoroscopy time and air kerma are useful metrics for evaluating radiation safety for routine procedures and for workflow planning for procedure time slots and equipment type. Improved documentation for complicated procedures offers an opportunity to significantly reduce extended procedure times and dose.

Statement of Impact

Currently, quality measures do not actively evaluate routine procedures for procedural safety since they do not bypass reporting thresholds. Our work shows a practical way to implement such measures. This dataset may support the future development of predictive models to pre-procedurally identify patients at risk for excess radiation exposure.

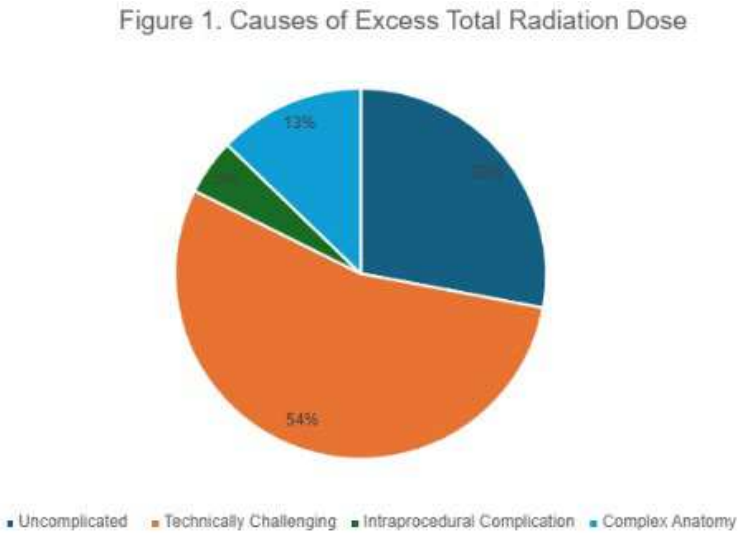

Figure 1. Graphical representation of various causes of excess radiation dose among the 329 outlier cases

Keywords

Radiation Safety; Fluoroscopy Time; Air kerma; Quality Metrics; Predictive Modeling