**Outcome of cancer surgery after inhalational and intravenous anesthesia**

**Ismail Gögenur**
**Professor, overlæge dr.med**
**Kirurgisk Afd.Center for Surgical Science**
**Sjællands Universitetshospital**
**Institut for klinisk medicin, Københavns Universitet**

**Objectives for the study:**
Various factors in the perioperative period, including the inflammatory and endocrine metabolic stress response are suggested to promote a micro metastatic process, which results in poor long-term oncologic outcomes. Inhalational anesthesia (INHA) may modulate anti- metastatic immunity by inhibiting cytotoxic cells such as NK cell and inhibit T- helper cell proliferation. Both of these effects is expected to reduce micrometastatic tumor foci in the postoperative period and thus result in reduced cancer survival.
In contrast, propofol-based total intravenous anesthesia (TIVA) is suggested to have anti-inflammatory features and to be advantageous compared with INHA by promoting the activation of T-helper cells, decreasing matrix metalloproteinases, and not suppressing NK cell activity to the same extend as INHA. It could thus be expected that the choice of anesthesia may result in a shift in the immunological balance in the perioperative period giving rise to altered long-term oncological outcomes.
We aimed to systematically review the literature investigating studies reporting oncological outcomes or complications after cancer surgery.

**Methods:**
We performed a systematic review according to the PRISMA guidelines. Population: patients undergoing cancer surgery. Intervention: primary cancer sur-gery with either INHA or TIVA. Comparison: TIVA versus INHA. Outcome: overall mortality and postoperative complications. All human studies meeting the PICO criteria were eligible for inclusion. Language was limited to English, French, German, Spanish and Scandinavian languages. No limitations were set on study design or publication year and we excluded animal studies, in vitro studies and anesthetic interventions in combination with other simultaneous interventions.

**Results:**
Due to heterogeneity, it was not possible to directly compare the included studies in a meta-analysis. Eight studies were included for analysis in the review. Four studies reported overall mortality in cancer patients and four studies reported postoperative complications. A total of 10,696 patients were included in the studies with a variation of 28 to 7030 patients in each study. The study participants were enrolled from 1998 to 2014 with cancer sites located in urologic, gastrointestinal, gynecologic, soft tissue, head and neck, breast and respiratory sites. Anesthetic agents consisted of sevoflurane, desflurane or isoflurane in INHA and propofol in TIVA. Most surgical interventions were performed electively.
In three studies including a total 10,193 patients statistical analysis are supporting the theory that TIVA could be favorable for cancer survival. Only one study reported a recurrence-free survival, which showed a significantly prolonged survival in patients undergoing surgery with TIVA.
The incidences of postoperative complications in 475 patients were comparable after INHA and TIVA, except one study reporting a significantly reduced risk of pulmonary complications after TIVA.

**Discussion and conclusions**

Researchers have emphasized the importance of several perioperative factors that may affect oncological outcomes, including the systemic inflammatory response, neuroendocrine influence

and the perioperative use of statins, metformin and COX2 inhibitors. Inhalational anesthetic agents may induce suppression of NK cell activity and T-helper cell proliferation. As both cell types serve as a part of the cell-mediated immunity, a down-regulation of these cell populations may increase the risk of micro metastasis in the perioperative window. Additionally, in vitro studies suggest that INHA may promote upregulation of hypoxia inducible factor 1-α, which has been identified as a key up- regulator of several downstream genes activating cell proliferation. Propofol activates the anti-metastatic immunity of T-helper cells and decreases the presence of some matrix metalloproteases , which has been suggested to correlate with cancer progression and growth. These immunological modulations of INHA and TIVA give reasons to hypothesis that TIVA is a better choice of anesthetic induction in cancer surgery compared with INHA.
There are reasons to hypothesize that the use of INHA is harmful in the perioperative period of cancer surgery. Despite TIVA seeming to lead to decreased mortality in patients with cancer in large retrospective studies, there is currently no evidence of high quality supporting TIVA being a superior choice compared with INHA. Thus, no guidelines for anesthetic induction in cancer patients can be advised until further evidence is provided.

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