Considerations and Implications of Parkinson's Disease on Anesthesia

Dr. Pallavi Patel College of Health Care Sciences
NOVA SOUTHEASTERN UNIVERSITY

Ryan M Caffrey SAA, Guy Nehrenz, EdD, MA, RRT
Nova Southeastern University, Department of Health Science, Fort Lauderdale, FL

Introduction and Background

Parkinson's Disease (PD) is the second most common neurological disease affecting the senior population. The onset of PD usually starts with neurological symptoms such as memory loss. Following the cognitive symptoms are motor symptoms such as bradykinesia and resting tremor. Testing such as gait analysis has led to early detection of these symptoms for more acute and aggressive treatment.

With an aging population and the increase in the need for medical care, including surgery. This correlates with more interactions between patients with PD and anesthesia practice. Patients with PD often have multiple comorbidities and medications that must be considered before delivering an anesthetic.

Anesthetic considerations for patients with PD can be divided into three categories: preoperative, intraoperative, and postoperative. Pre-operative considerations consist mostly of determining the medications the patient is on and how they will affect the anesthetic. Intraoperative considerations involve the patient's anesthetic of choice and airway management. Post-operative considerations mainly relate to postoperative delirium.

This poster aims to educate medical professionals about the contraindications and complications of anesthesia in this patient population.

Implications

Symptoms	Anaesthetic implications
Motor	
Tremor	Motion artefacts on monitoring (e.g. pulse oximetry, electrocardiography) Difficult intravenous access in ipsilateral limb Interference with patient-controlled analgesia
Rigidity	Difficulty in positioning for surgery and regional anaesthesia Potential difficult airway; difficult awake fibreoptic intubation Restrictive lung disease if chest rigidity
Bradykinesia	Slower postoperative functional recovery
Postural instability, falls	Associated injury and fractures from falls; need for fall prevention Slower postoperative functional recovery
Bulbar dysfunction	Pulmonary aspiration, dysphagia Retained secretions Laryngospasm
Motor fluctuations, dyskinesia	Require optimal timing of medication during peri-operative period Interfere with procedures that require immobility
Non-motor	
Autonomic dysfunction	Labile blood pressure and orthostatic hypotension May be worsened with other anaesthetic drugs and fluid status Delayed gastric emptying, ileus; worsened with surgery, bed rest, opioids and poor enteral intake Urinary dysfunction Altered temperature regulation
Cognitive impairment	Postoperative neurocognitive disorders Delayed emergence
Psychiatric disorders	Drug interactions between antidepressants, anxiolytics and antipsychotics with anaesthetic and analgesic medications. Postoperative delirium, acute psychosis, depression and anxiety
Pain	Drug interactions between analgesics and Parkinson's disease medication Co-existing chronic pain-related Parkinson's disease
Sleep disturbances	Worsened with hospital environment, sedative medication
Other	Fatigue, hyposmia, visual dysfunction and personality changes

Fig. 1. Anesthetic Implications Relating to patient PD symptomology *(Yim et al., 2022)*.

Operative Considerations

Pre-operative considerations range from maintaining plasma concentration levels on their antiparkinsonian medications, which have been linked to minimizing post-operative complications (Yim et al., 2022). The disease has also been acknowledged to impact their airway and cardiovascular systems significantly (Axelerad et al., 2021; Lee et al., 2023). Aspiration risk in patients due to changes to the pathophysiology of the disease is higher (Kim et al., 2020).

Pre-operative	Continuation of antiparkinsonian medication according to patient's home schedule Documentation of baseline non-motor symptoms to differentiate from new-onset symptoms postoperatively Schedule elective surgery earlier in the day for optimal symptom management
Intra-operative	Consider severity and laterality of Parkinsonian symptoms when deciding the mode of anaesthesia Rapid sequence induction preferred to prevent aspiration Avoidance of dopamine antagonists and drugs with significant interactions with antiparkinsonian medication Careful management of fluid and cardiovascular status, and avoidance of high doses of drugs associated with QT prolongation (e.g. ondansetron) in patients with severe dysautonomia Close monitoring of temperature for dysautonomia or Parkinsonism-hyperpyrexia syndrome Awareness of monitoring artefacts (e.g. tremor) Low threshold for further investigation of suspected cardiopulmonary complications (e.g. arterial blood gas, chest radiograph) Minimise electromagnetic interference with deep brain stimulator Multimodal opioid-sparing analgesia

Fig. 2. Assessing the different objectives that must be completed during the Preoperative and Intraoperative stages of the anesthetic to ensure patient safety *(Yim et al., 2022)*.

Post-Operative Complications

Over the course of 5 years, the progression of PD was measured by comparing two different types of anesthesia. It was determined that there was no significant difference in post-operative symptomology between the two PD groups. However, Jain et al., (2022) states that there may be a correlation between surgical length and post-op outcomes.

	GA			LA			*P*
	Levodopa off/DBS off	Levodopa on/DBS on	Improvement (%)	Levodopa off/DBS off	Levodopa on/DBS on	Improvement (%)	value
UPDRS	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	(%)
Part I	4.8 ± 2.2	2.9 ± 1.7	39.9 ± 27.7	5 ± 2	2.8 ± 2.1	42.3 ± 28.1	0.66
Part II	26.1 ± 8.5	10.9 ± 4.9	55.7 ± 18.7	23.7 ± 9.2	9.2 ± 6.4	57.4 ± 22.4	0.86
Part III	50.4 ± 12.2	23.5 ± 9	53.5 ± 14.9	48.1 ± 14.1	18.9 ± 7.5	59.1 ± 13.1	0.38
Brady	20.8 ± 3.9	12.5 ± 4.7	40.5 ± 17.6	20.7 ± 5.9	11 ± 3.9	44.7 ± 19.5	0.47
Tremor	7.2 ± 6.3	1 ± 1.6	75.8 ± 33.7	5.4 ± 4.5	0.3 ± 0.6	84.1 ± 35.9	0.1
Rigidity	10.2 ± 3.8	3.2 ± 2.6	70.2 ± 21.8	10.4 ± 4.3	1.5 ± 1.5	84 ± 16.3	0.07
Posture and gait	4.3 ± 1.4	2.6 ± 1.2	40.2 ± 23	4.4 ± 1.4	2.2 ± 1.2	47.6 ± 25.5	0.18
Axial	10.1 ± 3.3	5.8 ± 2.4	42.4 ± 19.2	9.9 ± 4.1	5.1 ± 2.7	44.2 ± 21.6	0.59
Part IV	5 ± 2.4	2.4 ± 1.8	28.2 ± 85.5	5.6 ± 1.4	1.8 ± 1.6	67.4 ± 27	0.07
Total	86.4 ± 21.5	39.6 ± 12.6	53.2 ± 13.3	82.4 ± 25.2	32.7 ± 14.9	58.5 ± 14.2	0.27
H&Y stage	3.5 ± 0.8	2.4 ± 0.4	28.3 ± 17.3	3.5 ± 1	2.6 ± 0.6	22.9 ± 18.3	0.36
ADL score	56.4 ± 21.5	86.8 ± 9.9	35.3 ± 22.8	56.4 ± 25.9	87.9 ± 18.1	37.2 ± 23.9	0.87

UPDRS: Unified Parkinson's Disease Rating Scale; H&Y: Hoehn and Yahr; ADL: activities of daily living; GA: general anesthesia; LA: local anesthesia.

Fig. 3. Measures of long-term post-operative complications from general anesthetics and local anesthetic procedures over 5 years *(Tsai et al., 2019)*. Comparisons were made with differences in deep brain stimulation and its help with improving patient symptoms post-operatively.

Discussion

The progression of PD impacts a patient's heart, lungs, and airway, which may present difficulties when administering an anesthetic. Airway physiology may make maintaining the patient's ventilation difficult once the patient has been extubated (Kim et al., 2020). Furthermore, impacts on the lower esophageal sphincter and delayed gastric emptying lead to a higher risk of aspiration in these patients (Yim et al., 2022; Nicholson et al., 2002).

Alterations in blood pressure may be due to changes in the signal conduction of the sinal atrial node and loss of vascular tone (Lee et al., 2020). Decreases in lung compliance may lead to lower vital capacities for patients on the ventilator; different ventilator modes and reduced tidal volumes may be required (Axelerad et al., 2021). Furthermore, due to the resting tremor in these patients, obtaining initial vitals and monitoring changes during an anesthetic may be difficult. Challenges in monitoring may increase the likelihood of errors (Yim et al., 2022).

The anesthetic choice is another factor that influences patient outcomes. Local anesthesia may be less risky than general anesthetics (Hani et al., 2020). TIVA with Propofol or maintenance with Sevoflurane has shown promise as well, with little impact on dopamine-producing areas of the brain (Tsai et al., 2020; Ling et al., 2020)

Overall, vigilance must prevail, especially in patients presenting with PD symptoms.

Conclusion

Research should make disease detection more efficient. Therefore, coordination with other medical specialties may become necessary when completing an anesthetic plan.

Performing an anesthetic on a patient with PD presents many challenges. Patient safety should improve significantly with knowledge and training. Patient safety is a priority, and making anesthesia more amenable to patients with diseases like these means more life-saving surgical alternatives.

REFERENCES

Bani Hani, D. A., Aleshawi, A. J., Al Shalakhti, M. H., Alhowary, A., Al-Jararahih, O., Al-Mistarehi, A.-H., & Yassin, A. (2020). Spinal versus General Anesthesia for Patients with Parkinson's Disease. *International Journal of General Medicine, 13*, 9–15.

Dhesi, J. K., & Moppett, I. K. (2022). Anesthesia and the older brain: What should we do? *Anaesthesia, 77 Suppl 1*, 8–10.

Docu Axelerad, A., Stroe, A. Z., Arghir, O. C., Docu Axelerad, D., & Gogu, A. E. (2021). Respiratory Dysfunctions in Parkinson's Disease Patients. *Brain Sciences, 11*(5), 595.

Jain, S., Rosenbaum, P. R., Reiter, J. G., Hill, A. S., Wolk, D. A., Hashemi, S., Fleisher, L. A., Eckenhoff, R., & Silber, J. H. (2022). Risk of Parkinson's disease after anesthesia and surgery. *British Journal of Anesthesia, 128*(4), e268–e270.

Kim, J.-I., Lee, D.-H., & Kim, H. (2020). Bilateral vocal cord paralysis during emergence from general anesthesia in a patient with Parkinson's disease. *Saudi Journal of Anaesthesia, 14*(1), 112–114.

Lee, B., Edling, C., Ahmad, S., LeBeau, F. E. N., Tse, G., & Jeevaratnam, K. (2023). Clinical and Non-Clinical Cardiovascular Disease Associated Pathologies in Parkinson's Disease. *International Journal of Molecular Sciences, 24*(16), 12601.

Ling, Y., Liu, L., Wang, S., Guo, Q., Xiao, Q., Liu, Y., Qu, B., Wen, Z., Li, Y., Zhang, C., Wu, B., Huang, Z., Chu, J., Chen, L., Liu, J., & Jiang, N. (2022). Characteristics of Electroencephalogram in the Prefrontal Cortex during Deep Brain Stimulation of Subthalamic Nucleus in Parkinson's Disease under Propofol General Anesthesia. *Brain Sciences, 13*(1), 62.

Lu, W., Chang, X., Bo, L., Qiu, Y., Zhang, M., Wang, J., Wu, X., & Yu, X. (2022). Risk Factors for Delirium after Deep Brain Stimulation Surgery under Total Intravenous Anesthesia in Parkinson's Disease Patients. *Brain Sciences, 13*(1), 25.

Nicholson, G., Pereira, A. C., & Hall, G. M. (2002). Parkinson's disease and anesthesia. *British Journal of Anesthesia, 89*(6), 904–916.

Tsai, S.-T., Chen, T.-Y., Lin, S.-H., & Chen, S.-Y. (2019). Five-Year Clinical Outcomes of Local versus General Anesthesia Deep Brain Stimulation for Parkinson's Disease. *Parkinson's Disease, 2019*, 5676345.

Tsai, S.-T., Tseng, G.-F., Kuo, C.-C., Chen, T.-Y., & Chen, S.-Y. (2020). Sevoflurane and Parkinson's Disease: Subthalamic Nucleus Neuronal Activity and Clinical Outcome of Deep Brain Stimulation. *Anesthesiology, 132*(5), 1034–1044.

Yim, R. L. H., Leung, K. M. M., Poon, C. C. M., & Irwin, M. G. (2022). Perioperative management of patients with Parkinson's disease. *Anesthesia, 77 Suppl 1*, 123–1