Original Research Article

Sedation versus General Anaesthesia for Transcatheter Aortic Valve Replacement (TAVR)

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ABSTRACT

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| **Background:** There is a debate regarding the best anaesthetic management for patients undergoing trans-catheter aortic valve replacement (TAVR). Both sedation and general anesthesia are used by anesthetists.  **Objective**: This study aims to compare the use of sedation and general anesthesia in trans-catheter aortic valve replacement.  **Methods**: Retrospective observational analysis of patients’ data presented for trans-catheter aortic valve replacement (TAVR) at Queen Alia Heart Institute (QAHI) over 5 years (in the period between February 2020 and March 2025). Patients were divided into two groups regarding their anaesthetic technique during the procedure: the general anaesthetic group (GA) and the sedation group. Both groups were compared according to their demographic, clinical, perioperative characteristics, hospital stay, complications, and outcomes.  **Results**: 69 patients underwent the TAVI procedure. The average age of patients was 76.7 years (ranging from 57 to 93 years). Female patients were 57.9 %. Female to male ratio was 1.4:1. The average BMI was 31.5 Kg/m². Incidence of comorbidities was high among the TAVI population: 91.3% were hypertensive, 49.3% were diabetic, 11.6% had hypothyroidism, 8.7% had a previous cerebrovascular accident (CVA) or transient ischemic attack (TIA), 7.2% had chronic respiratory disease and 10.1% had chronic kidney disease (CKD). The incidence of smoking was 30.4%. The average pre-procedural mean pressure gradient across the aortic valve was 49.4 mmHg. TAVI was performed under sedation in more than half of patients (56.5%), while 43.5% had a general anaesthetic. The average length of hospital stay was 3.9 days after the procedure. Patients who had the procedure performed under sedation had a shorter hospital stay (3.6 days) in comparison to the GA group (4 days). The overall mortality was 5.8%.  **Conclusion**: TAVI procedure is more commonly performed under conscious sedation than general anesthesia in our cardiac center. The use of conscious sedation was associated with shorter hospital stay than general anesthesia. |

*Keywords: Anaesthesia, Cardiac, Sedation, TAVI, Outcome, Hospital stay*

1. INTRODUCTION

Aortic stenosis (AS) is the most common valvular heart disease and the third most common cardiovascular disease after hypertension and coronary artery disease in the Western world. [1] AS is more common in elderly patients and is a major cause of mortality and morbidity. [2] It has a prevalence of around 2% of the population aged more than 65 years and over 4% of octogenarians. [3] Surgical aortic valve replacement (AVR) remains the gold-standard intervention for improving life expectancy and quality. [4]Transcatheter Aortic Valve Replacement (TAVR) may provide a less invasive alternative to the standard surgical aortic valve replacement (SAVR) for eligible patients with a high risk of SAVR. [5] Transcatheter aortic valve implantation (TAVI) is a relatively novel procedure that has undergone rapid development since its introduction and is expected to expand further in the near future. [6] Its main indication is in the treatment of severe symptomatic aortic valve stenosis. [7] Initially, the procedure was only indicated for high-risk patients who were not suitable for surgical aortic valve replacement (SAVR). [8] These patients are often old, and frail with significant comorbid conditions. However, rapid advances in the technology and the operators' skills required for TAVI have allowed the widening of the indications for its use such as aortic regurgitation, bicuspid valve, or valve-in-valve in degenerative bio-prosthetic surgical valves. [9] The first successful trans-catheter valve replacement procedure in the world was performed on 16 April 2002, by the Interventional Cardiologists Alain Cribier. [10] Alain Cribier is also known for performing the first transcatheter mitral commissurotomy in 1995 and the first balloon aortic valvuloplasty in 1986. [11]

There is currently a significant debate regarding the best anaesthetic management for patients undergoing trans-catheter aortic valve replacement (TAVR). [12] Both general anesthesia and sedation are used in different institutions. [13] Sedation is a minimal mode of anesthesia; in which intubation is not needed, which can potentially minimize respiratory complications in elderly and frail patients; as is often the case in trans-catheter aortic valve replacement (TAVR) patients. [14] Trans-catheter aortic valve implantation is nowadays a routine therapy for elderly patients with severe aortic stenosis and high perioperative risk. [15] With growing experience, further development of the devices, and the expansion to “intermediate-risk” patients, there is increasing interest in performing this procedure under conscious sedation. [16] Complications occurring during TAVI under sedation may mandate conversion to general anesthesia (GA) with unplanned endotracheal intubation. [17]

In this study, we will discuss the incidence of use of sedation and GA for trans-femoral TAVI, and we will report the incidence of complications and outcome after TAVI in a specialized tertiary cardiac center.

2. methods

This study is a retrospective observational analysis of patients presented for trans-catheter aortic valve replacement (TAVR) at Queen Alia Heart Institute (QAHI) over 5 years (in the period between February 2020 and March 2025). Patients were compared concerning their anaesthetic technique during the procedure and were divided into two groups: the general anaesthetic (GA) group and the sedation group. Both groups were compared according to their demographic, clinical, perioperative characteristics, hospital stay, complications, and outcomes. Ethical committee approval was obtained from the Institutional Review Board (IRB). Data was statistically analyzed using Word Excel.

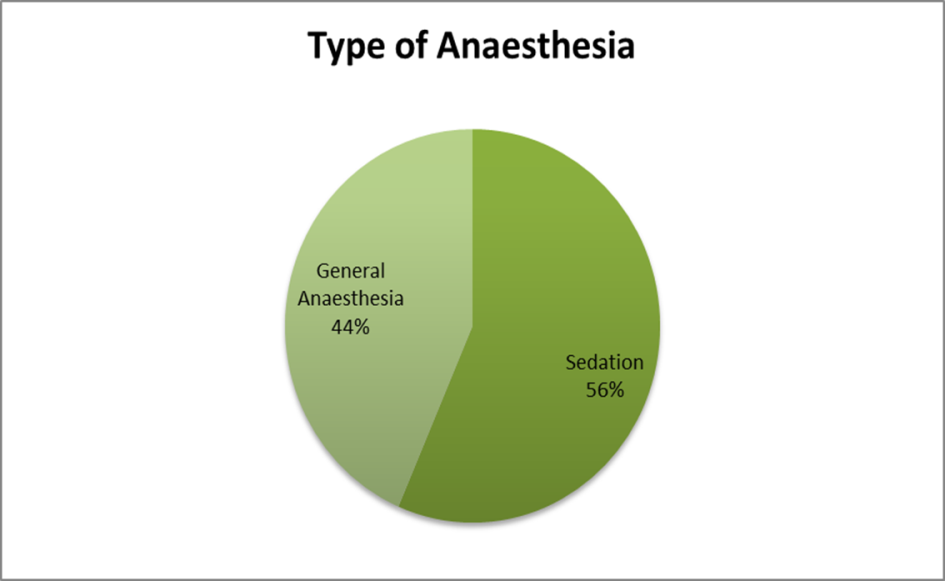
3. results

Data from 69 patients presented for TAVI was analysed. The average age of patients was 76.7 years (ranging from 57 to 93 years). Female patients were 40 (57.97%); while male patients were 29 (42.03%). Female to male ratio was 1.4:1. The body mass index (BMI) of patients ranged from 15.02 Kg/m² to 58.7 Kg/m² with an average BMI of 31.5 Kg/m². Incidence of comorbidities was high; as 63 patients (91.3%) were hypertensive, 34 patients (49.3%) were diabetic, 8 patients (11.6%) were hypothyroid, 6 patients (8.7%) had previous cerebrovascular accident (CVA) or transient ischaemic attack (TIA), 5 patients (7.2%) had chronic respiratory disease and 7 patients (10.1%) had chronic kidney disease (CKD). The incidence of smoking was 30.4%. The average Pre-procedural mean pressure gradient across the aortic valve was 49.4 mmHg indicating severe aortic stenosis. (Table 1: Demographic and clinical characteristics)

**Table 1: Demographic and clinical characteristics:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ***Characteristic:*** | ***Minimal*** | | ***Maximal*** | | ***Mean*** |
| Age (years) | 57 | | 93 | | 76.7 |
| Body mass index (BMI) (Kg/m²) | 15.02 | | 58.7 | | 31.5 |
| Pre-procedural haematocrit (%) | 27.1 | | 49.9 | | 35.7 |
| Pre-procedural mean pressure gradient across the aortic valve (mmHg) | 20 | | 90 | | 49.4 |
| Pre-procedural maximal pressure gradient across the aortic valve (mmHg) | 38 | | 130 | | 76.7 |
|  | | | | | |
| ***Characteristic:*** | | ***Number of patients*** | | ***Percentage*** | |
| Females | | 40 | | 57.97% | |
| Males | | 29 | | 42.03% | |
| Hypertensive | | 63 | | 91.3% | |
| Diabetic | | 34 | | 49.3% | |
| Hypothyroidism | | 8 | | 11.6% | |
| Chronic Kidney disease (CKD) | | 7 | | 10.1% | |
| Previous cerebrovascular accident (CVA) or transient ischaemic attack (TIA) | | 6 | | 8.7% | |
| Alzheimer | | 1 | | 1.5% | |
| Epilepsy | | 1 | | 1.5% | |
| Parkinsonism | | 1 | | 1.5% | |
| Bronchial Asthma | | 2 | | 2.9% | |
| Chronic obstructive pulmonary disease (COPD) | | 2 | | 2.9% | |
| Lung fibrosis | | 1 | | 1.5% | |
| Chronic Anaemia | | 9 | | 13% | |
| Systemic Lupus Erythematosus (SLE) | | 1 | | 1.5% | |
| Polymyalgia Rheumatica | | 1 | | 1.5% | |
| Osteoporosis | | 2 | | 2.9% | |
| Gout | | 1 | | 1.5% | |
| Heart failure (HF) | | 2 | | 2.9% | |
| Mitral valve disease | | 1 | | 1.5% | |
| Peripheral vascular disease (PVD) | | 1 | | 1.5% | |
| Smokers | | 21 | | 30.4% | |
| Non-smokers | | 43 | | 62.3% | |
| Ex-smokers | | 5 | | 7.2% | |

**Figure 1: Sedation versus G.A. in TAVI**



**Table 2: Peri-procedural characteristics:**

|  |  |  |
| --- | --- | --- |
| ***Characteristic:*** | ***Number of patients*** | ***Percentage*** |
| TAVI under sedation | 39 | 56.5% |
| TAVI under general anaesthesia | 30 | 43.5% |
| Conversion from sedation to general anaesthesia | 4 | 5.8% |
| Need for blood transfusion | 41 | 59.4% |
| Need for pacemaker | 14 | 20.3% |
| ***Characteristic:*** | ***Value*** | |
| Average post-procedural haematocrit (%) | 31.3 | |
| Average post-procedural mean pressure gradient across the aortic valve (mmHg) | 9.1 | |
| Average post-procedural maximal pressure gradient across the aortic valve (mmHg) | 16.2 | |
| Average length of hospital stay after procedure (days) | 3.9 | |

**Table 3: TAVI procedural and post-procedural complications:**

|  |  |  |
| --- | --- | --- |
|  | ***Number of patients*** | ***Percentage*** |
| No complications | 41 | 59.4% |
| Bleeding, vascular injury, and haematoma formation | 7 | 10.1% |
| Complete heart block | 10 | 14.5% |
| Trifascicular block | 2 | 2.9% |
| Left bundle branch block | 1 | 1.5% |
| Atrial fibrillation | 1 | 1.5% |
| Cardiopulmonary arrest | 4 | 5.8% |
| Respiratory arrest | 1 | 1.5% |
| Brain infarction | 1 | 1.5% |
| Acute Kidney Injury | 1 | 1.5% |
| Failure of procedure | 1 | 1.5% |
| Mortality | 4 | 5.8% |

The comparison between sedation and general anaesthesia (G.A.) for TAVI procedure showed almost similar age of patients (76.2 and 77.5 years, respectively), similar post-procedural haematocrit (31.4 and 31.3%), similar mean and maximal pressure gradients across the aortic valve and same mortality rate. (Table 4: Comparison between sedation and general anaesthesia (G.A.) for TAVI procedure)

**Table 4: Comparison between sedation and general anaesthesia (G.A.) for TAVI procedure:**

|  |  |  |
| --- | --- | --- |
|  | ***Sedation*** | ***G.A.*** |
| Number of patients (n, %) | 39 (56.5%) | 30 (43.5%) |
| Females (n, %) | 25 (64.1%) | 15 (50%) |
| Males (n, %) | 14 (35.9%) | 15 (50%) |
| Mean age (years) | 76.2 | 77.5 |
| Mean post-procedural haematocrit (%) | 31.4 | 31.3 |
| Mean post-procedural mean pressure gradient via the aortic valve (mmHg) | 9.08 | 9.07 |
| Mean post-procedural maximal pressure gradient via the aortic valve (mmHg) | 16.2 | 16.1 |
| Mortality (n, %) | 2 (5.1%) | 2 (6.7%) |
| Mean length of hospital stay after procedure (days) | 3.6 | 4 |

4. Discusion

Transcatheter aortic valve implantation (TAVI) was introduced experimentally in 1989, based on newly developed heart valve prosthesis, the stent-valve. This new stent valve was revolutionary because it is foldable and could be inserted via a catheter through an artery in the groin, without the need for sternal incision or cardiopulmonary bypass. [18] Since the first-in-human procedure in 2002, TAVI has become a new therapeutic method for elderly patients with severe co-morbidities and severe symptomatic aortic stenosis and is offered increasingly to patients at lower surgical risk. [19] TAVI can be performed by several routes: trans-femoral (most common), trans-subclavian, trans-aortic, or trans-apical. [20] The trans-carotid and transvenous routes have recently been described in the literature as alternative access routes where vessel access is difficult but is uncommonly performed. [21] In our center, all the patients in this study had the TAVI valve implanted via the trans-femoral route.

TAVI valves are broadly classified into two main types: balloon-expandable and self-expandable. Balloon-expandable valves use a balloon to expand the valve frame, while self-expandable valves rely on their own inherent shape memory to expand. Both types are commonly used in clinical practice. Nowadays, the self-expandable type is more commonly used.

Anaesthetic management in TAVI replacement has traditionally been general anesthesia (GA). [22] When GA is used for TAVI, the GA is of a ‘cardiac’ type; including high-dose opioids, neuromuscular blockade, tracheal intubation, transoesophageal echocardiography (TOE), invasive arterial monitoring, and central venous access. [23] However, with growing experience, further development of the stent-valves used and the expansion to "intermediate-risk" patients, there is increasing interest in performing this procedure under conscious sedation or monitored anesthesia care (MAC) rather than the previously favored approach of general anesthesia. [24] The proposed benefits of performing TAVI under sedation with local and regional anesthesia include; reduced procedure time, shorter intensive care unit (ICU) length of stay, reduced need for intra-procedural vasopressor support, rapid assessment of any neurological complications, avoidance of respiratory complications and rapid recovery with earlier hospital discharge. [25] In our heart center, anesthetists implement GA or sedation according to their clinical experience or individual patient’s factors.

We compared the implementation of GA and sedation for TAVI. Trans-femoral TAVI was performed under sedation in more than half of the patients (56.5%), while 43.5% had a general anaesthetic (G.A.). Of note, four patients (5.8%) of patients had the procedure under sedation initially; however, the procedure was converted under G.A. eventually. (Figure 1: Sedation versus G.A.) Blood transfusion was needed in 59.4% of patients. Overall, there was a drop in hematocrit from 35.7% before the procedure; to 31.3% thereafter. (Table 2: Peri-procedural characteristics) Cardiac pacing was needed in 14 patients (20.3%). After the TAVI procedure, the average length of hospital stay was 3.9 days (ranging from one day to 36 days). The median length of hospitalization is 2.5 days and the mode is 2 days. Most of the patients had no complications during the TAVI procedure (59.4%). The most frequent complications were related to arrhythmias, as 14.5% had complete heart block after the procedure. The second most frequent type of complication was related to bleeding, vascular injury, and haematoma formation, which occurred in around one-tenth of the patients (10.1%). The in-hospital mortality after the TAVI procedure was 5.8%. (Table 3: TAVI procedural and post-procedural complications)

In this study, most of the patients presented for TAVI had several comorbidities and advanced age (Table 1), and they were referred for TAVI as they were deemed to be high-risk and so frail for surgical aortic valve replacement (AVR). Sedation was used as the primary anaesthetic technique (with local/ regional anesthesia) in 56% of the study population. There were few cases of conversion from sedation to GA due to procedural complications such as vascular injury, bleeding, or heart rhythm disturbances (Table 3); however, most of the patients had no complications.

When comparing Sedation and GA, the results of our study showed no difference in the rate of complications, post-procedural pressure gradient through the aortic valve, or mortality. The overall hospital stay was shorter in patients who underwent TAVI under sedation than those who had a GA. Similar results were published in the literature by Hyman et al. with shorter hospital stay after TAVI procedure under sedation when compared to GA. [26, 27, and 28]

Limitations of this study are the retrospective nature of the study, the relatively small number of patients and that it is a single center study.

5. Conclusion

Conscious sedation was more commonly used than general anesthesia for the TAVI procedure in our center. The use of conscious sedation was associated with shorter hospital stay than general anesthesia after the TAVI procedure. We recommend the use of sedation over general anesthesia whenever feasible.

**DISCLAIMER (ARTIFICIAL INTELLIGENCE)**

Author(s) hereby declare that no generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

Ethical approval

The study was approved by the institutional ethics committee

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