Original Article

Perioperative anesthesia management for brachytherapy in cancer patients: A retrospective observational study

Vinod Kumar, Abhity Gulia, Rakesh Garg, Nishkarsh Gupta, Sachidanand J. Bharati, Seema Mishra, Sushma Bhatnagar

Oncoanesthesia and Palliative Medicine, Dr BR Ambedkar IRCH AIIMS, Delhi, India

Abstract

Background and Aims: Anesthetic management for brachytherapy require repeated exposure to anesthesia in elderly patients with comorbidities. The varying locations provide an anesthesiologist with further challenges.

Material and Methods: We studied retrospectively anesthesia type, details of anesthetic techniques and complications that occurred in patients having received anesthesia for brachytherapy in our institute in the last 6 years. Categorical variables were described as frequency and percentage, and continuous variables described as median and interquartile range. For continuous variables, mean values compared using two sample t tests for independent samples.

Results: The majority of patients were females who received brachytherapy for carcinoma cervix. A higher percentage of carcinoma breast and male genitourinary malignancies had comorbidities. Predominant side effects included 22 (1.85%) had hypotension, 19 (1.59%) had difficulty in putting spinal, 13 (1.09%) patients had tachycardia and 11 (0.92%) had headache in the postoperative period.

Conclusion: Neuraxial block as anesthetic technique in pelvic brachytherapy using fentanyl as additive helped reduce the dose of local anesthetic and avoided the complications of high spinal. The choice of anesthesia can vary depending on the duration and site of brachytherapy keeping in consideration the patient's factors.

Keywords: Anesthesia, analysis, brachytherapy, complications, epidural, general, retrospective, spinal

Introduction

Brachytherapy is the placement of radioactive sources within the body tissues or cavities near the tumor. It is indicated in pelvic malignancies (carcinoma cervix and endometrium), breast cancer, head and neck cancer, male genital cancers like prostate and carcinoma penis, and some inoperable cases of gastrointestinal malignancies. This provides a high absorbed dose of radiation to the tumor tissues and limited absorbed dose to surrounding normal tissues. Afterload techniques require a stable positioning of (nonradiating) applicator for the further procedure of loading the source of radiation. High dose rate (HDR) brachytherapy is usually given repeatedly at weekly intervals in the form of several sessions. In low dose rate (LDR) brachytherapy, the implants are placed and maintained *in situ* for a prolonged period. These procedures require not only an immobile patient during the procedure but also optimal pain relief as placement of radioactive implants is painful during its placement and while the applicator is in situ.[1]

Address for correspondence: Dr. Vinod Kumar,
Room No. 139, Dr BRAIRCH, AIIMS, Ansari Nagar,
Delhi - 110 029, India.
E-mail: vkchanpadia@gmail.com

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The process of brachytherapy involves the placement of implants, imaging of the applicator, and a computer-based calculation of dose for brachytherapy. The duration of the procedure is often variable leading to further challenges in perioperative anesthesia management.[2]

Brachytherapy typically requires the transport of anesthetized patients from the operating room, to various locations in the hospital for conducting brachytherapy. There is also a need to shift these patients for imaging to computed tomography or magnetic resonance imaging, and isolated radiation room. Management of patients at these locations is challenging for the anesthesiologist due to lack of specialized staff and facilities, compared with the setting of an operating theatre. The brachytherapy HDR sessions are repeatedly given to the patient, necessitating multiple exposures to anesthesia. Anesthetic management is crucial because the patients planned to receive brachytherapy may have associated comorbidities.[3]

The objective of this analysis was to discuss the anesthesia techniques and associated concerns in patients receiving brachytherapy in a tertiary care cancer institute based on our experiences in the last 6 years.

Material and Methods

The data was retrieved of patients who received brachytherapy over the last 6 years from May 2012 to September 2018 at the Selectron operating room (where brachytherapy procedures are done) of Dr. BRA IRCH, AIIMS, New Delhi, India after ethical permission from the institution (ref no. IEC-600/02.11.2018).

The study population includes patients who had undergone brachytherapy implant placement in the Selectron operating room as part of management for various malignancies. These patients were admitted to the radiation oncology units. The data were collected from the patient's records. The data regarding the demographics of patients, the localization and types of cancer for which brachytherapy was given, anesthesia type, details of the anesthetic procedure, airway management, and complications that occurred were retrieved.

Statistical analysis

All data were tabulated and analyzed. Descriptive statistics were used for analysis and the results expressed. Categorical variables have been described as frequency and percentage, and continuous variables described as median and interquartile range. For continuous variables, mean values compared using two-sample *t*-tests for independent samples. Differences in proportions were compared using the Chi-square test or Fisher's exact test, as appropriate. *P* value of <0.05 was considered statistically significant.

Results

We retrieved the charts of a total of 1192 patients who underwent brachytherapy under anesthesia. All the patients in our setup received HDR brachytherapy. The mean age of patients who received brachytherapy was 50.99 ± 10.74 years. The distribution of patients according to age is given in Table 1.

The majority of the patients were females (93.54%) whereas male patients were only 6.46%. Most patients were of carcinoma cervix, breast and genitourinary cancer of ASA physical status I & II [Table 2]. The common comorbidities found were hypertension (10.07%), DM (7.63%), hypothyroid (1.84%), and anemia (1.25%) [Table 3]. The number of sessions varied across the patients [Figure 1].

The duration of the procedure was variable being 15-30 minutes in cervical cancer patients and >60 minutes in carcinoma buccal mucosa, prostate cancer, and breast cancer patients. The anesthetic technique varies according to the procedure [Table 4]. Most of the patients received subarachnoid block as the anesthetic technique. The genitourinary malignancies and carcinoma cervix patients mostly received regional anesthesia. Supplemental oxygen by facemask was given to 88.5% of patients who had received regional anesthesia. All patients of carcinoma buccal mucosa and gastrointestinal malignancies received brachytherapy under general anesthesia. Airway devices used for controlled

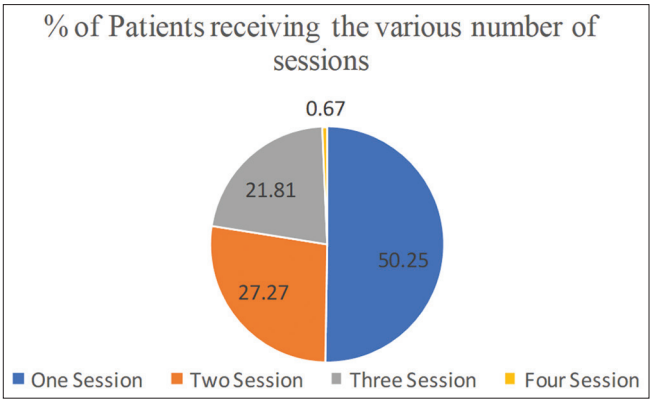

Figure 1: Number of brachytherapy sessions received

Table 1: Distribution of patients according to age

Age group (years)	No. of Patients (%)
20-40	230 (19.30)
40-60	727 (60.99)
>60	235 (19.71)

Table 2: ASA physical status of the patient according to diagnosis

	Number of patients (%)				
ASA physical status	**Carcinoma Cervix**	**Carcinoma Breast**	**Carcinoma buccal mucosa**	**Female genitourinary malignancies**	**Male genitourinary malignancies**
I	819 (80.4)	38 (60.30	23 (67.6)	19 (67.8)	24 (58.5)
II	185 (18.2)	23 (36.5)	8 (23.5)	7 (25)	14 (34.2)
III	15 (1.4)	2 (3.2)	3 (8.9)	2 (7.2)	3 (7.3)
Total	1019 (100)	63 (100)	34 (100)	28 (100)	41 (100)

Table 3: Distribution of comorbidities according to diagnosis

	Number of patients (%)				
Comorbidities	**Ca Cervix**	**Ca Breast**	**Ca buccal mucosa**	**Female genitourinary malignancies**	**Male genitourinary malignancies**
Hypertension	84 (8.24)	17 (26.91)	2 (5.9)	3 (10.71)	9 (21.95)
Diabetes Mellitus	71 (6.97)	9 (14.30)	0	2 (7.14)	3 (7.31)
Hypothyroid	16 (1.57)	4 (6.40)	0	0	1 (2.44)
Anaemia	15 (1.47)	0	0	0	0
Pulmonary Tuberculosis	5 (0.49)	0	0	0	0
Coronary artery disease & RHD	7 (0.68)	1 (1.62)	0	0	1 (2.44)
COPD	0	0	1 (2.95)	0	0
Epilepsy	2 (0.2)	0	0	0	1 (2.44)
Total	200 (19.62)	31 (49.22)	3 (8.85)	5 (17.85)	15 (36.57)

Table 4: Anaesthetic technique for brachytherapy

Anesthesia techniques	**Ca Cervix *n* (%)**	**Ca Breast *n* (%)**	**Male genitourinary malignancies *n* (%)**	**Female genitourinary malignancies *n* (%)**
Subarachnoid block (SAB)	947 (92.9)	0	12 (29.27)	14 (50)
Combine spinal epidural (CSE)	18 (1.76)	0	21 (51.22)	14 (50)
Caudal block	3 (0.3)	0	0	0
General anesthesia (GA)	33 (3.28)	51 (80.95)	8 (19.51)	0
IV Sedation	18 (1.76)	0	0	0
GA with Erector Spinae Plane block	0	3 (4.75)	0	0
GA with Serratus Anterior Plane block	0	9 (14.3)	0	0
Total	1019	63	41	28

ventilation in patients who received general anesthesia are given in Figure 2.

Regional anesthesia with 0.5% hyperbaric bupivacaine was given in 86.57% patients. The rest of the patients received combined spinal epidural with isobaric bupivacaine. Most patients received 0.5% concentration of bupivacaine with 0.29% received 0.375%. The dose of local anesthetic used for SAB was less than 1.2 ml in 40.50% (the sacral level of sensory block was differentiated from the lower lumbar level by the presence of sensations over the dorsum of the foot), 1.3 to 2.0 ml in 43.70% and >2 ml in 15.79% of patients. The level of sensory block achieved is given in Figure 3.

General anesthesia was the modality of choice in 8.7% of patients while conscious sedation was used in 1.5% of patients. The drugs used for GA and IV sedation are given in Table 5. Seventy eight percent of patients had received opioids. IV fentanyl was used in GA while for neuraxial block; fentanyl was used as an additive to the local anesthetic.

Twenty-two patients (1.85%) had hypotension, 13 (1.09%) patients had tachycardia under anesthesia while, 11 (0.92%) patients had headaches in the postoperative period. Only 5 patients had a bloody tap, 6 patients had inadequate block, 4 patients had arrhythmia, 2 had bronchospasm and 2 had high spinal blocks in the intraoperative period. Five patients had also reported shivering in the postoperative period.

Discussion

Brachytherapy is a short duration procedure involving multiple sessions requiring anesthesia along with the requirements of early transportation post procedure, adequate pain relief, and due precautions about the patient's medical conditions. We found 77.94% of patients to be ASA I, 19.97% being

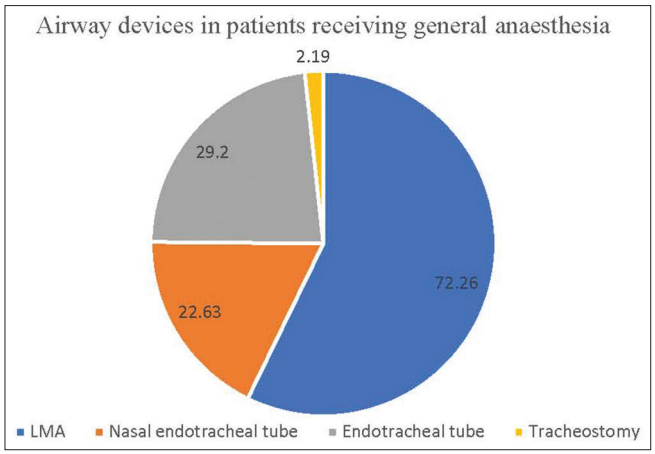

Figure 2: Types of airway devices used in patients receiving general anesthesia

Table 5: The type of drugs used for general anesthesia and IV sedation

Drugs	No. of patients received (%)
Propofol with atracurium and fentanyl	111 (9.31)
Propofol with vecuronium and fentanyl	29 (2.43)
Propofol with fentanyl and midazolam	18 (1.51)
Dexmedetomidine with fentanyl	2 (0.17)

ASA II, and only 2.10% of patients were categorized as ASA III. In contrast, J. Benrath reported that most patients were ASA II with around one-third found ASA III or IV. In the patient population recruited 40% of the patients were old age (age >60). We found that 39.7% of patients of carcinoma breast and 41.5% of male genitourinary malignancies were ASA II/III. The semi-emergent nature of the procedure leads to almost not much time for optimization, geriatric patients with added comorbidities require close monitoring even in the postoperative period to minimize any chances of complications.

Comorbidities are more commonly seen in older breast cancer patients.[4,5] Ismail *et al.* in their study on the effect of neuraxial anesthesia on tumor progression in patients receiving brachytherapy for cervical cancer reported that most patients belonged to ASA II.[6]

The duration of the procedure was variable. It is less in carcinoma cervix (15-30 min) and more in the prostate carcinoma buccal mucosa, and breast cancer. The variability in the duration of the procedure has a bearing on the anesthesia technique and drugs used which should be curtailed to ensure an early painless recovery and safe transportation.

We have observed that the most common cancer was carcinoma cervix for which brachytherapy was indicated. Majority of the carcinoma cervix patients present in the middle age between

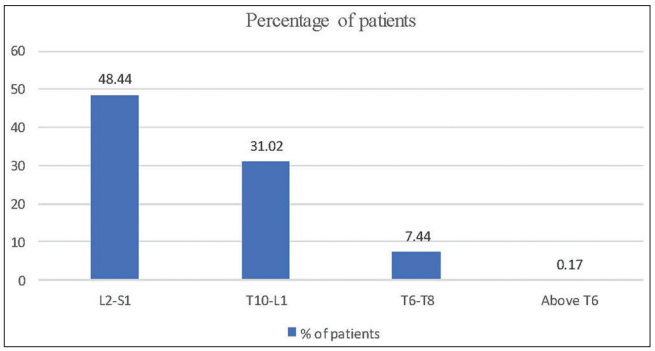

Figure 3: Level of Sensory block achieved in patients receiving neuraxial block

40 and 60 years. The high burden of carcinoma cervix in India and other south Asian countries is due to poor to moderate living standards and lack of screening.[7] In our setup, only 5.12% of patients received brachytherapy for carcinoma breast.

The use of brachytherapy for treatment has been discussed in terms of morbidity related to the treatment and the availability of alternative methods of treatment. The modality of choice must be based on the success rates, the complication/side effects and disadvantages that occur after treatment. Although head and neck cancers rank among the top cancers in terms of incidence, but in our study only 2.85% of head and neck cancer patients received brachytherapy. Brachytherapy in head and neck cancers is associated with a high incidence of osteoradionecrosis (4.5%–20%)[8,9] This could be the reason for the lesser use of brachytherapy in these patients. J Benrath *et al.* studied patients undergoing brachytherapy in Vienna and reported that most of the patients had breast cancer (70.1%), with a smaller proportion having female genital organ tumors (16.8%) and prostate cancer (3.9%).[2] The commonest indication for treatment was breast carcinoma so most patients (56.7%) underwent a single treatment.

In our study, 50% of patients received a single session of treatment whereas 21.81% received three sessions and a very few received four sessions also. This correlates to the multiple session recommended for the treatment of carcinoma cervix. These patients incur huge expenses due to long distance traveling and so they stay near to the hospital. Often these poor patients drop out of therapy as soon as they start feeling better. This may be the reason that only 21.81% of patients completed three sessions.

We also found the preferred use of regional anesthesia for pelvic brachytherapy. Neuraxial anesthesia is better as it reduces the requirement of systemic opioids and other anesthetic drugs. Approximately 95% of carcinoma cervix

patients were done under regional anesthesia while only 5% of patients required GA/monitored anesthesia care with sedation. A lower dose of hyperbaric bupivacaine 0.5% (1-1.5 ml) provided adequate immobility and painless conditions for the procedure along with ensuring an early safe transportation. Use of anesthesia for brachytherapy for even short duration brachytherapy as in carcinoma cervix has surgical implications as correct positioning of the implants facilitated by immobility due to anesthesia help provide high radiation doses to the tumor along with preventing damage to the surrounding normal tissue. This leads to an overall decrease in the long-term morbidity of the patient post-procedure. Only a few patients received caudal block or IV sedation for the procedure. Regional anesthesia provides adequate analgesia and immobilization. A recent meta-analysis also suggests that neuraxial anesthesia should be preferred for gynecologic brachytherapy as it provides improved pain control, decreased opioid consumption along with no increased risk of anesthesia complications when compared to other techniques.[10] It results in a high degree of patients' satisfaction. Benrath *et al*. had used single shot spinal anesthesia in 30% patients, spinal catheters 53%. CSE used in 7% of patients and only epidural catheters in 10% of cases.

Petereit DG *et al*. have reported the use of sedation in 98% of cases.[11] In our setup, we found it convenient and less risky to transfer patients who have received regional anesthesia to the radiotherapy suite as compared to those subjected to general anesthesia. Also, the beneficial effects of prolonged analgesia with regional anesthesia are more comforting for the patients. Roessler *et al*. reviewed brachytherapy anesthesia and suggested that spinal anesthesia can be preferably used as an anesthetic modality for pelvic malignancies.[12]

The level of sensory block achieved was sacral in 48.44%. The upper level of anesthesia was below T10 in 79.46% patients. Despite a lower sensory block achieved in most patients, there was no requirement of additional analgesia. The possible explanation may be that cervix and upper vagina are innervated by pelvic splanchnic nerves of S2-4 which are blocked with a low dose of local anesthetic. In patients given lower local anesthetic doses, fentanyl was used as an additive in most of the cases. Systemic opioid in the form of IV fentanyl was used in a small fraction of patients. The lower level of the block was aimed to avoid side effects during the shifting of the patient to the brachytherapy suite where specialized staff was lacking. All patients received paracetamol 1 gm before the start of the procedure. The use of NSAIDS is known to ease the central abdominal pain which might occur in some patients and cause discomfort.

The level of regional anesthesia achieved in Benrath study was T3-T6 in 29%, T7-T10 in 61% and below T10 in only 10%. They have used a higher volume of local anesthetic in the neuraxial block and avoided additive like morphine or fentanyl. We have used a lower dose of the local anesthetic in the neuraxial block for pelvic brachytherapy as it suits the distant location of our brachytherapy suite in terms of safety. We managed the patient`s pain with multimodal analgesia.

Only 10.2% of our patients received GA as patients receiving brachytherapy for the upper body were lower in number. The majority of breast cancer patients were done under GA; some of them were supplemented with serratus anterior or erector spinae block for analgesia. General anesthesia was given using IV anesthetic drugs like fentanyl, propofol, and atracurium with the addition of regional block wherever feasible to decrease the dose of opioids. TIVA is preferred over inhalational anesthesia considering that propofol preserves the immune function and has less risk in causing cancer recurrence.[13] Sedation was used in a very few patients using midazolam, low doses of propofol or dexmedetomidine. Carcinoma cervix and prostate cancer patients must lie still during prolonged treatment as movement may cause displacement of the applicator. This may lead to underdosing or overdosing. This prolonged stillness in the geriatric patient may cause stiffness of hip joints.

The limitation of our study is that since the patient`s information is collected from the hospital recorded data and lacks long term side effects and survival time. As anesthetic technique can have long term effects on individuals, so long term follow up could have added more information.

Conclusion

Neuraxial anesthesia should be preferred for pelvic malignancies. For patients requiring general anesthesia, TIVA can be considered a preferred modality with the use of a regional block wherever feasible.

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Conflicts of interest
There are no conflicts of interest.

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