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ORIGINAL ARTICLE

Dexmedetomidine: an alternative for epidural anesthesia in tension-free vaginal-tape surgery

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Abstract
Purpose Anesthetic management of tension-free vaginal-tape (TVT) procedures is sometimes difficult to deal with, especially when surgeons request a cough test. Dexmedetomidine has unique sedative and analgesic properties while having minimal respiratory effects, making it suitable for perioperative use in monitored anesthesia care. We aimed to compare dexmedetomidine and epidural anesthesia in TVT patients.
Methods Forty-nine women [American Society of Anesthesiologists (ASA 1–3)] with genuine stress incontinence confirmed by preoperative bladder function studies were included in this double-blind, randomized study. The patients were randomly assigned to one of two groups: group D received 0.5 μg/kg dexmedetomidine IV applied as bolus over 10 min and continued with 0.5 μg/kg/h infusion, and local anesthesia (lidocaine 2% with epinephrine) performed by the surgeon. Group E received epidural anesthesia with 15 ml of 0.25% bupivacaine + 100 μg fentanyl. Patients were monitored every 5 min for mean arterial pressure (MAP), heart rate (HR), peripheral oxygen saturation, respiratory rate, sedation, and intraoperative and postoperative pain. Ability to cough was also evaluated by the surgeon.
Results There was no difference in ability to cough, and this was evaluated by the surgeon as adequate, and there was no difference in scores between groups. Significant decreases in MAP and HR were observed 10 min after the start of surgery in group D compared with group E, and they were significantly decreased until first and second postoperative hours, respectively ($p < 0.05$). None of the patients had respiratory rate decrease or apnea. Side effects encountered postoperatively were similar.
Conclusion Dexmedetomidine can be an alternative to epidural anesthesia in TVT procedure requiring cough test.

Keywords Dexmedetomidine · Epidural · Tension-free vaginal tape

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Introduction

The estimated prevalence of urinary incontinence among women living in Europe is 35%, of whom urodynamic stress incontinence (USI) is a major cause, accounting for approximately 50% of cases [1]. Whereas many therapies are available for USI, surgeons have been using minimally invasive surgical sling methods, with excellent results. Tension-free vaginal tape (TVT) is a minimal-access surgical sling procedure for treating USI in women. TVT has a highest cure rate of any other conventional anti-incontinence procedures; this minimally invasive surgery is performed as an ambulatory procedure and is associated with a

very low incidence of intra- or postoperative complications [2, 3]. The procedure can be performed under general, regional, or spinal anesthesia [4, 5]. Anesthesia management of these procedures is sometimes difficult to deal with, especially when surgeons request a cough test. The patient must be responsive enough to cough when required and at the same time comfortable and pain free while the surgeon is doing the procedure. Our first experiences with this technique was using general anesthesia and later spinal anesthesia. Both had number of problems related to anesthesia types, especially when a cough test was needed. Later, epidural anesthesia gained popularity and seemed to be the right choice, as it allowed patients to cough and be pain free at the same time. An optimal regimen would provide complete analgesia and sedation during tape insertion and an orientated patient able to cooperate with incontinence testing [6].

Dexmedetomidine is a highly selective α_2 adrenergic receptor agonist initially used for short-term sedation of mechanically ventilated patients in intensive care units [7]. Dexmedetomidine has unique sedative and analgesic properties while having minimal respiratory effects, making it more suitable for perioperative use in monitored anesthesia care. Having a distribution half-life of approximately 8 min and a terminal half-life of 3.5 h makes it also suitable for ambulatory-setting patients [8, 9].

We aimed to compare the role of dexmedetomidine and epidural anesthesia in TVT patients by evaluating sedation, analgesia, hemodynamic, and respiratory variables, patient and surgeon satisfaction, and side effects.

Materials and methods

After obtaining the approval of the Institutional Ethics Committee (Gülhane Military Medical Academy, Haydarpaşa Training Hospital) and written informed consent, patients undergoing elective TVT surgery were enrolled in this study. Fifty women American Society of Anesthesiologists (ASA 1–3)] with genuine stress incontinence confirmed by preoperative bladder function studies were included. Exclusion criteria were known allergy to any of the study medications, obesity (body mass index > 35 kg/m^2), contraindications to the use of any anesthetic drugs, renal insufficiency, and chronic use of medical therapy that might influence the outcome of the study (preoperative opioids or α_2 agonists) or drug abuse.

After the patients had been taken to the operating room, crystalloid infusion was started through a 20-gauge IV cannula inserted in an appropriate antecubital vein, and the mean arterial pressure (MAP), heart rate (HR), and peripheral oxygen saturation (SpO_2) were monitored (Cato PM 8040; Dräger, Lübeck, Germany). All patients received 4 l/min O_2 through nasal cannulae. The patients were randomly assigned to one of two treatment groups using a computer-generated table; group D (dexmedetomidine) received 0.5 μg/kg IV dexmedetomidine applied as bolus in 10 min and continued with 0.5 μg/kg/h infusion and local anesthesia using 15 ml of 2% lidocaine with 1:200,000 epinephrine performed by the surgeon. Group E (epidural) received epidural anesthesia. Patients were placed in the left lateral position, after which the epidural catheter was placed at the L3–L4 interspaces and left in situ 3–4 cm inside the space. A test dose of 3 ml of bupivacaine 0.5% followed by 15 ml 0.25% bupivacaine + 100 μg fentanyl was given, analgesia levels were tested for adequacy (reaching T-10 level), and surgery was started. If analgesia levels were not adequate, 5 ml of 0.25% bupivacaine was repeated for a maximum of two times and in case of insufficient analgesia, epidural was considered failed, and general anesthesia was given.

Patients were monitored throughout the procedure, and values were recorded during surgery every 5 min for MAP, HR, SpO_2, respiratory rate, and sedation levels according to Ramsey sedation score. Intraoperative pain assessment was made on the basis of the verbal rating scale (VRS: 0 = no pain, 10 = worst pain imaginable), and postoperative pain assessment was made on a visual analog scale (VAS) using a 100-mm linear scale (VAS: 0 = no pain, 100 = worst pain imaginable). VAS and VRS were explained to the patients during the preoperative visit. Patients were asked during surgery every 5 min for pain assessment according to the VRS. If it was >4, or on the patient's request, 0.5–1 μg/kg of fentanyl was administered. The total fentanyl consumption by each patient was determined and noted. Aldrete scores were evaluated every 5 min in the postanesthesia care unit (PACU) for the first 15 min. A blinded research assistant at 30 min and 1, 2, 4, and 6 h recorded postoperative pain and sedation scores after completion of surgery. Additional analgesic need within 6 h and the time to first analgesic need were determined according to VAS. When VAS values were >40, diclofenac 75 mg IM was administered and noted. The first analgesic need was regarded as the time elapsed between the end of surgery and the administration of an additional analgesic.

Hypotension (MAP $< 35\%$ from baseline for 60 s) was treated with increasing rate of infusion of crystalloids; HR < 50 beats per minute was treated with atropine 20 μg/kg IV and noted as a complication. Respiratory depression (respiratory rate < 8 for longer one 1 min, $SpO_2 < 90$ lasting longer than 30 s, apnea longer than 20 s) was primarily treated by stopping the infusion drugs if they had been continued, verbal or tactile stimulation was used, and respiratory ventilation was performed and noted as a complication. Patients were asked by the surgeon

intraoperatively to cough, and ability to cough was evaluated as present (adequate) or not. The surgeon was asked also to score the ability to cough: 0 = unable to cough; 10 = strong cough.

Patients were questioned for the first 2 h in the PACU. They were later questioned on the ward for 6 h by a research assistant, who was not involved in the study, about the occurrence of any side effects, such as nausea, vomiting, diarrhea, epigastric discomfort, dizziness, peripheral edema, or headache, and these were recorded if present. On patient request or if nausea and vomiting occurred, ondansetron 4 mg IV was given. Patient and surgeon satisfaction with the anesthesia technique was assessed using a VAS: 0 = no satisfaction and 100 = mostly satisfied.

Data were expressed as mean (SD), numbers (%), or median (min–max). Unless otherwise specified, differences were assessed by *t* tests for continuous variables and by the chi-square test for categorical data. VRS and VAS were compared using analysis of variance (ANOVA) tests. Baseline patient data, consumptions of fentanyl and diclofenac, and initial analgesic requirement time between groups were compared with the unpaired Student's *t* test. The incidence of side effects was analyzed with the chi-square test. Analyses were performed with SPSS for Windows Version 11.5 (Chicago, IL, USA).

Results

Fifty-six patients were assessed for study eligibility (six failed to meet the inclusion criteria). The remaining 50 consenting patients who fulfilled the entry criteria were enrolled. One patient was unable to complete the entire study because of a failed epidural and was given general anesthesia; her data were excluded from the final analysis.

The two groups were comparable with respect to age, body weight, height, ASA physical status, and duration of surgery (Table 1). The intraoperative VRS and postoperative VAS pain scores were similar between groups (Table 2). When Ramsey sedation scores were compared, there was significant difference starting from 20 min intraoperatively till the postoperative 2 h ($p < 0.05$) (Table 2). Total fentanyl consumption, postoperative diclofenac consumption, first analgesic requirement time, patient satisfaction, and surgeon satisfaction with the technique were comparable (Table 3). Although when Aldrete scores were compared, group D at 5 min had lower scores compared with group E, measurements were similar (Table 3). All patients were able to cough, and this was evaluated by the surgeon as adequate. There was no difference in scores between groups (Table 3).

Table 1 Patient characteristics, operation time, and ASA status

	Group E ($n = 24$)	Group D ($n = 25$)
Age (years)	52 ± 8	55 ± 7
Weight (kg)	67 ± 9	69 ± 5
Height (cm)	162.3 ± 5.2	163.4 ± 3.8
Duration of surgery (min)	47 ± 15	50 ± 9
ASA-PS (I/II/III) (*n*)	16/8/0	18/5/2

Values are shown as number (*n*) of patients and mean ± standard deviation (SD). No significant differences were found between the two groups

ASA-PS American Society of Anesthesiologists physical status

Table 2 Intraoperative and postoperative pain scores

Intraoperative (min)	Group E ($n = 24$)		Group D ($n = 25$)	
	VRS	Ramsey sedation score	VRS	Ramsey sedation score
5	0 (0–3)	2 (1–2)	0 (0–2)	2 (1–2)
10	0 (0–6)	2 (1–2)	0 (0–2)	2 (1–3)
15	0 (0–5)	2 (1–3)	0 (0–2)	2 (1–3)
20	0 (0–3)	2 (1–2)	0 (0–3)	3 (2–4)*
30	0 (0–5)	2 (1–3)	2 (0–4)	4 (2–4)*
40	0 (0–5)	2 (1–3)	2 (0–3)	4 (2–4)*
50	0.5 (0–2)	2 (1–3)	2 (0–3)	4 (2–4)*
Postoperative (h)	**Group E ($n = 24$)**		**Group D ($n = 25$)**	
	VAS	Ramsey sedation score	VAS	Ramsey sedation score
1	0 (0–50)	2 (1–2)	10 (0–60)	3 (2–4)*
2	0 (0–40)	2 (1–2)	10 (0–60)	3 (2–3)*
4	10 (0–60)	2 (2)	10 (0–60)	2 (2)
6	5 (0–30)	2 (2)	20 (0–70)	2 (2)

Values are median (min–max)

* $p < 0.05$

Table 3 Intraoperative and postoperative analgesic consumption, initial time of analgesic requirement, Aldrete scores, patient and surgeon satisfaction

	Group E ($n = 24$)	Group D ($n = 25$)
Intraoperative fentanyl consumption (μg)	19 ± 31	24 ± 29
Postoperative diclofenac consumption (mg)	34 ± 44	57 ± 73
Initial analgesic requirement time (min)	61 ± 86	42 ± 66
Aldrete score (min)		
5	8 (8–10)	8 (6–10)*
10	8 (8–10)	8 (8–10)
15	8 (8–10)	8 (8–10)
Patient satisfaction	80 (60–100)	90 (60–100)
Surgeon satisfaction with the cough	100 (60–100)	90 (70–100)

Values are mean ± standard deviation (SD) or median (min–max)

* $p < 0.05$

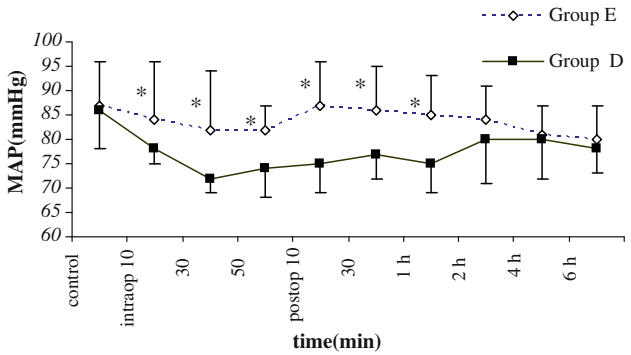

Fig. 1 Intraoperative and postoperative mean arterial pressure (MAP). *$p < 0.05$

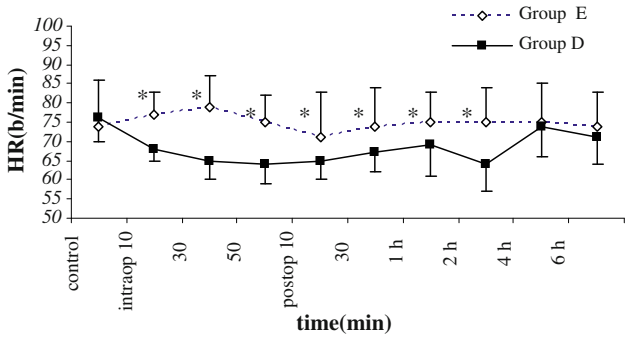

Fig. 2 Intraoperative and postoperative heart rate (HR). *$p < 0.05$

There was no difference in respiratory rate and SpO_2 between the groups (not reported), but significant decreases in MAP and HR were observed 10 min after the start of surgery in group D compared with group E, and they were significantly decreased until first and second postoperative hours, respectively ($p < 0.05$) (Figs. 1, 2).

None of the patients had significant respiratory rate decrease, $SpO_2 < 90$ lasting longer than 30 s, or apnea longer than 20 s requiring treatment. Side effects encountered postoperatively were dizziness, headache, and nausea and vomiting. There was no difference between groups regarding side effects. Ondansetron usage was also similar between groups (Table 4).

Table 4 Intraoperative and postoperative side effects

	Group E ($n = 24$)	Group D ($n = 25$)
Intraoperative side effects (n)		
Bradycardia	1	1
Hypotension	2	0
Antiemetic use	2	1
Postoperative side effects (n)		
Nausea	1	2
Vomiting	2	3
Antiemetic use	4	6
Dizziness	1	2
Weakness	0	1
Headache	0	1

There was no difference between groups

Discussion

Epidural anesthesia and dexmedetomidine infusion plus local anesthesia each produced comparable effects on ability to cough and respond to the surgeon intraoperatively. Patient and surgeon satisfaction was similar with both techniques in this challenging setting. Dexmedetomidine can be an alternative to epidural anesthesia in TVT surgery.

TVT is a surgical treatment for genuine USI. At the beginning, TVT was placed under local anesthesia to allow more precise placement of the tape by using an intraoperative cough test [3, 10], which is a useful technique during the procedure. The surgeon may be able to adjust the tape more precisely without compromising the success of the surgery or increasing the rate of urinary retention [10, 11]. A poor-quality intraoperative cough test at the time of TVT procedure is a predictor of immediate postoperative urinary retention [12]. Regimens for TVT procedures must avoid respiratory depression but allow the surgeon the assurance of performing blocks or asking the patient questions about the ongoing operation and requesting a cough test, while hypertension must be controlled in order to have a

bloodless operative field. All these factors present a challenge for the anesthesiologist. Selecting the ideal regimen to cover all aspects includes the use of general or spinal anesthesia, or monitored anesthesia care is still debated [4]. Some studies in the literature with different regimens also include propofol, but our initial experience with propofol was not very promising. We had patients either too deeply anesthetized (unresponsive) or not deeply enough, with little satisfaction from the surgeon, which lead us to this study using dexmedetomidine as an alternative.

Dexmedetomidine has sedative and analgesic properties [8, 13], with minimal ventilatory effects, making it more suitable for the perioperative use in monitored anesthesia care when compared with propofol [14]. This α_2-adrenergic receptor agonist offers a unique "cooperative sedation," anxiolysis, and analgesia, with no respiratory depression [14, 15]. Dexmedetomidine is usually administered as a continuous infusion, which makes it easy to titrate, and it is associated with a predictable and stable hemodynamic response [6, 7]. However, care and precautions should be taken when it is administered to patients who are volume-depleted, vasoconstricted, or have severe heart block [14], as dexmedetomidine can cause severe hypotension and bradycardia. Our results also demonstrated a similar effect: patients receiving dexmedetomidine had lower MAP and HR compared with the epidural group. Hypotension is a common side effect and occurs because of the vasodilatory effects of the central α_2 receptors [14, 16, 17]. In our study, we observed no unresponsive patient with the infusion dose used. Patients were observed to be arousable and alert when stimulated; however, it is possible in certain clinical scenarios where sedatives are combined that patients can become unresponsive. Dexmedetomidine dosing should be individualized and titrated to the desired clinical effect, and precautions related to airway management and hemodynamic changes should be available.

Effects of different anesthetic techniques were evaluated in different studies. Local anesthetic infiltration does not alter urethral function, allows coughing to mimic nonanesthetic conditions, and is ideal for surgery. Using this technique was found to have high long-term cure rates with low complications such as voiding dysfunction [18]. But this is not well tolerated by the patients, who require sedation or general anesthesia. In another study, the effect of spinal anesthesia on urethral function and cough pressure was evaluated; coughing under spinal anesthesia may not be as efficient as coughing without a spinal, and this resulted in cough-stress test being unable to reproduce preanesthetic conditions in women with a spinal anesthesia [19]. Similar to spinal anesthesia, epidural anesthesia can also cause weakness in cough pressures; however in our study, we saw no difference between the dexmedetomidine and epidural anesthesia groups.

Although we have not done an official cost analysis, simply compared the amounts of dexmedetomidine and epidural used, the average wholesale price for dexmedetomidine is approximately $25.00 per vial (in Turkey) compared with $20 per epidural set. The dexmedetomidine infusion seems to be little more expensive, but still this is not an official cost analysis because other costs related to each treatment options were not included (e.g., infusion pump set for dexmedetomidine or cost of local anesthetic for epidural). Definitive conclusion regarding cost needs to be answered in future studies.

There are several limitations to this study. First, we did not have the long-term outcomes of the two techniques, which offers better comparisons. We also used no pressure measurement to determine cough and urethral retroresistant pressure. Another limitation is that the doses for both groups were selected arbitrary according to previous use in different patient population.

There are very few published descriptions of sedation for TVT insertion. This is the first clinical study showing the use of dexmedetomidine in TVT where there is a constant challenge for the anesthesiologist. Dexmedetomidine infusion was successful, with no major significant side effects, and comparable with epidural anesthesia. In conclusion, dexmedetomidine can be an alternative to other drug regimens and techniques in the TVT procedure.

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