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Efficacy of Ultrasound-Guided Continuous Transversus Abdominis Plane Block versus Continuous Epidural Analgesia in Postoperative Pain Management Following Abdominal Surgery

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Abstract: ***Postoperative pain increases morbidity and acts as a hindrance to early recovery. In this study, we have compared Epidural analgesia and Transversus abdominis plane block (TAPB) Primary Objective Comparison of postoperative opioid requirement in first 24 hours following surgery in patients given continuous TAPB and continuous epidural analgesia measured as the proportion of patients who used more than 2µg/kg of fentanyl during the first 24 h on arrival at the recovery ward METHODS 92 patients with ASA status I and II, aged 18– 68 years, posted for abdominal surgeries at Medical College, Trivandrum were enrolled in this observational study by consecutive sampling. After routine pre-anaesthetic check-up, all patients had General Anaesthesia standardized with Propofol, Isoflurane, Fentanyl titrated to effect and Vecuronium. Preoperatively the EA patients had an epidural catheter placed at appropriate level and at the end of the procedure, a bolus of 6 to 8 ml of Bupivacaine 0.25% + 50µg fentanyl. The data was entered into a master chart using Microsoft excel and analysed using statistical software CONCLUSION From our study, we can conclude that continuous epidural infusion provides better postoperative analgesia when compared to continuous TAP infusion. Fentanyl consumption was significantly lower in the epidural group compared to the TAP group. Epidural analgesia also provided lesser postoperative pain scores at rest and movement.***

Keywords: TAP block, epidural analgesia, Fentanyl, Bupivacaine, Postoperative analgesia

1.Background and Review of Literature

Pain management after abdominal surgeries is a crucial factor determining the overall postoperative outcome of the patient. Multimodal analgesia is preferred to a single technique. Modalities for pain control include opioids, NSAIDs, I V patient controlled analgesia, neuraxial blockade and peripheral nerve blocks. The best-accepted analgesic approach is continuous epidural analgesia (11), but it comes with its share of problems including hemodynamic instability, motor weakness, and limited application in anticoagulated patients. Peripheral nerve block techniques have gained popularity over the years. Abdominal field blocks have been around for a long time and have been extensively used as they are mostly technically unchallenging. The Transversus Abdominis Plane (TAP) infiltration is an alternative approach to providing postoperative analgesia to the anterior abdominal wall. TAP infiltration is relatively easy to perform, generally safe, and can be performed in patients who are anti-coagulated.

Epidural Block

Neuraxial blockade has a wide range of clinical applications for surgery, obstetrics, acute postoperative pain management, and chronic pain relief. Single-injection spinal or epidural anaesthesia with local anaesthetic is most commonly used for lower abdominal surgeries. Continuous catheter-based epidural infusions of dilute local anaesthetics and opioids are used for obstetric labour analgesia and postoperative pain relief after major surgery (e.g., thoracic, abdominal, lower limb) to provide analgesia for days. (12) More recently, however, the goals of epidural analgesia have shifted from reduction of morbidity and mortality in high-risk patients to facilitation of fast-track recovery in otherwise healthy patients undergoing various types of elective inpatient surgical procedures (13).

2.Anatomy of Epidural Space

Extensive studies on the anatomy of epidural space allowed the successful conduct and thus popularity of this type of neuraxial blockade. Everything outside the dural sac but within the vertebral canal can be considered to constitute the epidural space. Its outer boundaries are thus the walls of the vertebral canal, including the vertebral bodies and discs anteriorly, pedicles laterally, laminae and ligamenta flava posteriorly. Though often considered as a potential space, the epidural space has contents, specifically fat, vessels, and nerves. The epidural fat provides a padding effect for the nerves. The cleft-like space between the epidural fat and canal wall allows passage of catheters and injected fluid.

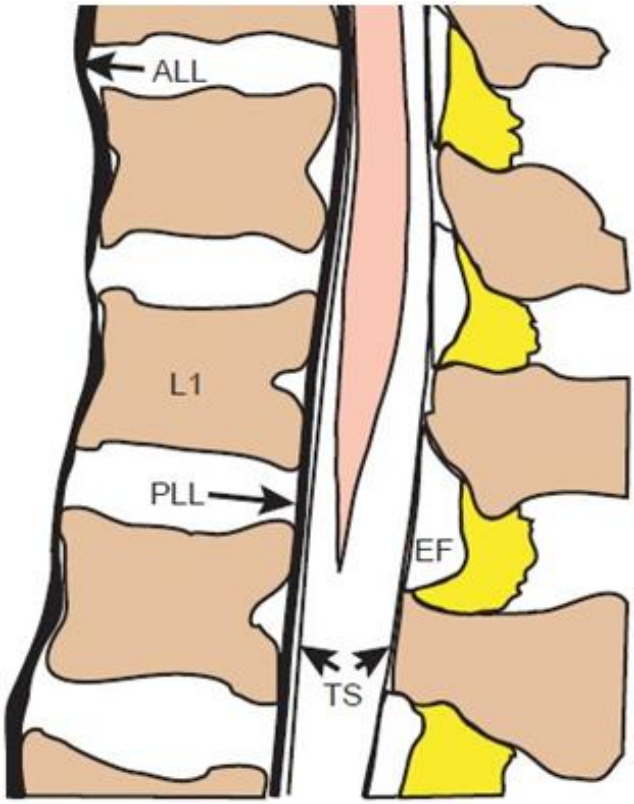


Figure 1: Diagram of the lower thoracic and upper lumbar vertebral column, including vertebrae T9 through L2 and parts of the eighth thoracic and third lumbar vertebrae. ALL, anterior longitudinal ligament; EF, epidural fat; PLL, posterior longitudinal ligament; TS, thecal sac. Ligamentum flavum is yellow, bone is brown, the spinal cord is pink, and veins are blue

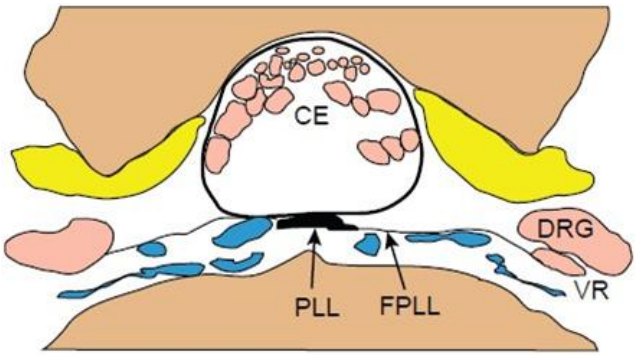


Figure 2: Diagram of a lumbar vertebra. CE, cauda equina; DRG, dorsal root ganglion; FPLL, Fascia of the poster longitudinal ligament; PLL, posterior longitudinal ligament; VR, ventral root. Ligamentum flavum is yellow, bone is brown, the spinal cord is pink, and veins are blue

Contents of the Epidural Space

Fat

The epidural space is filled with fatty areolar tissue. The amount of epidural fat varies in direct proportion to the amount of fat stored elsewhere in the body. The epidural fat is relatively vascular and appears to change to a denser consistency with aging. This change in consistency may account for the significant variations in required drug dosage in adults especially when utilizing the caudal approach to the epidural space. The epidural fat appears to perform two functions: (a) it serves as a shock absorber for the other contents of the epidural space as well as the dura and the contents of the dural sac; and (b) it serves as a depot for drugs injected into the cervical epidural space. This second function has direct clinical implications when choosing opioids for cervical epidural administration.

Epidural Veins

The epidural veins are concentrated primarily in the anterolateral portion of the epidural space. These veins are valveless and hence transmit both the intrathoracic and intra-abdominal pressures. As pressures in either of these body cavities increase because of Valsalva or compression of the inferior vena cava by the gravid uterus or tumour mass, the epidural veins distend and decrease the volume of the epidural space. This decrease in volume can directly affect the volume of drug needed to obtain a given level of neural blockade. Because this venous plexus serves the entire spinal column, it serves as a ready conduit for the spread of hematogenous infection.

Epidural Arteries

The arteries that supply the bony and ligamentous confines

of the cervical epidural space as well as the cervical spinal cord enter the cervical epidural space via two routes: the intervertebral foramina, and direct anastomoses from the intracranial portions of the vertebral arteries. There are significant anastomoses between the epidural arteries. The epidural arteries lie primarily in the lateral portions of the epidural space. Trauma to the epidural arteries can result in epidural hematoma formation and/or compromise of the blood supply of the spinal cord itself.

Lymphatics

The lymphatics of the epidural space are concentrated in the region of the dural roots where they remove foreign material from the subarachnoid and epidural space.

EPIDURAL ANAESTHESIA

It was the independent work of two French physician Jean-Anthanase sicard and Fernand cathelin that shown light into the epidural anaesthesia via caudal approach. Later the lumbar approach was demonstrated by the Spanish surgeon Fidel Pages Mirave. The two possibilities for identification of the epidural space the "loss of resistance" technique and the technique of the "hanging drop" were developed by Achille Mario Dogliotti, an Italian, and Alberto Gutierrez, an Argentinean physician, at the same time. In 1956 John J. Bonica published the paramedian approach to the epidural space. Introduction of indwelling epidural catheters and embracement epidural analgesia by parturient resulted in the wide popularity of this unique neuraxial blockade (14).

Conduct of Epidural Anaesthesia

Preparation

Patient preparation include consent, monitoring, and resuscitation equipment, intravenous access, and choosing the patient and drugs appropriately depending on comorbidities and the nature of surgery. Sterility is particularly more important than spinal anaesthesia because of indwelling catheter insertion. The extent of the surgical field must be understood so that the epidural may be inserted at the appropriate level-that is, the lumbar, low-, mid-, or high-thoracic, or less commonly, cervical. Commonly used needle for epidural puncture is the Tuohy needle. These needles are usually 16 to 18 g in size and have a 15-to 30-degree curved, blunt “Huber” tip designed to both reduce the risk of accidental dural puncture and guide the catheter cephalad.

The needle shaft is marked in 1-cm intervals so that depth of insertion can be identified. The catheter is made of a flexible, calibrated, durable, radiopaque plastic with either a single end hole or multiple side orifices near the tip. Multiple orifice catheters are superior due to more efficient local anaesthetic distribution, but carry a relatively high chance of inadvertent epidural vein cannulation. The method of identifying the epidural space must also be predetermined. Most practitioners use a loss-of resistance technique to either air or saline, rather than the hanging drop technique. An additional decision about the type of syringe (i.e., glass versus slow-resistance plastic and Luer-Lock versus friction hub) is required.

Position

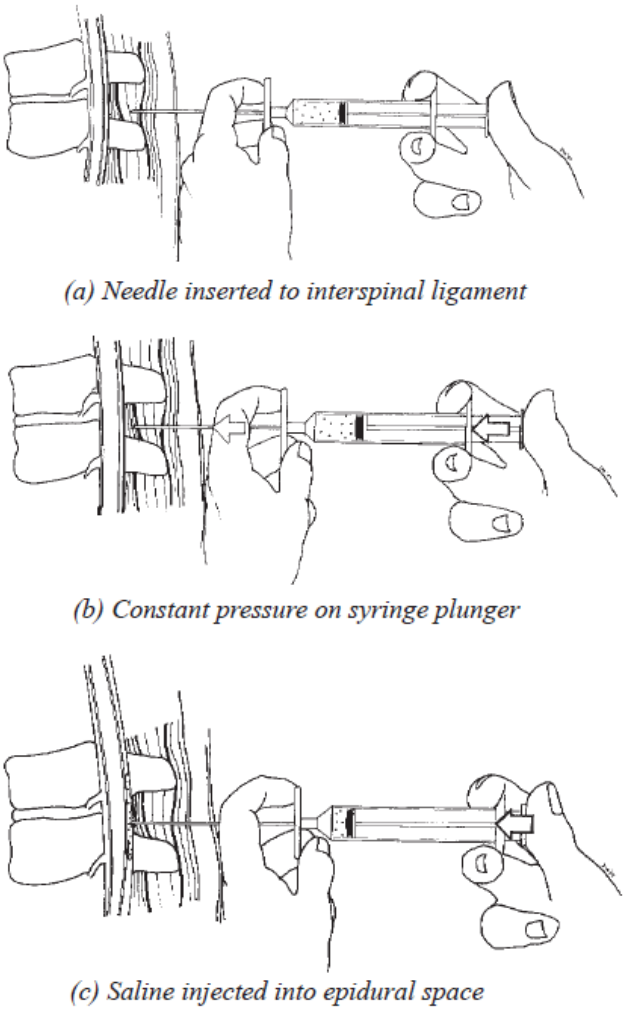
It can be done in both sitting and lateral decubitus position. Success rates are similar in both positions though sitting position offers a faster insertion time.

Projection and Puncture

The level of insertion depends on the surgery. After proper positioning, sterile skin preparation, and draping, the desired interspace is identified and a local anaesthetic skin wheal is raised at the point of needle insertion. Because epidural needles are relatively blunt, it is sometimes helpful to pierce the skin with a 18G hypodermic needle before inserting the epidural needle. For epidural anaesthesia using the midline approach, the epidural needle is inserted through the subcutaneous tissue and into the interspinous ligament. The interspinous ligament has a characteristic “gritty” feel, much like inserting a needle into a bag of sand. This is especially true of younger patients. If the interspinous ligament is not clearly identified, then one should be suspicious that the needle is not in the midline. After engaging the interspinous ligament, the needle is advanced slowly through it until an increase in resistance is felt. This increased resistance represents the ligamentum flavum. The epidural needle must now traverse the ligamentum flavum and stop within the epidural space before puncturing the spinal meninges. The epidural space is most commonly identified using the loss of resistance or hanging drop method.

Loss of Resistance method

Air or saline are the two most common non-compressible media used to detect a loss-of-resistance when identifying the epidural space. Each involves intermittent (for air) or constant (for saline) gentle pressure applied to the bulb of the syringe with the dominant thumb while the needle is advanced with the non-dominant hand. A combination of air and saline may also be used, incorporating 2 mL of saline and a small (0.25 mL) air bubble. Usually the ligamentum flavum is identified as a tougher structure with increased resistance, and when the epidural space is subsequently entered, the pressure applied to the syringe plunger allows the solution or air to flow without resistance into the epidural space. Fluid is said to be more sensitive than air in detecting epidural space and also reduces the chance of epidural vein cannulation.



(a) Needle inserted to interspinal ligament

(b) Constant pressure on syringe plunger

(c) Saline injected into epidural space

Figure 3: Loss of Resistance Technique

Hanging-drop technique

This technique is based on the presence of sub atmospheric pressure within the epidural space. After the needle is placed into the ligamentum flavum, a drop of solution such as saline is placed within the hub of the needle. When the needle is advanced into the epidural space, the solution should be "sucked in".However using negative-pressure methods are poorly reliable and only useful in the sitting position. The sub atmospheric pressure has been related to expansion of the epidural space as the needle pushes the dura away from the ligamentum flavum. The negative intrathoracic pressure may influence the pressure in the epidural space in the thoracic region and should be maximal during inspiration. But the timing of needle advancement to coincide with inspiration may be difficult.

When the epidural space is identified, the depth of the needle at the skin should be noted. The syringe can then be removed and a catheter gently threaded to approximately the 15-to 18-cm mark to ensure a sufficient length has entered the epidural space. The needle can then be carefully withdrawn, and the catheter is withdrawn to leave 4 to 6 cm in the space. Catheter space less than 4 cm in length in the epidural space may increase the risk of catheter dislodgement and inadequate analgesia, whereas threading more catheter may increase the likelihood of catheter malposition or complications.

Paramedian Approach

In mid to high thoracic regions where the high angulation of the spine makes midline approach problematic, paramedian has found to be beneficial. Here the needle is inserted 1 to 2 cm lateral to the inferior tip of the spinous process of the vertebra above the desires space. The needle is then advanced horizontally to meet the lamina and then redirected medially and cephalad to enter the epidural space. Before activating epidural blockade, a test dose of 2% lignocaine containing 10 to 15 mcg of adrenaline as vascular marker is injected to detect the presence of an inadvertent intravascular placement, using end points of an increase in heart rate of more than 10 beats / min or an increase in systolic blood pressure more than 15 mm Hg.

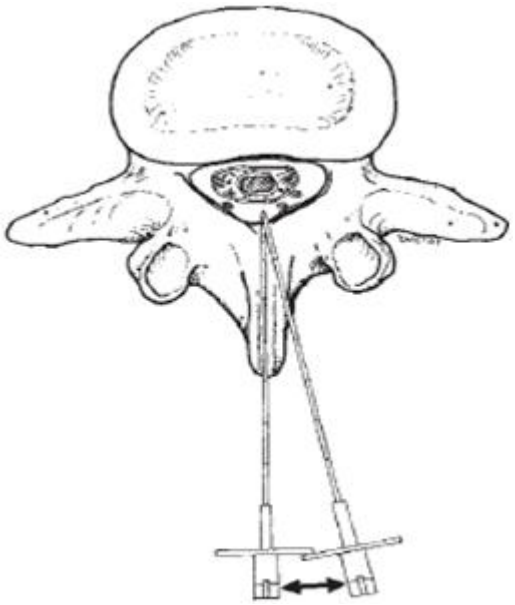


Figure 4: Median Vs Paramedian approach Physiological Effects of Epidural Blockade

The segmental nerves in the thoracic and lumbar region contain somatic sensory, motor and autonomic (sympathetic) nerve fibres. Sensory and autonomic fibres have a smaller diameter and are more easily blocked than larger, more rapidly-conducting motor fibres. The relationship between sensory and autonomic outflow is complex, but sympathetic block usually extends 1-2 levels higher than sensory block.

Effects on Organ Systems

Cardiovascular system

Vasodilatation of resistance and capacitance vessels occurs, causing relative hypovolemia and tachycardia, with a resultant drop in blood pressure. This is exacerbated by blockade of the sympathetic nerve supply to the adrenal glands, preventing the release of catecholamines. If blockade is as high as T2, sympathetic supply to the heart (T2-5) is also interrupted and may lead to bradycardia. The overall result may be inadequate perfusion of vital organs and measures are required to restore the blood pressure and cardiac output, such as fluid administration and the use of vasoconstrictors. Sympathetic outflow extends from T1 -L2 and blockade of nerve roots below this level, as with, for example, knee surgery, is less likely to cause significant sympathetic blockade, compared with procedures requiring blockade above the umbilicus.

Respiratory system

Usually unaffected unless blockade is high enough to affect intercostal muscle nerve supply (thoracic nerve roots) leading to reliance on diaphragmatic breathing alone. This is likely to cause distress to the patient, as they may feel unable to breathe adequately.

Gastrointestinal system

The blockade of sympathetic outflow (T5-L1) to the GI tract leads to predominance of parasympathetics (vagus and sacral parasympathetic outflow), leading to active peristalsis and relaxed sphincters, and a small, contracted gut, which enhances surgical access. Splenic enlargement (2-3 folds) occurs.

Endocrine system

Nerve supply to the adrenals is blocked leading to a reduction in the release of catecholamines.

Genitourinary tract

Urinary retention is a common problem with epidural anaesthesia. A severe drop in blood pressure may affect glomerular filtration in the kidney if sympathetic blockade extends high enough to cause significant vasodilatation. (15)

Problems in Epidural Blockade

1. **Inadequate blockade**: Commonly manifest as too low blockade at upper level or inadequate blockade at lower level, especially if the initial bolus dose of local anaesthetic is small. L5-S1 region is particularly difficult to block. If not already done; adding rapidly acting opioids like fentanyl will speed up the onset of blockade and extend the number of segments blocked.
2. **Missed segments**: Usually managed in the same way as inadequate blockade. If a segment is missed, turning the patient to that side can be tried. Epinephrine containing solutions are more effective in dealing with missed segments.
3. **Visceral pain during abdominal surgery**: Peritoneal stimulation during appendicectomy and during a difficult herniorrhaphy may produce abdominal pain, requiring blockade up to T5-T6. Hence local anaesthetics should be used within allowable dose to titrate blockade to this level. If there is a delay in onset, IV or epidural opioids or light general anaesthesia may be required.
4. **Inability to thread epidural catheter**: This often indicates that a false loss of resistance has occurred before reaching ligamentum flavum and the needle has halted superficial to ligamentum flavum. Injection of

local anaesthetic at this point will result in failure and should not be attempted. The ideal course of action would be to withdraw the needle and catheter together and repeat the procedure. A single shot of long acting local anaesthetic may be attempted if the anaesthetist is firmly convinced about the position of the needle tip and the planned surgical procedure is likely to be accomplished within the duration of the long acting local anaesthetic. However, this is usually not recommended because of the unpredictability of outcome

5. **Dural Puncture**: In case of an inadvertent dural puncture, it is feasible to convert to a subarachnoid block by maintaining the needle in position and injecting the appropriate dose of long acting local anaesthetic. If the anaesthesiologist wants to continue with the epidural blockade, another interspace (preferably upper) should be chosen and the catheter to be threaded upward. Bolus dose via needle is should not be done and only slow smaller doses are recommended through epidural catheter.
6. **Subarachnoid cannulation**: This may occur at the time of initial insertion of epidural needle or catheter. Incidence of subarachnoid cannulation vary from 0.2 to 0.7 % (16).Failure to recognize this complication can lead to total spinal anaesthesia if a bolus dose of local anaesthetic is injected. Epidural catheters can also penetrate dura later, having initially located in the epidural space. Hence it is recommended to give a test dose before each epidural top up.
7. **Systemic Toxicity of local anaesthetics**: Systemic toxicity with local anaesthetics is a complication that is unique to epidural and nerve block because of the high volume of drugs used and is rare with subarachnoid block because the dose of drug used is too low to cause systemic toxicity even if injected intravascularly. Both cardiovascular and neurological toxicity occur with epidural anaesthesia. Because the plasma concentrations of local anaesthetics required to cause serious cardiovascular toxicity is very high, this usually results from an inadvertent intravascular injection. However CNS toxicity may result from both intravascular injection and absorption from epidural space. An adequate test dose and incremental injection of local anaesthetics are the most important methods to prevent both CNS and cardiovascular toxicity during epidural anaesthesia.
8. **Epidural Hematoma:** It is a rare complication of epidural anaesthesia, seen more commonly in patients who are on anticoagulants. (17).If not recognized and evacuated early, bleeding within the epidural canal can cause ischemic compression of the spinal cord and lead to permanent neurological deficits. The risk factors of epidural hematoma include difficult or traumatic needle or catheter insertion, coagulopathy, elderly age and female gender (18). The features suggestive of a space occupying bleed in the vertebral canal include radicular pain, prolonged blockade longer than the expected duration of the neuraxial technique and bowel or bladder dysfunction and should promptly investigated with an MRI. Incidence of hematoma following epidural technique was found to be 0.07 per 10, 000 in a national wide audit by NHS United Kingdom (19).
9. **Cannulation of an epidural vein:** This complication is commonly seen in parturient due to the epidural venous engorgement associated with pregnancy and the incidence may vary from 1 to 10 % (20). Unrecognized epidural vein cannulation may result in systemic toxicity of the local anaesthetic with life threatening cardiovascular and CNS manifestations. It will also contribute to inadequate relaxation and analgesia. The identification of epidural space is commonly performed using the "loss of resistance "technique using saline or air. It has been suggested that if saline is injected into the epidural space before threading the catheter, it significantly decreases incidence of accidental venous catheter placement during combined spinal epidural block (21). This may be due to the widening of epidural space and pushing the vessels away from the needle tip. Other strategies to prevent this complication include gentle insertion of catheters that do not have sharp ends, avoidance of use of stylets, insertion of only 3 to 4 cm of catheter length, aspiration before injection by way of an epidural catheter and use of attest dose containing a vascular marker such as epinephrine.

Applications of Epidural Blockade (22)

Surgery

Upper and lower abdominal surgery, urologic surgery, pelvic surgery, hip surgery, vascular surgery, surgery in the obese patient, thoracic surgery, surgery of the neck and upper limb, radical mastectomy.

- Postoperative and post-trauma pain relief
- Obstetrics

For patient comfort, to avoid uncoordinated uterine action, to minimize foetal acidosis, to reduce use of "urgent "instrumental delivery or "painful delivery" needing general anaesthesia, to relieve pain during labour for medical indications, preeclampsia, for caesarean section.

Diagnosis and management of chronic pain

- Differential epidural block
- Diagnostic epidural opioid blockade
- Epidurography with metrizamide

Neurolytic epidural block

Pain due to vasospasm due to ergot poisoning, cold injuries of extremities, Raynaud disease or phenomenon and other vasospastic problems, phantom limb pain and causalgia, postherpetic neuralgia, pancreatitis, renal colic, acute priapism.

Epidural techniques

- Epidural electrical stimulation of spinal cord
- Epidural opioids

Continuous Epidural Analgesia

Analgesia delivered through an indwelling epidural catheter is a safe and effective method for management of acute postoperative pain. Postoperative epidural analgesia can

provide analgesia superior to that with systemic opioids (23). Of note, however, epidural analgesia is not a generic term but incorporates a wide range of options, including the choice and dose of analgesic agents, location of catheter placement, and onset and duration of perioperative use. Intraoperative use of the epidural catheter as part of a combined epidural-general anaesthetic technique results in less pain and faster patient recovery immediately after surgery than general anaesthesia followed by systemic opioids does (16).

Transeversus Abominis Plane Block

A substantial component of the pain experienced by patients after abdominal surgery is derived from the abdominal wall incision (25). Transversus abdominis plane (TAP) block is an effective method of blocking the sensory afferents supplying the anterior abdominal wall. The TAP infiltration is relatively easy to perform, generally safe, and can be performed in patients who are anti-coagulated [5, 6]. TAP infiltration can be performed as a single injection, or a catheter can be inserted for continuous local anaesthetic infusion (26)

Background

The transverse abdominis plane (TAP) block is a peripheral nerve block designed to anesthetize the nerves supplying the anterior abdominal wall (T6 to L1). It was first described by Rafi in 2001 as a traditional blind landmark technique using the lumbar triangle of Petit (27).

Local anaesthetic is injected into the plane between the transversus abdominis and internal oblique muscles, to block the anterior rami of the lower six thoracic nerves (T7-T12) and the first lumbar nerve (L1). Injection of local anaesthetic within the TAP potentially can provide unilateral analgesia to the skin, muscles, and parietal peritoneum of the anterior abdominal wall from T7 to L1. (28)

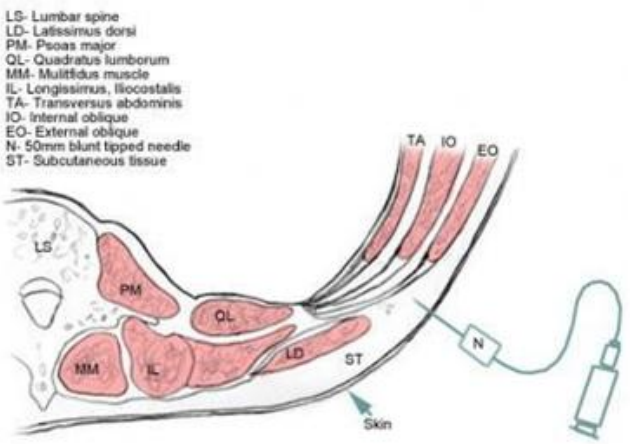


Figure 5: Anatomy of abdominal wall

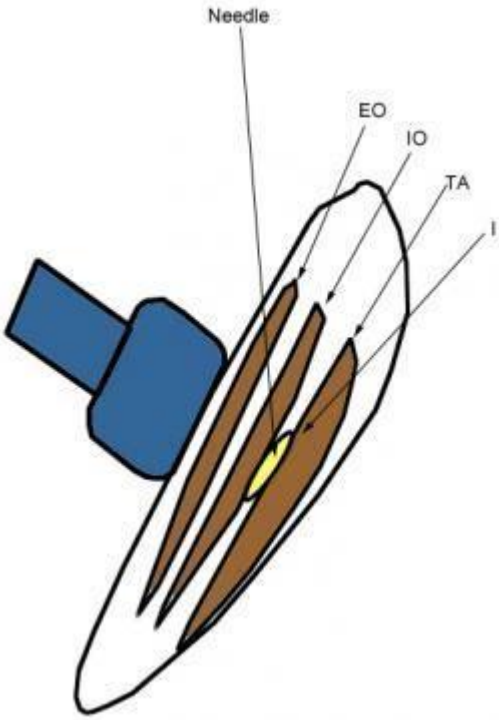


Figure 6: USG of abdominal wall

TAP block was shown to reduce the need for postoperative opioid use (29), increase the time to first request for further analgesia, and provide more effective pain relief, while decreasing opioid related side effects such as sedation and postoperative nausea and vomiting.

Indications

The TAP block is can be used as an adjunct for postoperative pain control after many surgeries including abdominal, gynecologic (30), or urologic procedures involving the T6 to L1 distribution. Surgical procedures investigated by randomized clinical trials include large bowel resection, caesarean delivery (31) (32), abdominal hysterectomy, open appendicectomy, and laparoscopic cholecystectomy (33, 34).

However, the TAP block has also found clinical utility in procedures such as abdominal and inguinal hernia repair (35), radical prostatectomy (34), nephrectomy , and many different laparoscopic procedures in general (5). Bilateral TAP blocks can be used for midline incisions.

This technique is useful in situations where epidural analgesia is contraindicated (i.e., anticoagulated patients). In addition, if prolonged analgesia is desired, a continuous TAP block technique with placement of a catheter can be employed.

Contraindications

There are only few contraindications for performing a TAP block. Absolute contraindications include infection at the site of injection, patient refusal or inability to cooperate, and allergy to local anaesthetics. (6)

Anatomy

The abdominal wall is composed of 5 paired muscles: 2 vertical muscles (the rectus abdominis and the pyramidalis) and 3 layered flat muscles (the external oblique, the internal oblique, and the transversus abdominis muscles).

The internal oblique muscle is the intermediate layer of the 3 paired, flat abdominal muscles. It originates broadly from the anterior portion of the iliac crest, lateral half of the inguinal ligament, and thoracolumbar fascia. The internal abdominal oblique inserts on the inferior border of the 10th-12th ribs, the linea alba, and the pubic crest via the conjoint tendon. The muscle fibres of the internal oblique course upward in a superomedial orientation, perpendicular to the muscle fibres of the external oblique.

The transversus abdominis muscle is the deepest of the 3 paired, flat abdominal muscles. It originates on the internal surfaces of the 7th–12th costal cartilages, thoracolumbar fascia, anterior three fourths of the iliac crest, and lateral third of the inguinal ligament. It forms a broad aponeurosis that helps make up the rectus sheath before it fuses in the midline to the linea alba. Above the arcuate line, the transversus abdominis aponeurosis contributes to the posterior rectus sheath. Below the arcuate line, it is fused with the other flat muscles as the anterior rectus sheath. The upper fibrous anterior part of the muscle lies posterior to the rectus abdominis muscle and reaches the xiphoid process. The posterior aponeuroses of the transversus abdominis and internal oblique muscles fuse and attach to the thoracolumbar fascia.

The transversus abdominis plane is the fascial plane superficial to the transversus abdominis muscle. In the TAP, the intercostal, subcostal, and L1 segmental nerves communicate to form the upper and lower TAP plexuses, which innervate the anterolateral abdominal wall, including the parietal peritoneum. Therefore, TAP blockade requires anaesthesia of the upper (also known as the subcostal or intercostal) TAP plexus, as well as the lower TAP plexus, located in the vicinity of the deep circumflex iliac artery.

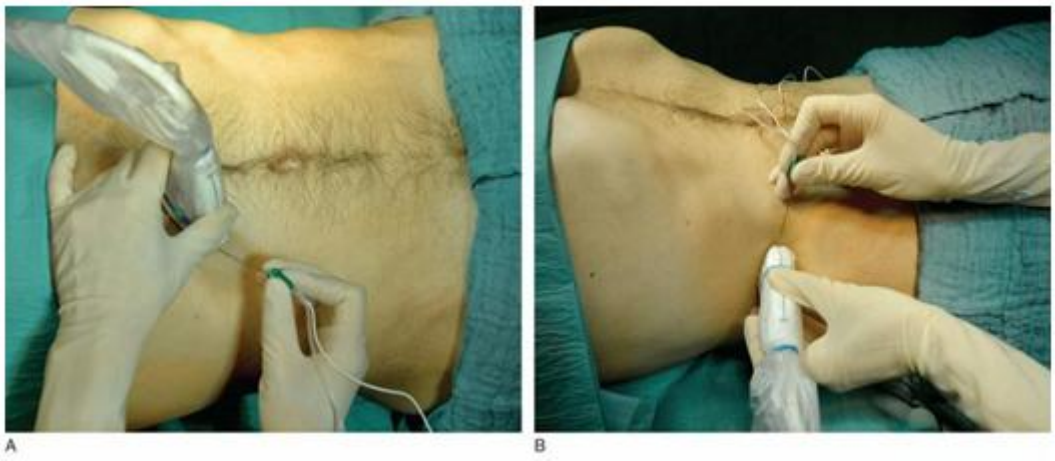
The subcostal approach to the TAP block ideally anesthetizes the intercostal nerves T6–T9 between the rectus abdominis sheath and the transversus abdominis muscle. The lateral TAP block in the midaxillary line between the thoracic cage and iliac crest as well as between the internal oblique and transversus abdominis muscles ideally should reach intercostal nerves T10– T11 and the subcostal nerve T12 (37). Of note, the umbilicus is innervated by intercostal nerve T10. The L1 segmental nerves in the TAP are not covered by the lateral TAP block and require an anterior TAP block medial to the anterior superior iliac spine. A posterior approach to block the TAP plexuses via the triangle of Petit has also been described. TAP blocks provide somatic analgesia of the abdominal wall including the parietal peritoneum.

Traditional (Blind) Approach

In this approach, the lumbar triangle of Petit is identified. The triangle of Petit is formed by the iliac crest as the base, the external oblique muscle as the anterior border, and the latissimus dorsi muscle as the posterior border. The floor of the triangle is made up of the fascia from both the external and internal oblique muscles (see the image below). A needle is inserted perpendicular to the skin just cephalad to the iliac crest near the midaxillary line. The TAP is identified using a 2-pop sensation (loss of resistance). The first pop indicates penetration of the fascia of the external oblique muscle, and the second indicates penetration of the fascia of the internal oblique muscle. Local anaesthetic is then injected with multiple aspirations.

Subcostal TAP Block

A linear transducer is placed alongside the lower margin of the rib cage as medial and cranial as possible for the subcostal TAP block (Figure 7a). The rectus abdominis muscle and its posterior rectus sheath are visualized along with the transversus abdominis muscle deep to the posterior rectus sheath.



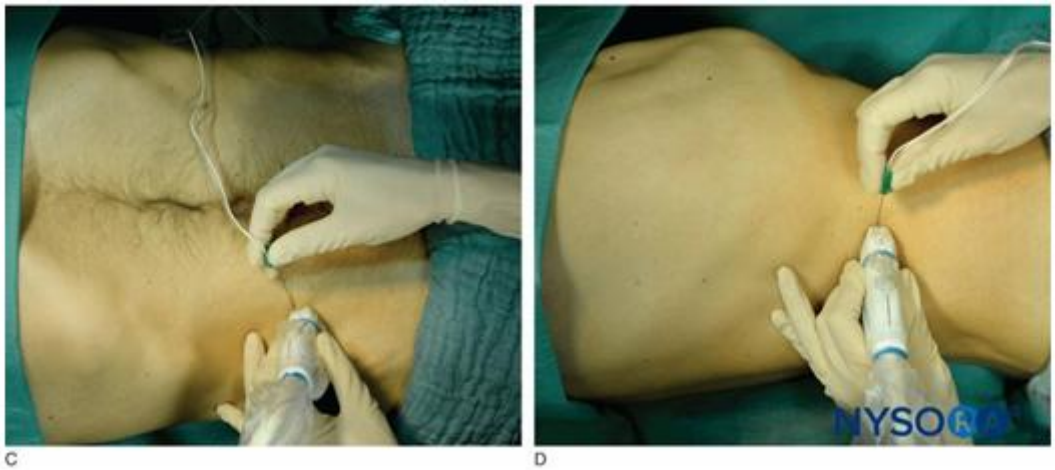


Figure 7: Patient and transducer position for different TAP block approaches: subcostal (A), lateral (B), anterior (C), and posterior (D)

The target is the fascial plane between the posterior rectus sheath and the transversus abdominis muscle. The needle is inserted above the rectus abdominis close to the midline and advanced from medial to lateral (alternatively, lateral to medial). The endpoint of injection is the spread of local anaesthetic between the posterior rectus sheath and the anterior margin of the transversus abdominis muscle.

Lateral TAP Block

For the lateral TAP block, a linear transducer is placed in the axial plane on the midaxillary line between the subcostal margin and the iliac crest (Figure 7b). The three layers of abdominal wall muscles are visualized: external and internal oblique as well as the transversus abdominis muscles. The target is the fascial plane between the internal oblique and the transversus abdominis muscles. The needle is inserted in the anterior axillary line, and the needle tip is advanced until it reaches the fascial plane between the internal oblique and transversus abdominis muscles approximately in the midaxillary line.

Anterior TAP Block

A linear transducer is placed medial to the anterior superior iliac spine pointing toward the umbilicus with a caudad tilt for the anterior TAP block (Figure 7c). The three abdominal wall muscles are visualized (see discussion for the lateral TAP block). The target is the same fascial plane at the level of the deep circumflex iliac artery. The needle is inserted medial to the anterior superior iliac spine. The needle tip is advanced until it is placed between the internal oblique and transversus abdominis muscles adjacent to the deep circumflex iliac artery.

Posterior TAP Block

For the posterior TAP block, the linear transducer is placed in the axial plane in the midaxillary line and moved posterior to the most posterior limit of the TAP between the internal oblique and transversus abdominis muscles (Figure 7d). The target is the most posterior end of the TAP. The needle is inserted in the midaxillary line and advanced posteriorly until it reaches the posterior end of the TAP (38).

Equipment

The equipment needed includes syringes for local anaesthetic, a 21-gauge 100-mm needle with tubing, antiseptic for skin disinfection, and an ultrasound machine with high-frequency probe (10-5 MHz) and ultrasound gel.

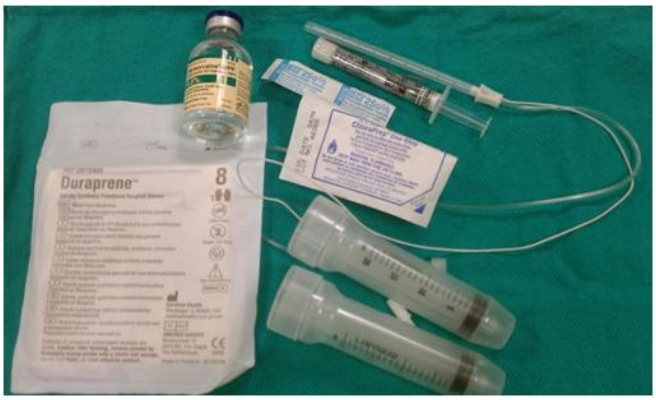


Figure 8: Equipment for TAP Block Monitoring & Follow-up

The type and duration of monitoring for this block do not differ from other peripheral nerve blocks preformed today. These include standard ASA monitors with ECG, blood pressure, and oxygen saturation. Additional monitoring beyond the acute time frame to perform the block is not required.

Complications

Overall, the TAP block is a relatively safe procedure with minimal complications. In addition to the common complications associated with any peripheral nerve block (i.e., local anaesthetic toxicity, intravascular injection, nerve injury, bleeding, and infection), inadvertent peritoneal puncture is a risk with this block.

The exact incidence of peritoneal puncture is unknown. One investigator who has performed several hundred TAP blocks reported no complications related to peritoneal puncture. A review article on this subject reported only an allergic reaction upon injection with no other listed complications. However, one source does cite the incidence

in intraperitoneal injection as 2%.Bowel hematoma, enlarged liver laceration, and transient femoral nerve palsy are among serious but very rare reported complications (39). Other organ injury, namely spleen and kidney, are also possible complications.

Dose and Volume of Local Anesthetic

The TAP blocks are "tissue plane" blocks and thus require large volumes of local anaesthetic to obtain reliable blockade. For each of the TAP blocks, a minimum volume of 15 mL is recommended. The local anaesthetic dose needs to be considered for the size of the patient to ensure that a maximum safe dose is not exceeded, especially with dual bilateral TAP blocks.

Continuous TAP Infusion

Continuous catheter techniques are associated with excellent postoperative outcomes (40).For maintenance of block a catheter is passed through the needle to lie in the TAP. Catheters can be placed at the beginning, conclusion of surgery or as rescue blocks postoperatively. Epidural catheters, nerve block catheters, or multiholed wound catheters can be positioned in the midzone of the required block area with blockade maintained up to 5 days. Infusions are generally commenced bilaterally, and wound pain on subsequent days could be treated with a 10-mL bolus or increasing the infusion rate (41).

Assessment of Pain

Valid and reliable assessment of pain is essential for both clinical trials and effective pain management. The nature of pain makes objective measurement impossible. Acute pain can be reliably assessed, both at rest (important for comfort) and during movement (important for function and risk of postoperative complications), with one-dimensional tools such as numeric rating scales or visual analogue scales. Both these are more powerful in detecting changes in pain intensity than a verbal categorical rating scale. In acute pain trials, assessment of baseline pain must ensure sufficient pain intensity for the trial to detect meaningful treatment effects (42).

There are several well-designed pain scales that are used to help assess the extent of one's pain, all of which help improve communication between healthcare providers and patients. Some of these tools are most suited for people of certain ages, while others are more useful for people who are highly involved in their own health care. Pain scale results can help guide the diagnostic process, track the progression of a condition, and more.

The most commonly used pain scales are:

- Numerical rating scales (NRS) use numbers to rate pain.
- Visual analog scales (VAS) typically ask a patient to mark a place on a scale that aligns with their level of pain.

No one particular pain scale is considered ideal or better than the others for every situation. Qualitative scales are especially useful in assessing your response to treatment because they can clearly define whether your pain has improved or worsened. Qualitative pain scales are helpful in giving your healthcare provider an idea about the cause of your pain and whether it is associated with your medical problem or resulting from the treatment itself.

Numerical scales are more quantitative in nature, but most pain scales have quantitative features and qualitative features.

The well-known visual analogue scale (VAS) and numeric rating scale (NRS) for assessment of pain intensity agree well and are equally sensitive in assessing acute pain after surgery, and they are both superior to a four-point verbal categorical rating scale (VRS). They function best for the patient's subjective feeling of the intensity of pain right now-present pain intensity. They may be used for worst, least, or average pain over the last 24 h, or during the last week. There are some limitations with this, as memory of pain is not accurate and often coloured by changing context factors.

A Visual Analogue Scale (VAS) is a measurement instrument that tries to measure a characteristic or attitude that is believed to range across a continuum of values and cannot easily be directly measured. For example, the amount of pain that a patient feels ranges across a continuum from none to an extreme amount of pain. From the patient's perspective this spectrum appears continuous ± their pain does not take discrete jumps, as a categorization of none, mild, moderate and severe would suggest. It was to capture this idea of an underlying continuum that the VAS was devised. Operationally a VAS is usually a horizontal line, 100 mm in length, anchored by word descriptors at each end. The patient marks on the line the point that they feel represents their perception of their current state. The VAS score is determined by measuring in millimetres from the left hand end of the line to the point that the patient marks.

As such an assessment is clearly highly subjective, these scales are of most value when looking at change within individuals, and are of less value for comparing across a group of individuals at one time point. It could be argued that a VAS is trying to produce interval/ratio data out of subjective values that are at best ordinal. Thus, some caution is required in handling such data. Many researchers prefer to use a method of analysis that is based on the rank ordering of scores rather than their exact values, to avoid reading too much into the precise VAS score.

The Numeric Pain Rating Scale Instructions General Information: The patient is asked to make three pain ratings, corresponding to current, best and worst pain experienced over the past 24 hours. The average of the 3 ratings was used to represent the patient's level of pain over the previous 24 hours. Patient Instructions: "Please indicate the intensity of current, best, and worst pain levels over the past 24 hours on a scale of 0 (no pain) to 10 (worst pain imaginable)".

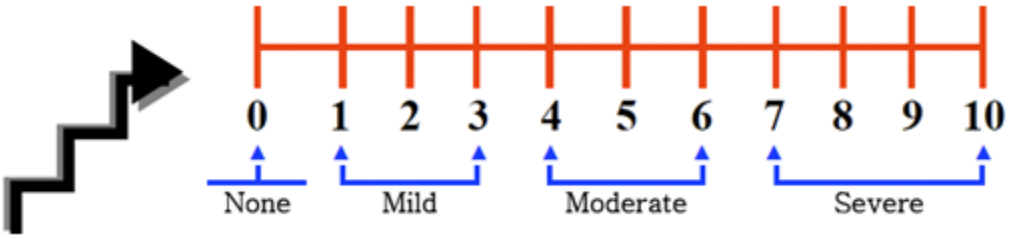


Figure 9: Numeric Rating Scale

Assessment of the intensity of acute pain at rest after surgery is important for making the patient comfortable in bed. However, adequate relief of dynamic pain during mobilization, deep breathing, and coughing is more important for reducing risks of cardiopulmonary and thromboembolic complications after surgery. Immobilization is also a known risk factor for chronic hyperalgesic pain after surgery, becoming a significant health problem in about 1%, a bothersome but not negligible problem in another 10%. Effective relief of dynamic pain facilitates mobilization and therefore may improve long-term outcome after surgery.

Assessment of pain only at rest will not reveal differences between more potent pain relieving methods, such as optimal thoracic epidural analgesia, compared with less effective epidurals or systemic opioid analgesia: systemic opioids can make the patient comfortable, even after major surgery, when resting in bed. However, severe dynamic pain provoked by movements necessary to get the patient out of bed, and mobilizing bronchial secretions by forceful coughing, cannot be relieved by systemically administered potent opioids without causing unacceptable adverse effects.

Local Anesthetics

Local anaesthesia results from the blockade of nerve impulses to abolish sensation. All currently available, clinically useful anaesthetics are either aminoesters or aminoamides. These drugs, when applied in sufficient concentration near the site of action, prevent conduction of electrical impulses by the membranes of nerve and muscle. In addition to blockade of impulses, local anaesthetics can inhibit various receptors, enhance release of glutamate, and depress the activity of certain intracellular signalling pathways. When local anaesthetics are given systemically, the functions of cardiac, skeletal, and smooth muscle, as well as transmission of impulses in the central and peripheral nervous systems and within the specialized conducting system of the heart, can all be altered. Local anaesthetics can abolish sensation in various parts of the body by topical application, injection near peripheral nerve endings and major nerve trunks, or instillation within the epidural or subarachnoid space. Toxicity may be local or systemic. The central nervous and cardiovascular systems are most commonly the targets for acute clinical toxicity caused by local anaesthetics.

In this study, we have used bupivacaine for infusions in both epidural and tap catheters.

BUPIVACAINE

Bupivacaine is an aminoamide local anaesthetic. It is a member of the homologous series of n-alkyl substituted pipecholyl xylidines first synthesised by Ekenstam in 1957.It was used clinically in 1963.

The strength used is 0.125% -0.75% with or without adrenaline 1: 200000 or 400000.Adrenaline does not prolong its effect but reduces its toxicity.

Physicochemical Properties

- Molecular wt: 288
- PKa 8.1
- Protein binding 95%
- Vd 1 Litre
- T ½ 210 min
- Clearance 8.3 L/MIN

PHARMACOKINETICS

Absorption

The site of injection, dosage, rate of injection, pharmacological properties influence the absorption of bupivacaine into systemic circulation. The order of peak plasma concentration after a single dose is intrapleural> intercostal> lumbar epidural> brachial plexus> subcutaneous> sciatic> femoral.

After rapid entry into venous circulation pulmonary extraction limits the concentration of the drug that reaches the systemic circulation for distribution to the coronary and cerebral circulation. The first pass pulmonary extraction for bupivacaine is dose dependant. So the uptake process becomes saturated rapidly.

Metabolism

Bupivacaine being an Amide is metabolised in liver. It undergoes N dealkylation to pipecolxylidine and is excreted in urine. A small percentage is excreted unchanged in urine

Clearance

Depends mainly on hepatic metabolism since renal excretion of unchanged drug is minimal. Accumulation of metabolites may occur in renal failure.

Placental transfer

Protein binding determines the rate and degree of diffusion of local anaesthetics across the placenta. Bupivacaine being

highly protein bound, 95%, has an umbilical vein/maternal arterial ratio of 0.3.

Foetal acidosis can cause accumulation of bupivacaine in the foetus by ion trapping.

Mechanism of Action

Reversibly inhibits peripheral nerve conduction by blocking voltage sodium and potassium channels on the internal nerve cell membrane.

- Toxicity
- Systemic toxicity
- CNS toxicity

Initial symptoms include feeling of light headedness and dizziness followed by visual and auditory disturbances like difficulty focusing and tinnitus. Other CNS symptoms include disorientation and feeling of drowsiness. Muscular twitching and tremor initially involving muscles of face and distal extremities can occur ultimately leading to generalised tonic clonic seizure.

Respiratory or metabolic acidosis will increase the risk of CNS toxicity (43). Convulsions caused by inadvertent intravenous bolus of local anaesthetic can be terminated by midazolam or thiopentone.

Cardiovascular System Toxicity

Local anaesthetics cause a decrease in the rate of depolarisation in the fast conducting tissues of purkinjee fibres and ventricular muscle due to decrease in the availability of fast sodium channels in cardiac membranes (44).

Bupivacaine depresses the rapid phase of depolarisation in purkinjee fibres and ventricular muscles more than lignocaine. Also the rate of recovery from a use dependant block is slower in bupivacaine treated papillary muscle when compared to lignocaine. This slow recovery results in incomplete restoration of sodium channel availability between action potentials leading to arrhythmogenic potential of bupivacaine.

Bupivacaine causes rapid and profound cardiovascular depression.

The ratio of the dose required for irreversible cardiovascular collapse (CC) and the dose to produce CNS toxicity, ie CC/CNS ratio is lower for bupivacaine than for lignocaine (45).

Ventricular arrhythmias and fatal ventricular fibrillation can occur more after rapid administration of a large dose of bupivacaine. But it is less frequent with lignocaine.

Cardiac resuscitation is more difficult after bupivacaine induced cardiovascular collapse. Acidosis and hypoxia potentiate the cardio toxicity (46).

Management

Basic CPR should be started and defibrillation performed as indicated according to ACLS Rapid institution of extra corporeal membrane oxygenation may be useful.

Rapid bolus of intralipid 20%, 1.5ml/kg should be administered without delay followed by infusion of 0.25ml/kg/min for the next 10minutes (47). (48).

Local Tissue Toxicity

Direct toxicity to nerves can occur if high intraneural concentrations are achieved. However use of ultra sound guidance for peripheral nerve blockade has reduced the incidence of neurologic sequelae. (49)

Intramuscular injection of bupivacaine can cause skeletal muscle damage. The effect is usually reversible and muscle regeneration occurs within 2 weeks of intramuscular injection. Local anaesthetic induced myotoxicity may involve action on mitochondria. (50)

3.Methodology

Study Design:

Observational Study

Study Setting:

Government Medical College Hospital, Thiruvananthapuram.

Study Population:

Patients undergoing abdominal surgeries in the mentioned study setting

Study Subjects

Subjects aged 18– 68 years undergoing abdominal surgeries in Medical College Hospital, between the years 2017 -2020, Trivandrum given either continuous TAP block or continuous epidural analgesia for postoperative pain management.

Exclusion criteria:

- Patients' refusal or retraction of previously given consent.
- American society of anaesthesiologist (ASA) grade 3 or above
- Allergy to local anaesthetics
- Pregnancy
- Regular opioid medication prior to surgery;
- Intellectual impairment or psychiatric condition precluding adequate communication
- Spinal cord disorder;
- Bleeding disorder
- Infection near the proposed catheter insertion sites

Sampling technique:

Consecutive sampling

Sample size:

Sample size was fixed as 45 on each group

Proportion of patients who needed more than 200µg of morphine during the first 24 hours among patients given USG guided TAP block = 43.5% (p1)

Proportion of patients who needed more than 200µg of morphine during the first 24 hours among patients given epidural analgesia = 73.3 % (p2)

Power = 80%, significance level 5%

Variables

Primary outcome: the proportion of patients who used more than 2µg/kg of fentanyl during the first 24 h on arrival at the recovery ward.

Secondary outcome: Pain measured with 0–10 Numerical Rating Scale during rest and movement in the recovery ward and at 1, 6, 12 and 24 hours after surgery

Methods

After obtaining the institutional Research Methodology and Ethics Committee approval for the study, 92 patients with ASA status I and II, aged 18– 68 years, posted for abdominal surgeries were be enrolled in the study. A valid written consent was taken from each patient.

All patients underwent pre-anaesthetic check-up where a detailed history and physical examination of the patient was performed along with all relevant investigations.

For all patients, general anaesthesia was standardized with propofol induction (2 -2.5 mg/kg), maintenance with isoflurane (0.2 – 1%) in oxygen and nitrous oxide, fentanyl (1 – 2 mcg/kg) titrated to effect and vecuronium.

Preoperatively the EA patients had an epidural catheter placed at appropriate level (T10 – L3) by a senior anaesthetist.

The TAP patients received bilateral TAP catheters (lateral approach) at the end of the surgery, inserted by the senior anaesthetist.

In the EA group, an 18-gauge Tuohy needle with loss of resistance to air was used and a test block was administered at that time. At the end of the procedure, before shifting to the post-anaesthetic care unit (PACU), a bolus of 6 to 8 ml of bupivacaine 0.25% + 50µg fentanyl was given, followed by bupivacaine 0.125% infusion at 5 to 10 ml/hour (rate based on clinical effect, which was assessed regularly) for 24hours.

In patients who received TAP block, the catheters were inserted bilaterally through an 18-gauge Tuohy needle using an ultrasound-guided approach at the end of the surgery. In this group a 20 ml bolus of bupivacaine 0.25%+50µg fentanyl was administered prior to insertion of an 18-gauge clear epidural catheter and was followed by an infusion of 0.125% bupivacaine for 24 hours through each catheter at 4-6 ml/hour. In both groups, infusion was commenced at the end of the surgical procedure. All patients were provided with paracetamol 1.0 g QID (orally or intravenous) and fentanyl iv if patient complained of pain.

The primary outcome is the proportion of participants who used more than 2µg/kg of fentanyl during the first 24 hours on arrival at the recovery ward.

Secondary outcomes were pain measured with 0–10 NRS at rest and movement in the recovery ward and at 1, 6, 12 and 24 hours.

Data Analysis

Data was entered in Microsoft excel and analysed using appropriate statistical analytical software. Quantitative variables are expressed as mean and standard deviation. Qualitative variables are expressed in proportion. Test of significance will be done using chi square test and other appropriate statistical tests as per required.

4.Results

The data was entered into a master chart using Microsoft Excel and analyzed using statistical software. Qualitative variables were expressed in proportion and quantitative variables as mean and standard deviation. Tests of significance were done using chi square test and student t test. A probability value (P value) of less than or equal to 0.05 considered as significant.

Table 1: Comparison of Groups Based On Age Distribution

Age	TAP		Epidural		Total		χ^2	df	P
	N	%	N	%	N	%			
≤40	13	28.3	7	15.2	20	21.7			
41 -60	28	60.9	30	65.2	58	63			
>60	5	10.9	9	19.6	14	15.2	3.012	2	0.222
Total	**46**	**100**	**46**	**100**	**92**	**100**			

The mean age in the TAP group was 47.2 and in the Epidural group were 51.9. There was no significant difference of age groups among the two groups (p =0.222).

Table 2: Comparison of Groups Based On Gender

Sex	TAP		Epidural		Total		χ^2	df	P
	N	%	N	%	N	%			
Male	21	45.7	20	43.5	41	44.6	0.044	1	0.834
Female	25	54.3	26	56.5	51	55.4			
Total	46	100	46	100	92	100			

The groups had similar gender distribution with 45.7% males and 54.3% females in TAP group and 43.5%males and 56.5% females in the epidural group (p = O.834)

Table 3: Comparison of Groups Based On ASA Grade

ASA	TAP		Epidural		Total		χ^2	df	P
	N	%	N	%	N	%			
Grade 1	11	23.9	19	41.3	30	32.6	3.166	1	0.075
Grade 2	35	76.1	27	58.7	62	67.4			
Total	46	100	46	100	92	100			

The two groups had no significant difference in ASA grade (p=0.075)

Table 4: Comparison of Surgical Procedures in Both Groups

Surgery	TAP		Epidural		Total	
	N	%	N	%	N	%
Anterior Resection	3	6.5	6	13.0	9	9.8
Cystectomy	5	10.9	1	2.2	6	6.5
Exploratory Laparotomy	0	0.0	1	2.2	1	1.1
Exploratry Laparotomy	5	10.9	0	0.0	5	5.4
Hemicolectomy	3	6.5	2	4.3	5	5.4
Mesenteric Ischemia	2	4.3	0	0.0	2	2.2
Myomectomy	3	6.5	3	6.5	6	6.5
Nephrolithotomy	1	2.2	0	0.0	1	1.1
Rectopexy	3	6.5	5	10.9	8	8.7
Ruptured Appendix	3	6.5	4	8.7	7	7.6
Sigmoid Volvulus	0	0.0	1	2.2	1	1.1
Sigmoidectomy	4	8.7	5	10.9	9	9.8
Staging Laparotomy	6	13.0	9	19.6	15	16.3
TAH	8	17.4	9	19.6	17	18.5
Total	46	100.0	46	100.0	92	100.0

$\chi 2$=15.279 df=13 p=0.290

Both groups of patients underwent similar surgical procedures. (p = 0.290)

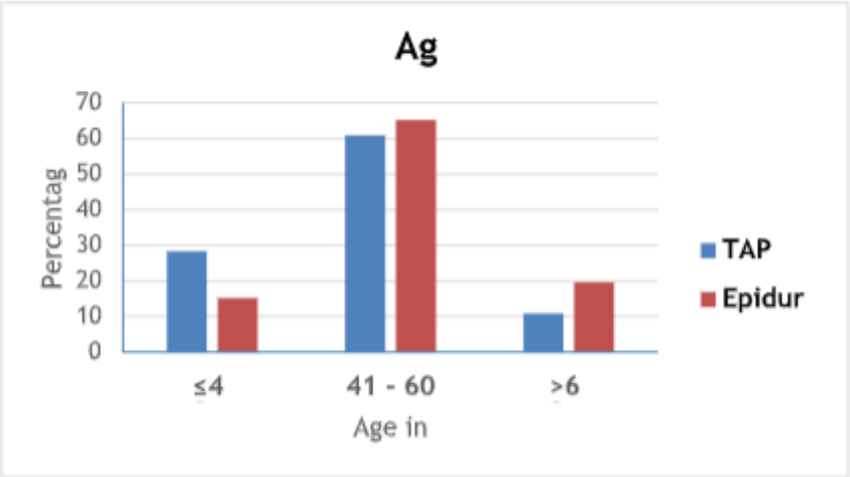


Figure 10: Age distribution in two groups

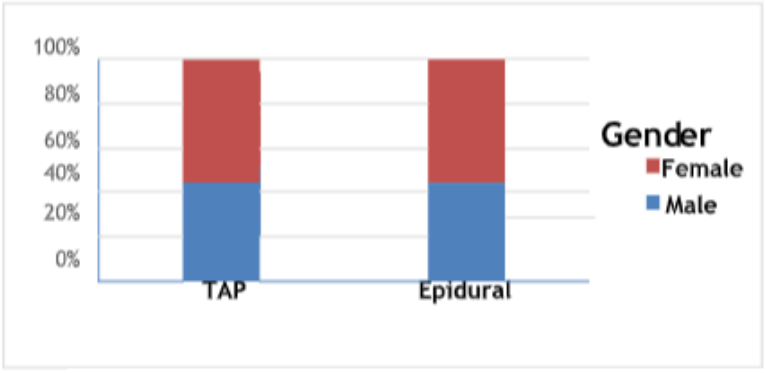


Figure 11: Gender distribution in two groups

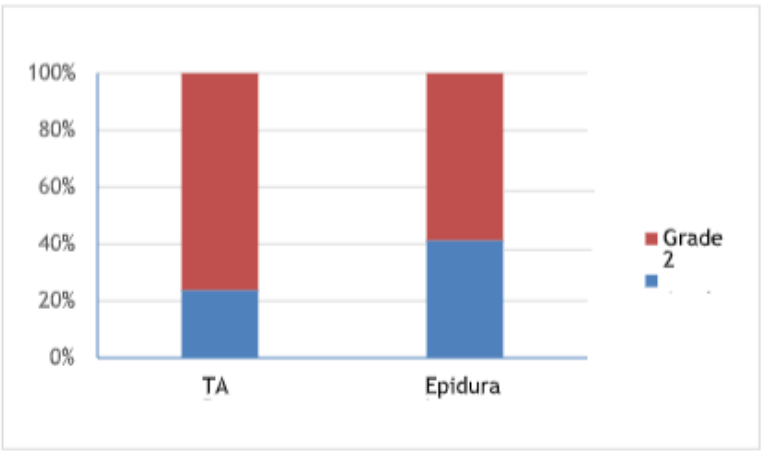


Figure 12: ASA Grade in two groups

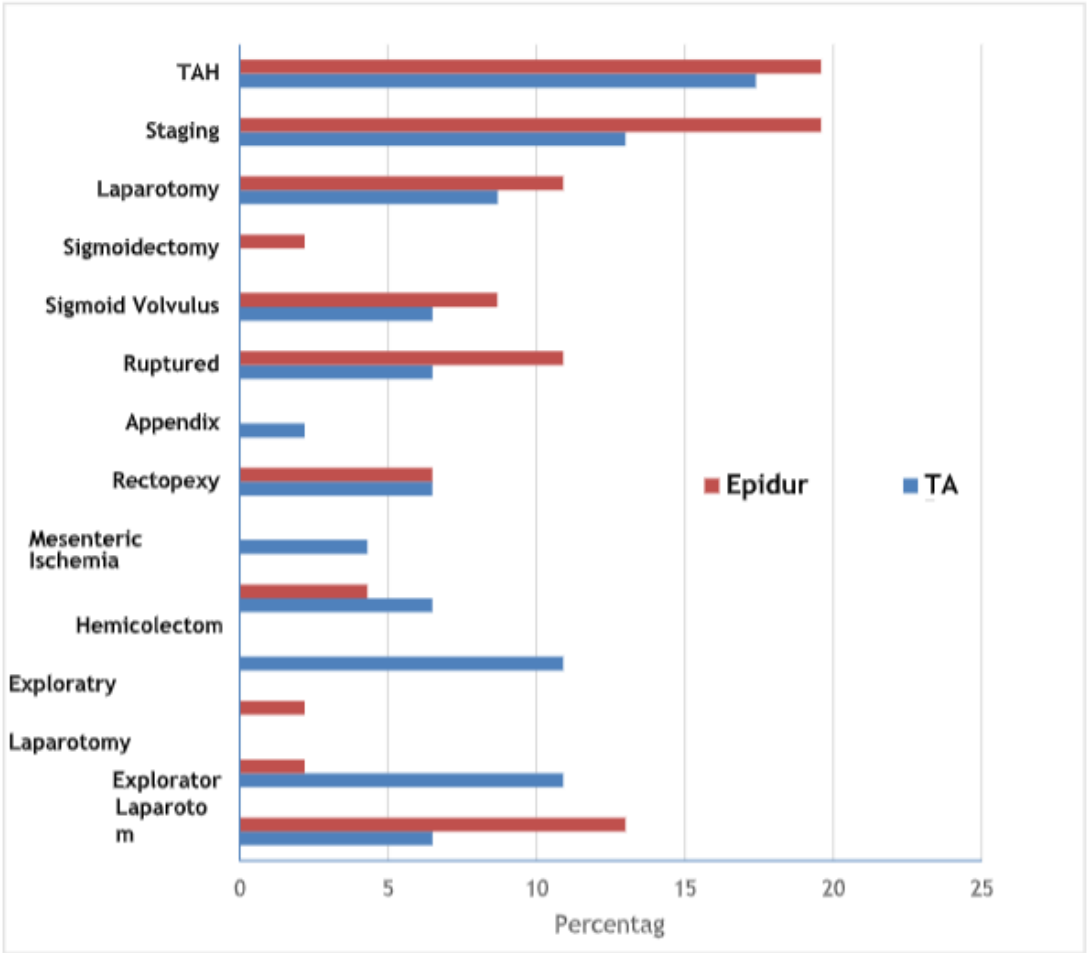


Figure 13: Surgical procedures in two groups

Comparison of Outcome Variables

1. Proportion of patients requiring more than 2mcg/kg fentanyl

In our study, we found that fentanyl consumption was significantly lower for the epidural group than the TAP group (p = 0.031).

In the TAP group 47.8% of patients required more than 2mcg/kg of fentanyl in the first 24 hours postoperatively, compared to 26.1% in the epidural group.

Table 5: Fentanyl Consumption in 24 hours

Fentanyl consumption	TAP		Epidural		Total		χ2	df	p
	N	%	N	%	N	%			
≥2 mcg/kg	22	47.8	12	26.1	34	37	4.665	1	0.031
<2 mcg/kg	24	52.2	34	73.9	58	63			
Total	46	100	46	100	92	100			

The mean fentanyl consumption was significantly lower in the epidural group (60.9 mcg) compared to the TAP group (109.7) (P <0001).

Table 6: Total Fentanyl Consumption

Category	N	Total Fentanyl in 24 hours in microgram		t	p
		Mean	sd		
TAP	46	109.7	52.3	4.629	<0.001
Epidural	46	60.9	48.8		

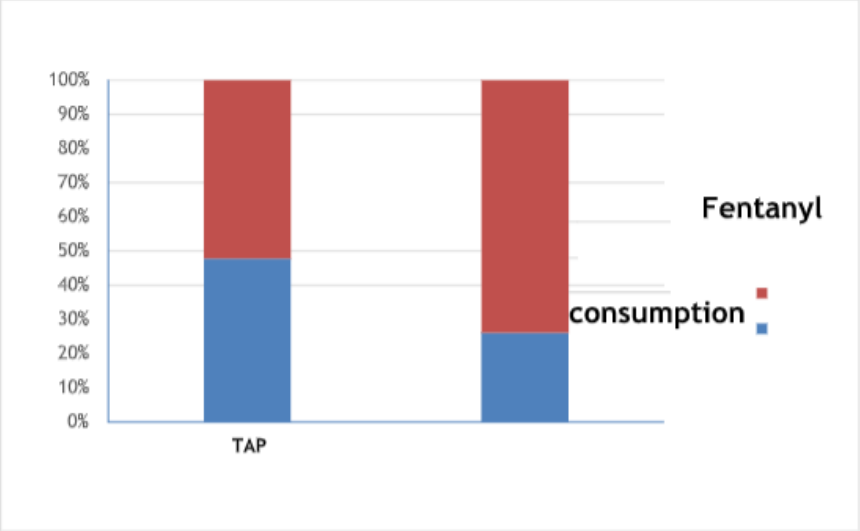


Figure 14: Fentanyl consumption in two groups

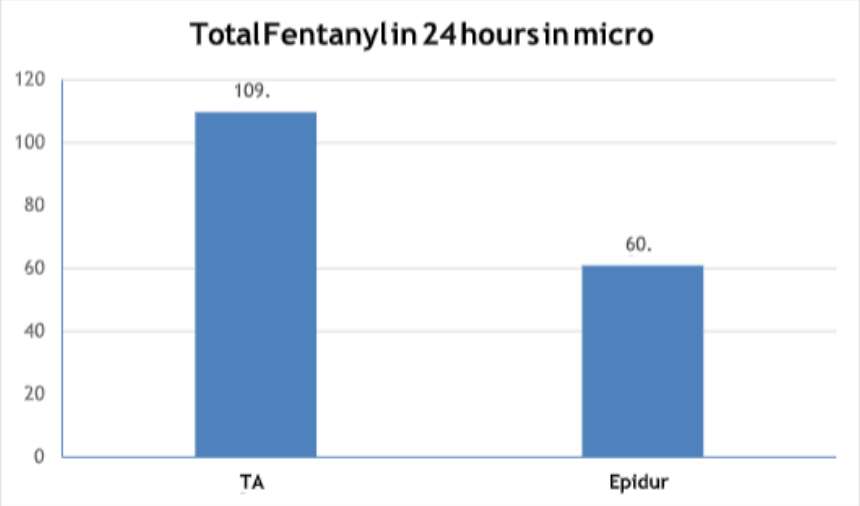


Figure 15: Total Fentanyl consumption in in 24 hours in two groups

Comparison of Painscores Using Numeric Rating Scale at Rest And Movement

At Rest

Table 7: Comparison of NRS at rest in 24 hours in two groups

NRS at rest	TAP		Epidural		t	P
	Mean	sd	Mean	sd		
At 0 hr	0.6	1.1	0.1	0.4	2.686	0.009
6 hr	2.1	1.1	1.4	1.3	2.726	0.008
12 hr	1.7	0.8	1.3	1.4	1.753	0.083
24 hr	1.3	0.9	0.7	1.0	3.003	0.003

It was found that Pain scores at rest using numerical rating scale at 0, 6, 12, 24 hours were significantly lower in the epidural group compared to the TAP group.

On Movement

Table 8: Comparison of NRS at movement in 24 hours in two groups

NRS at Movement	TAP		Epidural		t	p
	Mean	Sd	Mean	Sd		
At 0 hr	1.02	1.54	0.52	0.66	2.023	0.046
6 hr	2.78	1.55	2.13	1.19	2.269	0.026
12 hr	2.37	1.22	1.87	0.91	2.231	0.028
24 hr	1.93	1.06	1.50	0.62	2.393	0.019

It was found that Pain scores on movement using numerical rating scale at 0, 6, 12, 24 hours were significantly lower in the epidural group compared to the TAP group.

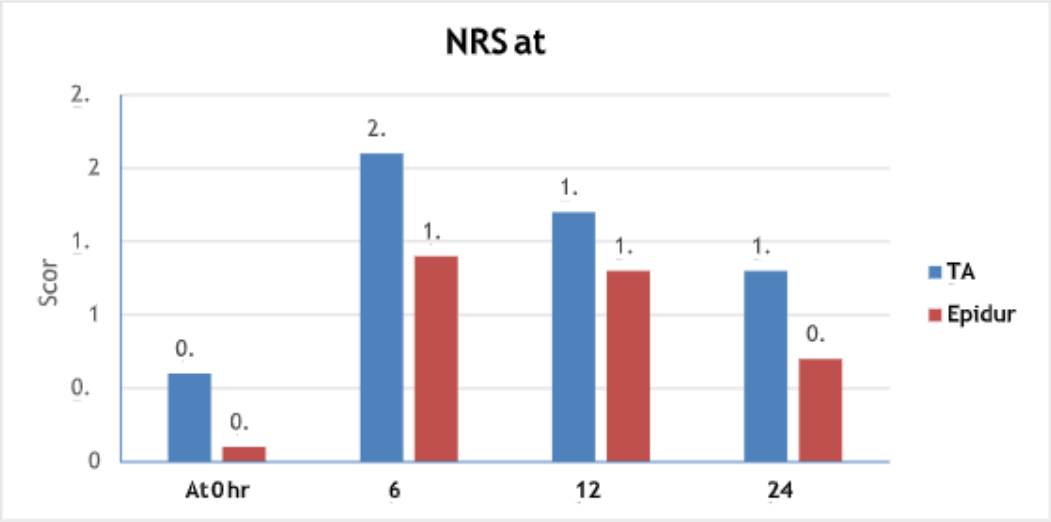


Figure 16: NRS at rest in 24 hours in two groups

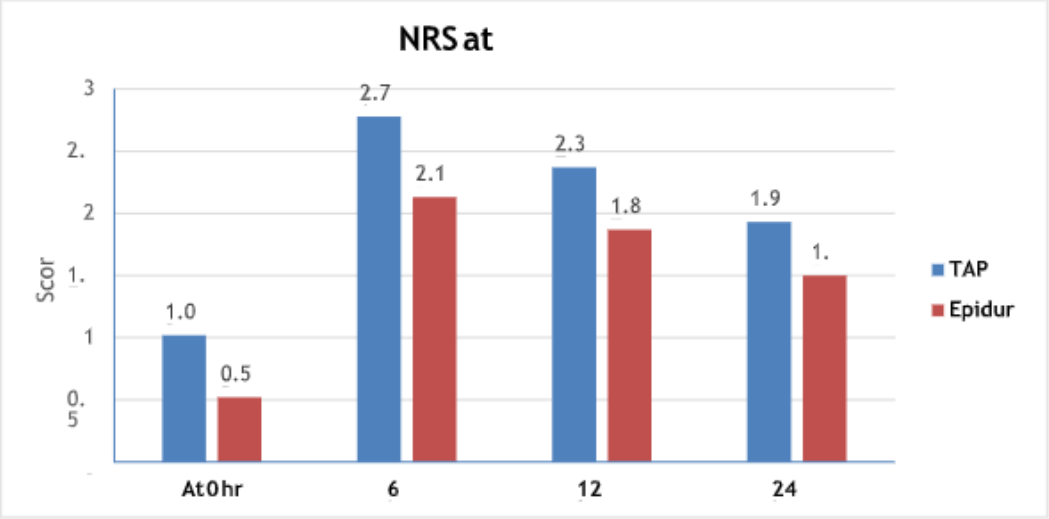


Figure 17: NRS at movement in 24 hours in two groups

5.Discussion

Acute pain after abdominal surgery is a common and often undertreated entity. If poorly controlled, acute pain after abdominal surgery is associated with a variety of unwanted postoperative consequences. This includes patient suffering from distress, respiratory complications, delirium, myocardial ischemia, prolonged hospital stay, and an increased likelihood of chronic pain.

The components of post abdominal surgery pain are – pain due to incision (major component), and visceral pain (51). Traditionally, analgesia for abdominal surgery is provided either by means of systemic drugs such as opioids, ketamine, NSAIDs, α2 agonists, and paracetamol or by means of epidural anaesthesia. Peripheral nerve blockade is an alternative means of providing analgesia by anesthetizing the sensory nerves conveying pain impulses from the incision site to the spinal cord and brain.

Continuous epidural analgesia has been considered the reference standard for postoperative analgesia after abdominal surgery (52). It is potentially more flexible in providing analgesia for the relevant dermatomes and, in contrast to the TAP technique, it also covers part of the visceral innervations involved in the surgery.

The TAP block is a peripheral nerve block that anesthetizes the abdominal wall. The advent of ultrasound as a means of localizing the nerves for block placement provides excellent results for this technique. Supporters of this technique suggest that analgesia provided by the TAP block is equal or superior to that provided by systemic opioids such as morphine. It is claimed that postoperative opioids consumption and opioid-derived adverse effects can be reduced (33). Furthermore, the TAP block may have a lower risk of complications in patients compared with epidural analgesia.

In our study total of 92 patients were divided into 2 groups of 46 each. Groups were matched for age, gender and ASA physical status and type of surgery. In our study the epidural group had lesser post-operative consumption of fentanyl as rescue analgesia compared to the TAP group (26.1% vs 47.8%) ; p = 0.031; On comparing post-operative pain, we found that pain scores on rest and movement were significantly lower in the epidural group compared with the tap group.

The results are in contrast with those of previous studies that reported analgesic benefits of TAP block in abdominal surgeries. Rao Kadam et al reported that there was no significant (TAP vs EA) difference demonstrated in the pain score in the PACU (0 and 1 hour) or in the wards (days 1 to 3) either at rest or dynamically ($P \geq 0.1$) (26).

McDonnell et al. [11] reported statistically significant reduction in morphine requirements after large bowel resection in patients receiving TAP block with 20 ml of 0.375% bupivacaine ($P < 0.05$). Moreover, Hebbard [14] reported that subcostal TAP block provided postoperative analgesia after upper abdominal surgery in a series of 20 patients. In addition, Carney et al. [15] reported that TAP block provides highly effective postoperative analgesia during the first 24–48 h. Overall, during the first 24 postoperative hours, the TAP block reduced the mean intravenous morphine requirements by more than 70%. This reduction in opioid requirement resulted in fewer opioid-mediated side effects.

Our study is consistent with study by Niraj et al. [16] reported that rescue analgesia with tramadol was significantly higher in the TAP block (400 mg) group than in the epidural group (200 mg) ($P = 0.002$).

Epidural analgesia can provide optimal analgesia for abdominal wall structures as well as for deep visceral pain; however, it is unquestionably contraindicated in sepsis, hemodynamic instability, or anticoagulant medications, which necessitate the importance of another safe and reliable technique, where TAP block would be effective.

From our study, we infer that epidural analgesia is more superior for post-operative pain control. But epidural does come with its own share of problems. Thus, continuous TAP infusion is a good alternative to patients in whom epidural is contraindicated as in sepsis, coagulopathy and hemodynamic instability.

6.Conclusion

From our study, we can conclude that continuous epidural infusion provides better postoperative analgesia when compared to continuous TAP infusion. Fentanyl consumption was significantly lower in the epidural group compared to the TAP group. Epidural analgesia also provided lesser post-operative pain scores at rest and movement.

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