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Case Series

Efficacy of the Combined Thoracic Epidural and Ultrasound Guided Erector Spinae Plane Block in Relieving the Postoperative Pain in Patients Undergoing Video Assisted Thoracoscopic Esophagectomies for Carcinoma Oesophagus: A Case Series

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Abstract:

No single mode of analgesia is appropriate and effective to control the postoperative pain after video assisted thoracoscopic esophagectomy surgery. Thoracic epidural no doubt provides good analgesia but is accompanied by failures and technical difficulties and is not sufficient to control the pain following VATS TTE. Ultrasound guided Erector Spinae nerve block in combination thoracic epidural, can increase the efficacy of pain relief and its very safe and easy to perform.

Keywords: analgesia, thoracic surgical procedures, nerve block, anesthesia, epidural

Introduction

Video-assisted thoracoscopic surgery for transthoracic esophagectomy (VATS TTE) is a very popular and less invasive mode of surgery for management of patients with carcinoma esophagus. However it causes moderate to severe degree of postoperative pain in 12.7% of patients in the first 24 hours and in 15.6% of patients in the first 48 hours. Obesity, age, smoking, chronic pain in the first month post operatively and presence of chest tubes are some of the predisposing factors of pain [1]. If this acute severe post-operative pain is not controlled, it may lead to a chronic post thoracotomy pain in 20 - 47% of patients [2].

Thoracic epidural analgesia (TEA) and paravertebral block (PVB) are established modes of analgesia for open surgery such as thoracotomy but there is no gold standard for regional analgesia for VATS [3]. Thoracic epidural analgesia is associated with complications like spinal cord injury, epidural abscess and hematoma, local anesthetic toxicity, hemodynamic instability, infections and catheter-related complications.

It also requires a certain level of expertise. Moreover the thoracic epidural alone cannot block the pain sensation arising from multiple structures and vast dermatomes in this particular surgery. Over the last few years, new techniques to block the chest wall have been described with the use of ultrasound. These include the serratus anterior plane block, retrolaminar, rhomboid/intercostal, pecs 1 and 2 and erector spinae plane (ESP) block. Ultrasound-guided (USG) ESP block was found to be a simple and safe technique for providing analgesia in the thoracic region in both acute pain (trauma, surgery) and chronic pain (chronic neuropathic pain) as well as acute post traumatic pain and it is now recommended in VATS too [4].

ESP block performed properly at the level of T5 transverse process provides analgesia from T3 to T9 thoracic segments and paravertebral region, acting on both the ventral and dorsal rami of the spinal neurons by the process of diffusion through the intertransverse connective tissue complex [5]. Even though studies on ESP are fewer than that on TEA, the safety profile and efficacy has been found to be equally satisfactory and is considered in patients where TEA or PVB is undesirable or contraindicated. Moreover, the analgesic effect of a combined thoracic epidural and erector spinae plane block has not been studied yet.

This study details five cases where the analgesic effects of combined thoracic epidural and ultrasound guided ESPB in patients undergoing

VATS esophagectomy in the immediate post-operative period was evaluated.

Description of cases:

Five patients who underwent VATS esophagectomy under general anaesthesia were given combined thoracic epidural and erector spinae plane blocks for analgesic management. Barring a female patient, the rest were male, middle aged and elderly (Table 1). All had complaints of difficulty in swallowing food, pain and discomfort in the chest and upper abdomen, regurgitation of food and indigestion. All received neoadjuvant chemotherapy and radiotherapy. Body Mass Index (BMI), ASA status, presence of comorbidities, staging of the disease, personal habits and nutritional status were noted. Routine investigations like complete blood count, blood sugar, kidney and liver function tests, thyroid status, coagulation profile, chest X ray and ECG were obtained preoperatively along with 2D echocardiography and pulmonary function tests. Incentive spirometry and deep breathing exercises were initiated by the physiotherapist. All patients were given anxiolytics and an antihistaminic on the night before surgery.

Anesthetic management:

Informed consent was taken, anesthesia machine checked, standard monitors applied and appropriate drugs and equipment were kept ready in the operating room (OR). Patients were kept in the sitting position. Skin was prepped with 2% chlorhexidine isopropyl alcohol solution.

A high-frequency ultrasound linear array transducer probe 6-13MHz was cleaned with 2% chlorhexidine and 70% isopropyl alcohol and covered with a sterile sheet. It was placed longitudinally 3 cm lateral to the T5 spinous process in the right side. Three muscles are visible in the following sequence: trapezius, rhomboid major, and erector spinae. A 20G Tuohy's epidural needle was inserted in a cephalocaudal direction until its tip lay in the plane between rhomboid major and erector spinae muscles (Fig 1).

The correct placement was indicated by the linear spread of normal saline that will lift the erector spinae muscle off the underlying transverse processes and intercostal muscles. After confirming spread, epidural catheter was inserted through the needle for around 3-4 cm and fixed in the back (Fig 2). Following that thoracic epidural was given in the sitting position in the T10-11 or T11-12 space with loss of resistance technique and the epidural catheter threaded and fixed accordingly (Fig 3). Patients were then made to lie supine and general anaesthesia was administered.

After preoxygenation with 100% O2 for three minutes, patients were premedicated with inj. glycopyrrolate 0.04 mg/kg iv, inj palonosetron 0.075 mg iv, inj tramadol 1.5 mg/kg iv and induced with inj propofol 2 mg/kg iv and inj vecuronium 0.1mg/kg iv. Patients were ventilated with oxygen and nitrous oxide in the ratio of 60:40 and isoflurane 0.4% for four minutes and then intubated with left-sided double lumen endotracheal cuffed tube of 37 Fr. Maintenance was done with O2, nitrous oxide, isoflurane and vecuronium infusion at the rate of 0.05 mg/kg/hr IV. Under asepsis, right sided subclavian vein was cannulated. Patient was then turned into right lateral position. 10 ml of 0.25% ropivacaine was injected through the erector spinae block catheter and one lung ventilation was initiated. Once the thoracic part was over, the patient was turned back to the supine position and the double lumen endotracheal tube was replaced by a single lumen oral cuffed endotracheal tube (8mm).

Thoracic epidural was initiated with bolus of 10 ml of 0.25% ropivacaine. Intraoperatively, infusion at erector spinae was started with 0.2% ropivacaine at 3 ml/h and thoracic epidural with 0.2% ropivacaine at 4 ml/h which was continued in the post-operative period with 0.1% ropivacaine. Post operatively, patients were left intubated, sedated and paralysed overnight. Multimodal analgesia was completed with inj. paracetamol 1g IV 6 hourly and inj. diclofenac 75mg IV BD. Degree of postoperative pain was assessed by VAS score at rest and on movement after patients were weaned at 9 am the next day and at 2, 4, 6, 12 and 24 hours (Tab/graph 1,2). Vitals were monitored and complications noted. Other variables studied were intraoperative and post-operative hemodynamic vitals, blood loss and duration of surgery (Graph 1).

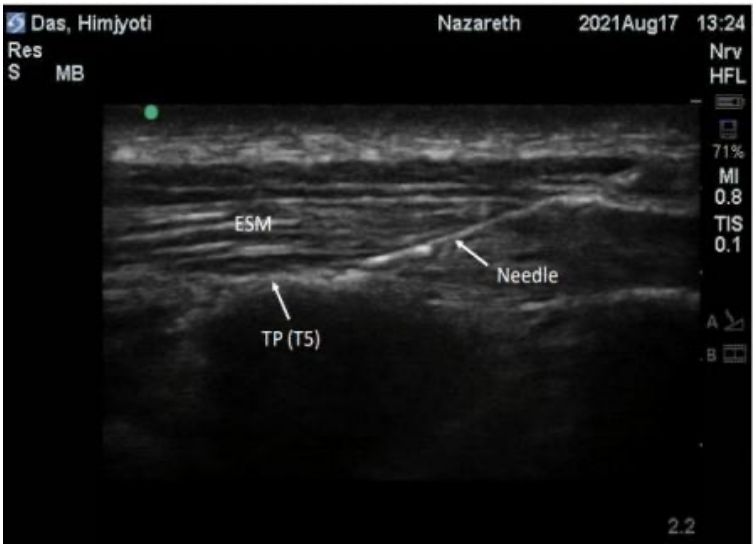


Figure 1: Ultrasound image of the needle lying (in plane) in between the tip of transverse process of the vertebra and the erector spinae muscle

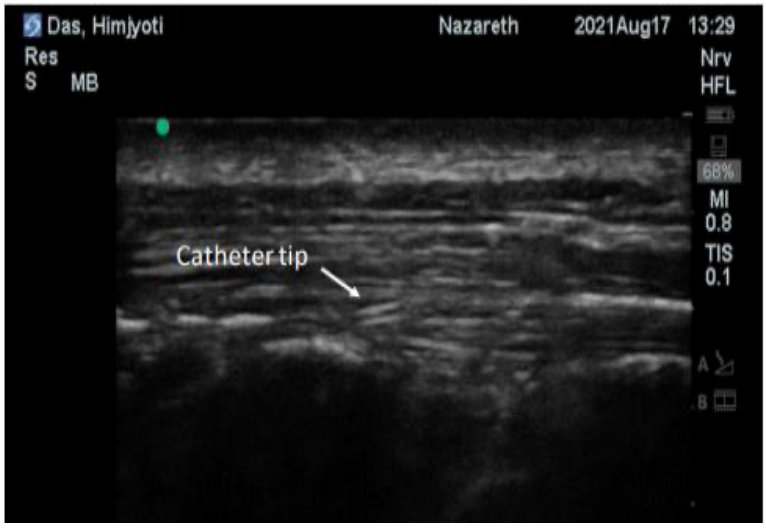
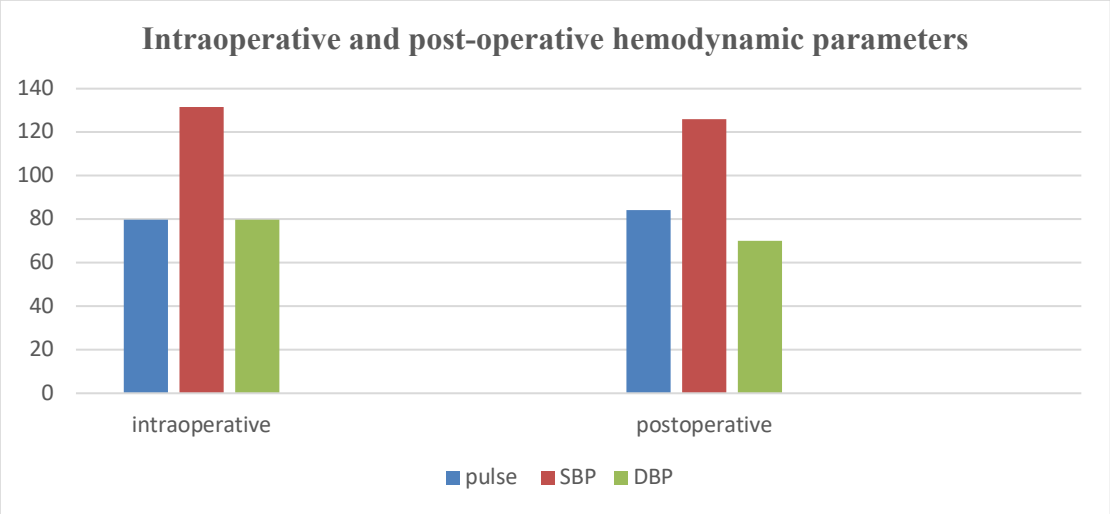


Figure 2: Ultrasound image of the catheter coming out from the tip of the needle

Figure 3: Both epidural and erector spinae catheters fixed in the back

Table 1: Demographics, staging, comorbidities, ASA Status, duration of surgery and duration of stay in intensive care unit (ICU)

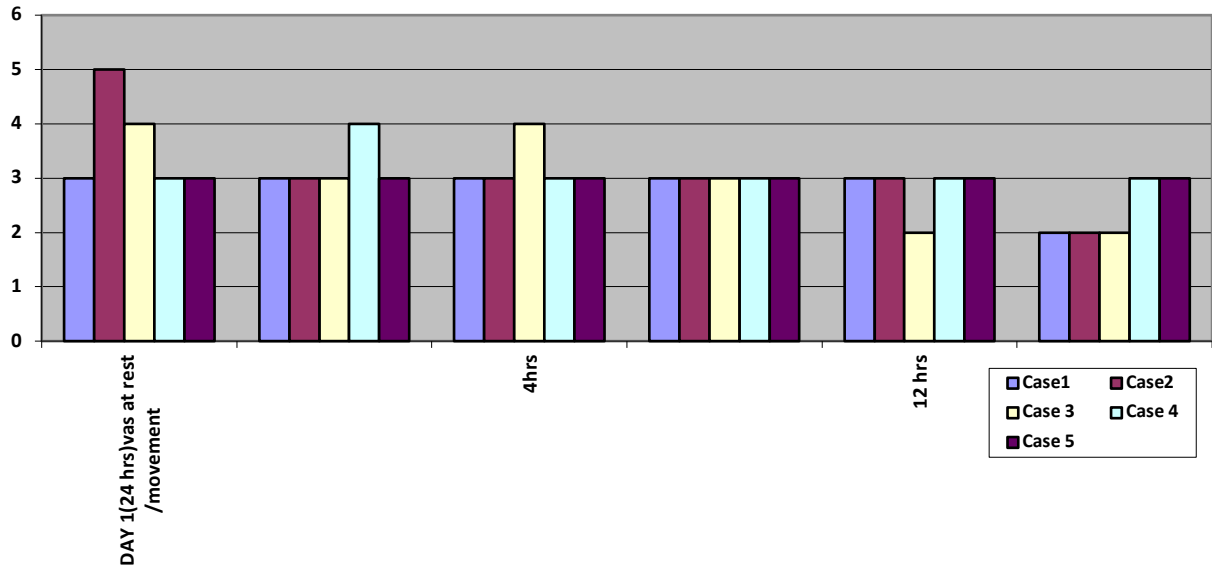
Sl. No.	Age(y)/sex/BMI(kg/m^2)	CT/RT	Staging	comorbidities	Blood loss (mL)	Duration of surgery (h)	Duration of stay in ICU (Days)
1	33/M/26	Yes	YPT2N0M0	smoker	600	7	3
2	61/F/24	Yes	YPT3N0M0	Nil	500	8	4
3	44/M/27	Yes	YPT3N1M0	Nil	500	7	4
4	45/M/26	Yes	YPT3N1M0	smoker	600	5.5	3
5	73/M/26	yes	YPT2N0M0	Nil	600	6	4



Graph 1: Intraoperative and post-operative hemodynamic parameters

Table 2: Post-operative VAS scorings at rest

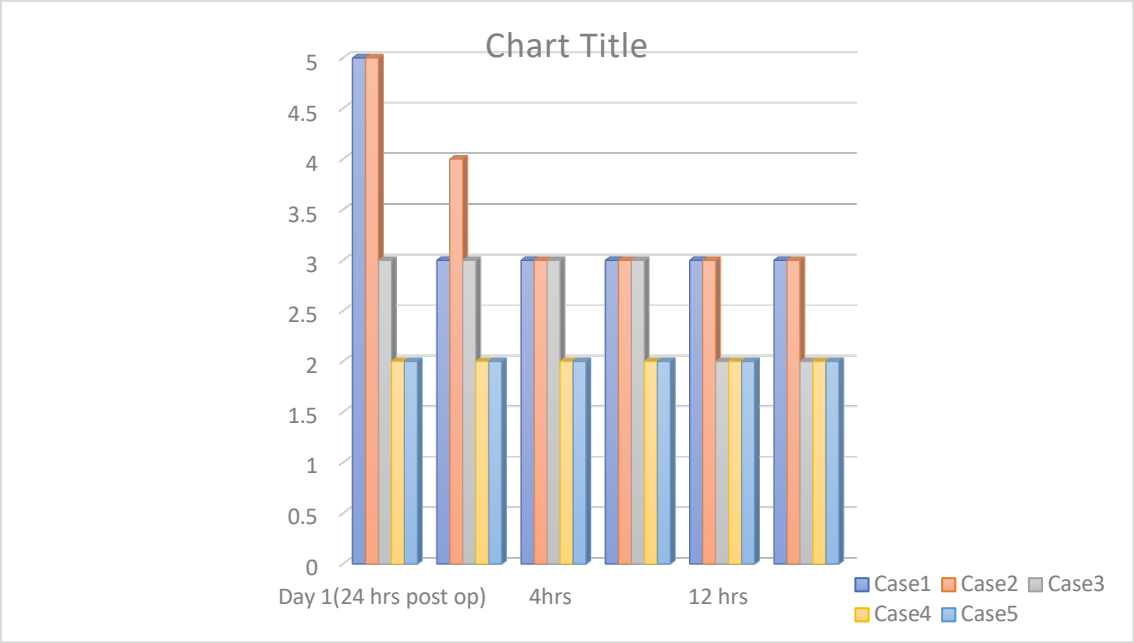
Sl. No	VAS score at rest					
case	DAY 1(24 h)	2 h	4 h	6 h	12 h	48h
Case1	3	3	3	3	3	2
Case2	5	3	3	3	3	2
Case 3	4	3	4	3	2	2
Case 4	3	4	3	3	3	3
Case 5	3	3	3	3	3	3



Graph 2: Post-operative VAS scores at rest

Table 3: Post-operative VAS scorings on movement

Sl. No.	Post-operative VAS score on movement					
case	Day 1(24 h)	2 h	4 h	6 h	12 h	48 h
Case1	5	3	3	3	3	3
Case2	5	4	3	3	3	3
Case3	3	3	3	3	2	2
Case4	2	2	2	2	2	2
Case5	2	2	2	2	2	2



Graph 3: Postoperative VAS scores on movement

Discussion

41-69% of patients suffer from moderate to severe degree of pain after surgery in spite of many advances in pain management techniques [6]. The pain experienced after thoracotomy is one of the most severe experienced by patients among all surgeries. This is because multiple pain signals are generated during division and retraction of muscles, retraction and fracture of ribs, ligament stretching, intercostal nerve injuries, costochondral joints dislocation and pleural irritation by the intercostal drains.

Pain is also transmitted by sympathetic nerves innervating the lungs and mediastinum, vagus nerve from the thoracic structures and phrenic nerve from the handling of pericardium and mediastinum and shoulder pain transmitted by the stretching of brachial plexus during positioning [7]. Hence, managing post-operative pain after VATS esophagectomy is a huge challenge mandating a multimodal analgesic regimen for all patients.

The different analgesic modalities used either alone or in combination include thoracic epidural, thoracic paravertebral block, intercostal nerve blocks, serratus anterior plane block, erector spinae plane block and interpleural blocks. Out of these, thoracic epidural analgesia and paravertebral block are the most commonly practised. TEA improves the quality of postoperative pain control, lessens the postoperative respiratory complications and surgical stress-induced immunosuppression, decreases the risk of atrial fibrillation, supraventricular tachycardia, deep vein thrombosis, ileus, postoperative nausea and vomiting and improves the bowel function, postoperative morbidity, length of hospital stay and mechanical ventilation, and thus reduces the costs. [8] However, its side effects like hypotension, pruritus, urinary retention motor blockade and a relatively high failure rate [9] (32%) defined by either catheter replacement or supplementing with another analgesic regimen such as patient-controlled analgesia limits its usefulness. Interobserver variability among anaesthetists regarding the precise dermatomal level for administering the epidural block [10] may be one of the reasons leading to inadequate analgesia [11].

Nowadays, superficial plane blocks have attained popularity with almost similar efficacy with minimum complications and failures if administered with ultrasound. USG guided erector spinae block (ESPB), a relatively new block is in use since 2016 provides analgesia for thoracic and

chest wall surgery. However, it is not useful as a sole anesthetic. ESPB is more superficial, simpler and safer under ultrasound guidance as compared to TEA and TPVB, and it can also be used in patients on anticoagulant therapy [12].

In ESPB, the transverse process is an important anatomical landmark. It is easier to locate the target point, the interfascial plane between the erector spinae muscle and transverse process, by using ultrasound. Ultrasound reduces the risk of pneumothorax, nerve palsy, hematoma and lung injury.

In a study done on cadavers, ESPB showed spread of the injection from the epidural and neural foraminal spaces over two to five levels to intercostal spaces over five to nine levels [13]. Local anesthetics also penetrate anteriorly through the intertransverse connective tissue to the thoracic paravertebral space where they block not only the ventral and dorsal rami of spinal nerves but also the rami communicantes that transmit sympathetic fibers providing both visceral and somatic analgesia [14]. ESPB also provides sensory block at multi-dermatomal levels across the posterior, lateral and anterior thoracic wall [15].

Hence, a combination of thoracic epidural at the level of T10-11 space and right-sided unilateral USG-guided erector spinae plane block was used as the analgesic regimen for patients undergoing VATS esophagectomy to achieve the advantages of both and to cover the extensive dermatomes needed for pain relief.

Patient demographics, staging, comorbidities, ASA Status, duration of surgery and duration of stay in intensive care unit (ICU) were recorded (Table 1). Most of the patients were elderly males and smokers. Average duration of surgery was 6.7 hours and average duration of stay in ICU was 3.6 days.

All patients showed good VAS scores at rest and on movement (Tables 2, 3; figures 2, 3) and were extubated on day 1. Chest physiotherapy and incentive spirometry were started within 24 hours with minimal pain and discomfort. There was no hemodynamic instability intra or postoperatively (Graph 1). No procedural or surgical complications occurred. Epidural catheters were removed after 2 to 4 days. Deep vein thromboprophylaxis was started and all patients were discharged uneventfully after 3 to 4 days of ICU stay. No immediate complications were seen.

Although ESPB alone was used in few VATS cases, this combined mode of analgesia has not been described in literature. USG-guided single shot injection of thoracic ESPB with ropivacaine as a part of multimodal analgesia was found to provide effective postoperative analgesia, patient satisfaction and less emergence agitation after VATS [16]. A preemptive single-shot ESPB may prove to be an effective analgesia management after VATS [17]. Continuous ESPB using catheters is also found to be safe decreasing opioid consumption and its side effects [18].

Three level erector spinae plane block with catheters has been used in an open esophagectomy case followed by reconstructive esophagogastroplasty as a part of multi-modal analgesia. The catheters were inserted in T5 and T10 on the right side and T9 on the left side before surgery. Patient was pain free in the first 48 hours [19].

A recent case report highlighted the advantage of ultrasound-guided bilateral ESP block in a patient undergoing VATS esophagectomy. EPSB was performed at level T5 on the right side and T7 on the left side. On the right side, the catheter was inserted cranially from T1 to T7 to cover thoracic dermatomes and on left side, it was introduced caudally from T4 to T12 to cover abdominal dermatomes. The patient did not require postoperative mechanical ventilation. The infusion was continued till 3 days during which the patient was pain free with no opioid consumption [20].

Dual epidural catheters (DEC) were used in 81 patients undergoing Ivor-Lewis esophagectomy under general anesthesia. This was compared to a single thoracic epidural catheter for post-operative pain relief at rest and on movement for three days. DEC technique significantly reduced pain in comparison to the single epidural catheter technique. The catheter-related adverse events were less and a 50% reduction was noted in the combined rate of major postoperative complications [21].

Continuous thoracic epidural analgesia (TEA), thoracic paravertebral block (PVB) and erector spinae plane (ESP) block were individually compared regarding postoperative pain relief, opioid requirements, postoperative nausea and vomiting (PONV), respiratory events and length of stay in thoracic surgeries. No statistically significant differences were noted in pain scores. The authors concluded that the ESP block was an effective and safe alternative to either TEA or PVB in thoracic surgeries for perioperative pain management [22].

ESPB combined with thoracic paravertebral using 15ml of 0.25% bupivacaine has been found to be effective in reducing the acute postoperative pain in patients undergoing wedge resection by VATS [23].

There is not a single gold standard regional analgesia technique for VATS. Although TEA may not be proven superior to other analgesic regimens,

it is ubiquitously efficient as an analgesic treatment [24]. In this study, the combination of TEA and USG-guided erector spinae block provided an effective and extensive analgesia in VATS esophagectomy. The ERAS program recommends the use of a multimodal regime to target different kinds of pain signals in the peripheral and central nervous system. It emphasises the use of regional anesthesia to avoid opioid use as much as possible and starting oral medications, mobilisation and early discharge as soon as possible [25].

Conclusion:

There is an absence of a single consensus for choice of analgesia for VATS esophagectomy among anesthetists. Thoracic epidural, still the most popular, has its own disadvantages and the newer blocks lack clarity on efficacy, volume of distribution and mechanism of spread of local anaesthetics. However, the combination of both TEA and ESPB may provide a synergistic blockade effect and reduce the failure rates associated with both. In the future more randomised controlled trials could be undertaken to better compare the two.

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