# Comparison between Ultrasound Guided Transversus Abdominis Plane Block and Local Anesthetic Instillation in Patients Undergoing Laparoscopic Hysterectomy

Thesis

Submitted for Partial Fulfilment
of Master Degree in **Anesthesiology**

By


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2020

بسم الله الرحمن الرحيم

# قالوا

# سبحانك لا علم لنا إلا ما علمتنا إنك أنت العليم الحكيم

صدق الله العظيم

سورة البقرة الآية: ٣٢

# Acknowledgments

*First and foremost, I feel always indebted to **Allah** the Most Beneficent and Merciful.*

*In a few grateful words, I would like to express my deepest gratitude and appreciation to **Professor Doctor/Reem Hamdy Elkabarity,** Professor of Anesthesia, Intensive Care and Pain Management, Faculty of Medicine, Ain Shams University for her unlimited help, kind encouragement and generous support throughout this whole work. It was a great honor for me to work under her guidance and supervision and to accept me to be one of her students.*

*I would like to express my deepest gratitude and appreciation to **Assistant Professor/ Mona Ahmed Mohamed Ammar,** Assistant Professor of Anesthesia, Intensive Care and Pain Management, Faculty of Medicine, Ain Shams University, for her precious help and benefcial advices throughout this thesis. It has been a great honor to work under her supervision.*

*No word could express my feeling of gratitude and respect to **Dr/ Milad Ragaie Zakry** Lecturer of Anesthesia, Intensive Care and Pain Management, Faculty of Medicine, Ain Shams University, for the great and generous help throughout this entire work.*

Mohamed Hammad

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# List of Abbreviations

| Abb. | Full term |
|---|---|
| *ASA* | *American Society of Anesthesiologist* |
| *BMI* | *Body mass index* |
| *BP* | *Blood pressure* |
| *CBC* | *Complete blood picture* |
| $CO_2$ | *Carbon dioxide* |
| *DRG* | *Dorsal Root Ganglion* |
| *ECG* | *Electrocardiogram* |
| $EtCO_2$ | *End tidal Carbon monoxide* |
| *HR* | *Heart rate* |
| *HS* | *Highly significant* |
| *IAP* | *Intra-abdominal pressure* |
| *IASP* | *International Association for the Study of Pain* |
| *IPLA* | *Intraperitoneal local anesthetic* |
| *Kg* | *Kilogram* |
| *mg* | *Millgram* |
| *MHz* | *Mega hertz* |
| $N_2O$ | *Nitrous Oxide* |
| *NIBP* | *Non-invasive blood pressure* |
| *NS* | *Non-significant* |
| *NSAIDs* | *Non-steroidal anti-inflammatory drugs* |
| *OR* | *Operation room* |
| *PaCO2* | *Artieral carbon monoxide pressure* |
| *PAG* | *Periaqueductal grey* |
| *PT* | *Prothrombin time* |
| *PTT* | *Partial thromboplastin time* |
| *RVM* | *Rostral ventromedial medulla* |
| *SD* | *Standard deviation* |
| $SpO_2$ | *Oxygen Saturation* |
| *SVR* | *Systemic vascular resistance* |
| *TAP* | *Transversus abdominis plane* |
| *VAS* | *Visual analogue scale* |
| *WDR* | *Wide dynamic ranges* |

# INTRODUCTION

Laparoscopy is a minimally invasive procedure allowing endoscopic access to peritoneal cavity after insufflations of a gas (usually $CO_2$) ***(Yildirım et al., 2018)***.

In experienced hands and in dedicated centres, laparoscopic hysterectomy for uteri weighing ≥1 kg is feasible and safe. Minimally invasive surgery retains its well-known advantages over open surgery even in patients with extremely enlarged uteri ***(Uccella et al., 2018).***

Transversus abdominis plane block (TAP block) was described in 2001 as an anesthetic blockage for the management of postoperative pain in patients after abdominal surgery. The original technique was performed by injecting a dilution of 20 mL of local anesthetic drugs into each side of the abdomen, reaching the transversus neurofascial plane of the abdomen via a percutaneous approach through Petit's lumbar triangles. Studies in cadavers confirmed that the application of local anesthesia at this level blocks the nerve roots from T10 to L1 ***(Calle et al., 2014).***

Recent studies suggested that intraperitoneal instillation of local anesthetic significantly reduces pain intensity scores in the early postoperative period after laparoscopic hysterectomy surgery and helps in improving the postoperative recovery profile and outcome ***(Badawy, 2017).***

The mechanism of action of Intraperitoneal instillation of local anesthetic is not fully understood, although it is likely that there is a blockade of free afferent nerve endings in the peritoneum. Systemic absorption of local anesthetic from the peritoneal cavity may also play a part in reduced nociception ***(Kahokehr, 2013).***

# AIM OF THE WORK

Aim of the present study is to assess degree of pain control, effect on hemodynamics, effect on postoperative analgesic requirements & any possible complications in patients undergoing laparoscopic hysterectomy and compare between Transverses abdominis plane block and intraperitoneal local anesthetics instillation.

# Chapter 1
# PAIN PATHWAYS

## Nociception versus Pain:

Nociception includes all forms of information processing triggered by noxious stimuli (i.e., stimuli that are damaging to normal tissues). In awake animals or human subjects, nociception may lead to withdrawal or vegetative responses and/or to the sensation of pain. Pain as defined by the International Association for the Study of Pain (IASP) is "an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage." Although pain is always a subjective sensation, nociception can be measured in terms of objective parameters ***(Sandkühler, 2013).***

The term *nociception* is derived from *noci* (Latin for harm or injury) and is used to describe neural responses to traumatic or noxious stimuli. All nociception produces pain, but not all pain results from nociception. Many patients experience pain in the absence of noxious stimuli. It is therefore clinically useful to divide pain into one of two categories: (1) **acute pain**, which is primarily due to nociception, and (2) **chronic pain**, which may be due to nociception, but in which psychological and behavioral factors often play a major role ***(Rosenquist and Vrooman, 2013).***

## Acute pain

Acute pain is caused by noxious stimulation due to injury, a disease process, or the abnormal function of muscle or viscera. It is usually nociceptive. Nociceptive pain serves to detect, localize, and limit tissue damage. This type of pain is typically associated with a neuroendocrine stress response that is proportional to the pain intensity. It's most common forms include post-traumatic, postoperative, and obstetric pain as well as pain associated with acute medical illnesses, such as myocardial infarction, pancreatitis, and renal calculi. Most forms of acute pain are self-limited or resolve with treatment in a few days or weeks. When pain fails to resolve because of either abnormal healing or inadequate treatment, it becomes chronic. Two types of acute (nociceptive) pain: somatic and visceral are differentiated based on origin and features. Nociceptive pain results from tissue damage causing continuous nociceptor stimulation ***(Rosenquist and Vrooman, 2013).***

## Somatic Pain

Somatic pain results from activation of nociceptors in cutaneous and deep tissues, such as skin, muscle and subcutaneous soft tissue. Typically, it is well localized and described as aching, throbbing or gnawing. Somatic pain is usually sensitive to opioids ***(Aitkenhead, 2013).***

## Visceral Pain

Visceral pain arises from internal organs. It is characteristically vague in distribution and quality and is often described as deep, dull or dragging. It may be associated with nausea, vomiting and alterations in blood pressure and heart rate. Stimuli such as crushing or burning, which are painful in somatic structures, often evoke no pain in organs. Mechanisms of visceral pain include abnormal distension or contraction of smooth muscle, stretching of the capsule of solid organs, hypoxaemia or necrosis and irritation by algesic substances. Visceral pain is often referred to cutaneous sites distant from the visceral lesion. One example of this is shoulder pain resulting from diaphragmatic irritation ***(Aitkenhead, 2013).***

Accordingly, visceral pain differs from somatic in several important ways. Visceral pain has the following properties:

- It is diffuse in character and poorly localized.
- It is typically referred rather than being felt at the source.
- It is produced by stimuli different from those adequate for activation of somatic nociceptors. Adequate stimuli for production of visceral pain include distention of hollow organs, traction on the mesentery, ischemia, and chemicals typically associated with inflammatory processes.

- It is associated with emotional and autonomic responses typically greater than those associated with somatic pain ***(Aitkenhead, 2013).***

**Pain pathways**

The dorsal horn of the spinal cord is the major receiving zone for primary afferent axons that transmit information from sensory receptors in the skin, viscera, joints, and muscles of the trunk and limbs to the central nervous system. Nociceptive primary afferent axons (i.e., those that respond to tissue damaging stimuli) terminate almost exclusively in the dorsal horn, which is therefore the site of the first synapse in ascending pathways conveying the sensory information that underlies conscious perception of pain. In addition, it contains neuronal circuits involved in generating local reflexes. In the Gate Control Theory of pain, ***Melzack and Wall (1965)*** proposed that inhibitory interneurons in the superficial part of the dorsal horn play a crucial role in controlling incoming sensory information before it is transmitted to the brain. This theory aroused a great deal of interest in organization of the dorsal horn. However, despite intensive study since then, our knowledge of the neuronal circuitry of the region remains limited ***(Todd and Richard, 2013).***

The dorsal horn contains four neuronal components: (1) central terminals of primary afferent axons, which arborize in different areas, depending on their diameter and the type of sensory stimulus that they respond to; (2) interneurons, with axons that remain in the spinal cord, either terminating locally or extending into other spinal segments; (3) projection neurons, with axons that pass rostrally in white matter to reach various parts of the brain; and (4) descending axons that pass caudally from several brain regions and play an important role in modulating the transmission of nociceptive information ***(Todd and Richard, 2013).***

## Laminae of Rexed

The spinal grey matter has been divided into 10 laminae on the basis of cyto-architectonic studies. Laminae I–VI make up the dorsal horn, VII–IX make up the ventral horn and lamina X is a cluster of cells around the central canal. Lamina I is termed the marginal layer, lamina II is the substantia gelatinosa (and is divided into IIo (outer) and IIi (inner). The laminae run the entire length of the cord fusing with the medullary dorsal horn ***(Ellis and Lawson, 2014).***

Laminae I and II, which are referred to as the superficial dorsal horn, constitute the main target for nociceptive primary afferents However, the deeper laminae (III–VI) also have an important role in pain: some nociceptive primary afferents terminate in this region, and many neurons in these laminae (including some projection cells) are activated by noxious stimulation. Lamina I, also known as the marginal layer, forms a thin sheet covering the dorsal aspect of the dorsal horn and