PROGRESS IN PELVIC RESEARCH

ISNP
International School
of Neuropelveology

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NEUROPELVEOLOGY

Latest Developments in Pelvic Neurofunctional Surgery

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CHAPTER I

PELVIC NEUROFUNCTIONAL ANATOMY

1. INTRODUCTION

The innervation of the pelvis is very complex. Sensory and motoric nerves are found in the pelvis; the sensory nerve fibers give information to the periphery of the brain (afferent), or vice versa (efferent), and the motoric nerves divide into the following nerves:

- The somatic nerves, which innervate the skeletal muscles (voluntary, or red, muscles). These nerves originate in the ventral roots of the spinal nerves.

- The autonomous nerves, which innervate the glands and the smooth muscles (involuntary, or white, muscles). These nerves divide into sympathetic nerves (ventral roots of spinal nerves T1–L2) and the parasympathetic nerves (ventral roots of spinal nerves S2–S4/S5).

This division is of great importance in understanding neural anatomy. Innervation of the pelvis is complex because all autonomous neural systems anastomose together in the inferior hypogastric plexus. However, a relative anatomical division of the different plexuses can be described so that the surgeon can, with understanding of these neural structures, reduce the morbidity resulting from radical operations.

The most important nerve groups are the sacral and the lumbar plexuses for the somatic nervous system, and the hypogastric plexus and the sympathetic trunk for the autonomous nervous system.

2. THE SACRAL PLEXUS

The sacral plexus is part of the somatic nervous system. The sacral plexus is formed from the lumbosacral trunk and the ventral rami of sacral nerve roots S1–S4/S5.

The sacral nerves have both afferent and efferent fibers; thus, they play a role in both sensory perception and the movements of the lower extremities (red skeletal muscles).

The pudendal and gluteal nerves arise at different levels from the sacral plexus, as does the nerve of the levator ani muscle *(Fig. 1.1)*.

The pelvic splanchnic nerves (parasympathetic fibers) arise from S2, S3, and S4; these nerves supply the descending colon and rectum, urinary bladder, and genital organs.

2.1. THE LUMBOSACRAL TRUNK

The lumbosacral trunk comprises the whole of the anterior division of the 5th and a part of that of the 4th lumbal nerve roots. It appears at the medial margin of the psoas major and runs downward over the pelvic brim to join the first sacral nerve, S1. Laparoscopic exposure of the lumbosacral trunk is best obtained by dissection of the lumbosacral space lateral to the external iliac vessels, by following strictly the caudal border of the psoas muscle. The trunk reveals itself as a white band that runs along the linea terminalis, about 1 cm below the obturator nerve.

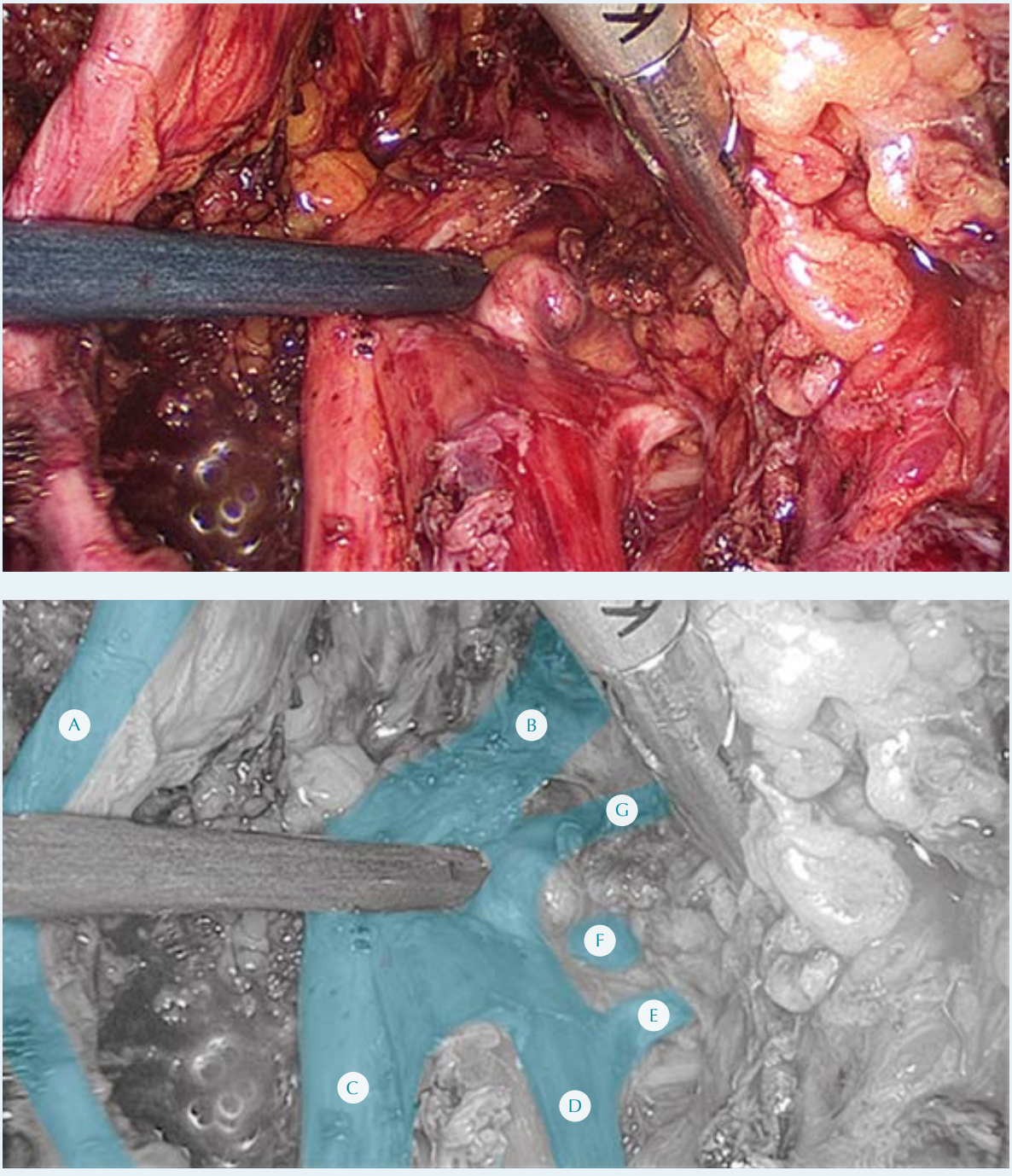


***Fig. 1.1*: Sacral plexus, sciatic nerve, superior and inferior gluteal nerves on the right side**

A: obturator nerve – B: sciatic nerve – C: sacral nerve S2 – D: lumbosacral trunk – E: superior gluteal nerve – F: piriform muscle – G: inferior gluteal nerve

2.2. THE GLUTEAL NERVES

The superior gluteal nerve emerges from the lumbosacral trunk about 2 cm above the great sciatic notch, and leaves the pelvis through the greater sciatic foramen above the piriformis, accompanied by the superior gluteal artery and the superior gluteal vein. This small nerve is extremely important for the stability of the pelvis because it supplies the gluteus medius, the gluteus minimus, and the tensor fasciae latae muscles.

2.3. SACRAL NERVES S1–S4/S5

The four (or sometimes five) sacral nerve roots emerge from the sacral foramens directly lateral to the sacral bone. From their emergence out of the sacral foramens, sacral nerve roots S1–S4/5S lie on the back of the pelvis and build the infracardinal portion of the plexus limiter laterally by the piriformis muscle, laterally by the sacral hypogastric fascia and the rectum, and ventrally by the cardinal ligament.

After crossing the cardinal ligament from the lateral, the sacral nerves building the supracardinal portion of the sacral plexus pass through the suprapiriformis space, cross the piriformis muscle, converge toward the lower part of the greater sciatic foramen, and unite to form the sciatic nerve at the infrapiriformis space.

The sciatic nerve and the inferior gluteal nerve leave the pelvis through the greater sciatic notch, caudal to the piriformis muscle.

The superior gluteal artery and vein run between the lumbosacral trunk and the first sacral nerve, and the inferior gluteal artery and vein run between the second and third sacral nerves. Sacral nerve S1 mediates the Achilles reflex.

S4 electrical stimulation does not produce any motoric reaction in the lower extremities, whereas stimulation of S3 nerves is confirmed visually by a deepening and flattening of the buttock groove as well as a plantar flexion of the large toe and, to a lesser extent, of the smaller toes. Stimulation of S2 produces an outward rotation of the leg and plantar flexion of the foot, as well as a clamp-like squeeze of the anal sphincter from the anterior to the posterior.

2.4. THE PUDENDAL NERVE

The pudendal nerve is a sensory and somatic nerve that originates from the ventral rami of the 2nd to 4th (and occasionally 5th) sacral nerve roots. After branching from the sacral plexus just proximal to the sacrospinous ligament, the nerve leaves the pelvis through the great sciatic notch *(Fig. 1.2)*, re-enters the pelvic cavity through the lesser sciatic notch, and finally travels to three main regions: the gluteal region, the pudendal canal, and the perineum. It accompanies the internal pudendal vessels upward and forward along the lateral wall of the ischiorectal fossa, being contained in a sheath of the obturator fascia termed the pudendal canal (Alcock's canal). The pudendal nerve gives off three distal branches: the inferior rectal nerve, the perineal nerve, and the dorsal nerve of the penis (in males) or the dorsal nerve of the clitoris (in females).

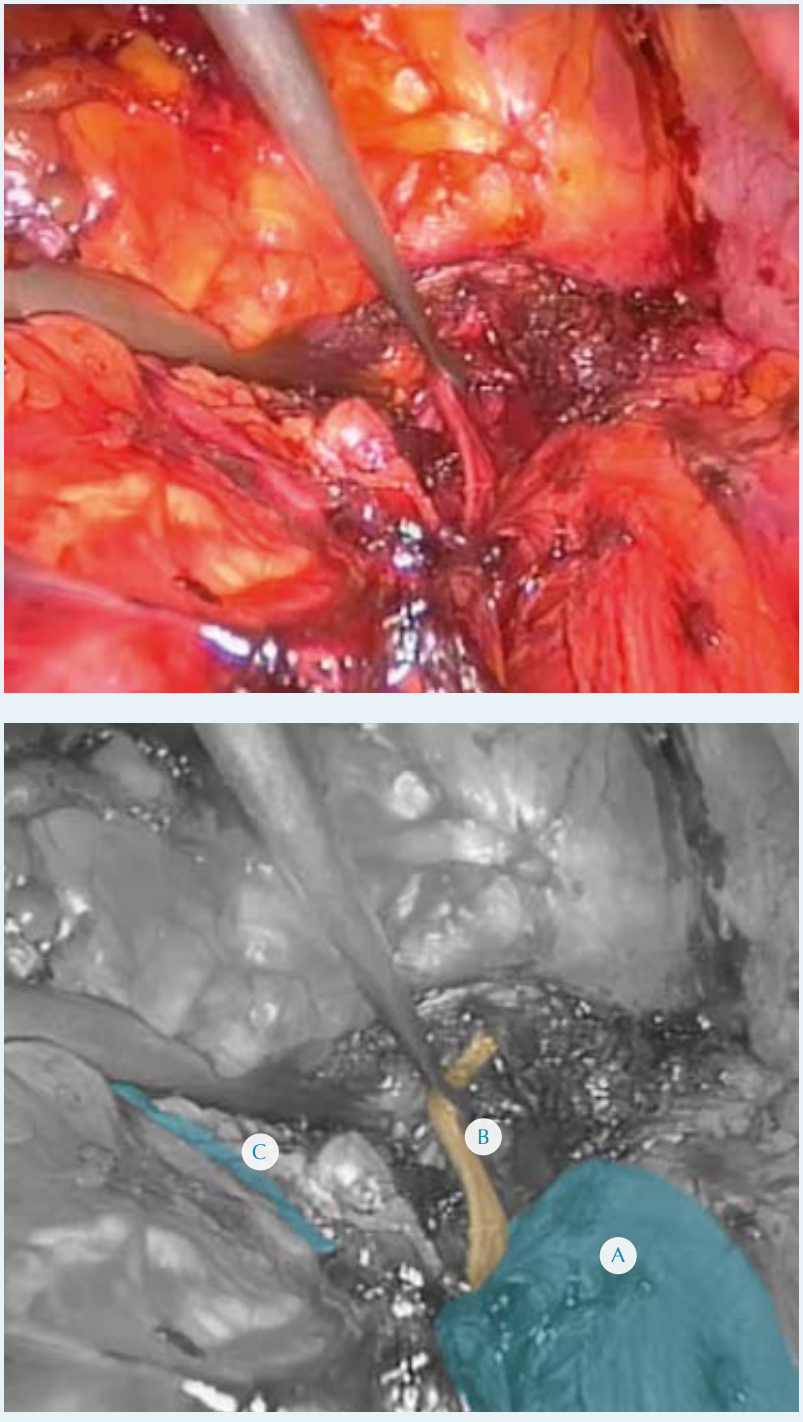
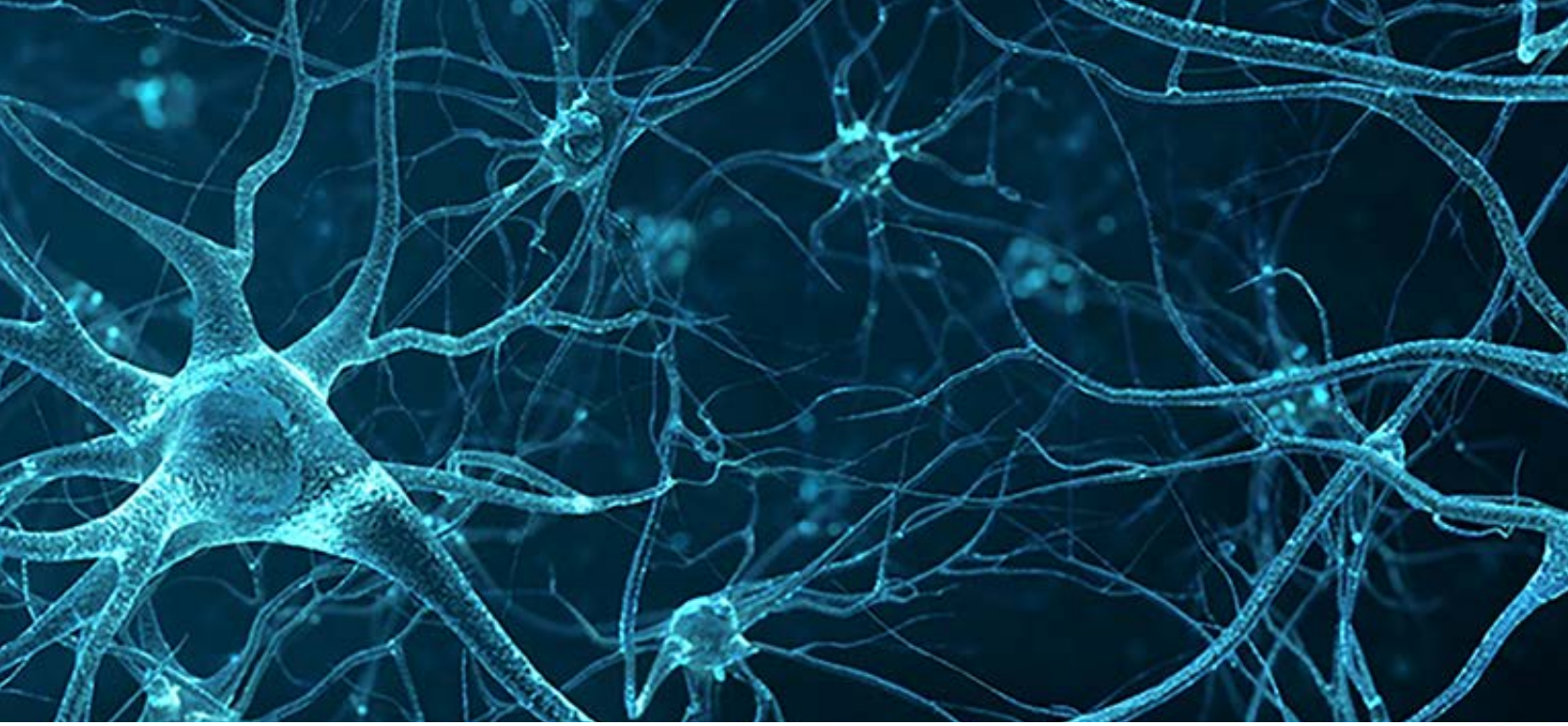


Fig. 1.2: Left intrapelvic pudendal nerve

A: sciatic nerve – B: pudendal nerve – C: obturator nerve



Prof. Marc Possover has become a pioneer in the fields of the neuropelveology that deal with neuropathic pelvic pain, endometriosis of the pelvic nerves, and dysfunctions of the pelvic nerves, and the world-wide pioneering leader in the use of laparoscopy for nerve-sparing techniques in pelvic surgeries and for implantation of neuroprosthesis to the pelvic nerves for recovery of pelvic function and locomotion in individuals with spinal cord injuries.

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