Pelvic nerve damage secondary to surgery for pelvic organ prolapse – risk procedures, symptoms and management – report of 92 cases.

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Introduction
All pelvic, perineal and obstetrical procedures potentially expose patients to pelvic nerve injuries. Damages happening during interventions (Primary Nerve Injury – PNI) are due to coagulation, suturing, ischemia or cutting and induce troubles of sensation, pain and dysfunctions starting immediately after the procedure or after a short interval of several days. In contrast, nerve lesions by fibrotic tissue or vascular compression/entrapment (Secondary Nerve Entrapment – SNE) usually require several months or even years to develop. Implantation of sutures or mesh material or hematoma/abscess formation in proximity to nerves constitute a risky situation for both PNI and/or SNE. Transvaginal sacrospinous colpopexy is the classical high risk procedure for pudendal nerve injury by direct lesion while suturing the sacrospinous ligament [1] but also by entrapment when a hematoma or an abscess of the ischio-rectal space develops. More recent interventions using mesh material for sacrospinal fixation [2], sacro-colpopexy or rectopexy may also expose patients to risk of nerve damage. However, reports about iatrogenic pudendal neuralgia are rare in current literature [3].
We thus believe that the rates of iatrogenic pelvic nerve damage secondary to pelvic organ prolapse surgery are unknown and probably widely underestimated. The purpose of this manuscript is to report about our experience with nerve injuries secondary to pelvic organ prolapse surgeries.

Materials and Methods
We report on all consecutive women who were referred to us for suspicion of pelvic nerve damage secondary to surgical interventions for pelvic organ prolapse. Preoperative assessment not only focused on gynecological aspects, but also included neurologic symptoms for pelvic nerves pathologies [5]. Patients were asked preoperatively a set of questions regarding potential causes (previous surgeries, endometriosis...), time of apparition, duration, and severity of pain using a graduated scale (Visual Analog Scale – VAS) from 0 “no pain” to 10 ”worst imaginable pain” for
standardized quantification of pain. This included also detailed information’s of pain involving the buttock, pudendal areas and the lower extremities. Information’s were also obtained on possible motor deficits of hip adduction (L3/Obturator Nerve), knee extensors (L1-L4/Femoral Nerve), ankle dorsiflexion (foot drop – L5) and ankle plantar flexion (S1). Sphincters dysfunctions, motor/sensitive urinary urgency or voiding difficulties were explored by urodynamic testing. Beside gynecologic palpation and vaginal sonography, clinical examination included exploration of all lumbosacral dermatomes and vaginal palpation (with eventual local anesthetic infiltrations) of the pudendal nerves and of the lower sacral nerves roots. Patients were requested to keep a record of their consumption of analgesics, which has been stopped before surgery. The same evaluations were performed at post-operative follow-up.

All procedures were performed by laparoscopic transperitoneal approach using simple instruments such as bipolar forceps, scissors, grasping forceps and a laparoscopic nerve stimulator, as described elsewhere [6]. Vision with possibility of magnification was obtained using a 10mm/0°-HDTV endoscope introduced through the umbilicus. The technique for exposure the different pelvic nerves and plexuses were reported largely in previous publications [7,8,9]. All procedures were focused on dissection of the nerve(s) suspected injured in preoperative assessment, avoiding unnecessary dissections. If any etiology such a fibrosis or vascular nerve entrapment, a suture, a clip or a mesh tying/compressing a nerve was found, exposure with decompression of the nerve – neurolysis – was performed. Laparoscopic Implantation Of Neuroprothesis – LION procedures [10,11] – were performed only in three indications:

- When no etiology for neural pain could be determined at laparoscopy, although neuropathic symptoms were certain
- In axonal nerve damage with symptoms such as detrusor hypo-/atonia, urinary or faecal incontinence, troubles of locomotion, hypo-/anesthesia in the corresponding dermatome(s). In such situations, the LION procedure was performed even when an etiology was found by laparoscopy.
- When the etiology (-ies) diagnosed by the laparoscopic exploration appeared not to be enough to explain the entire symptomatology especially the pelvic organs dysfunctions, at subjective intraoperative evaluation.

The LION procedure consisted of the implantation of a multiple channel electrode in direct contact to the nerve(s) suspected injured. In pelvic organs dysfunctions, octipolar electrodes were placed perpendicularly to the sacral nerves roots S2 to S4 enabling this way the stimulation of all three sacral nerves roots in different combinations with different currents at same time [5,12]. The interventions are then followed by a two-week test phase of external stimulation with alternative periods of switching “off” and “on” to assess the objective efficacy of the
neuromodulation. To be called effective, neuromodulation had to produce at least a 50% reduction in pain of the Visual Analog Scale and/or a significant improvement of the dysfunctions (complete control to incontinence in normal conditions of daily life, control of bladder pain, hypersensitivity or hyperactivity and voluntary bladder voiding with residual volume of less than 80ml).

All patients were clinically evaluated at the time of discharge, and on a two-month basis for the first 6 months following surgery, then yearly. Patients living abroad were followed up by telephone or by mail.

**Results**

Ninety-five consecutive patients were included in this study. Mean age of patients was 51 years (34-86) and mean BMI 29.9 (24-33). All procedures were performed by laparoscopy without any need of conversion to laparotomy or any major intra-operative complication or hemorrhage.

Table 1 show the kinds of nerve damages with corresponding interventions, neurologic symptoms and type of lesions, primary or secondary. The most common previous interventions observed in our series were laparoscopic rectopexies – more than laparoscopic sacrocolpopexy – which produced PNI associated with the step of suturing the mesh to the sacral bone, as well as for SNE due to fibrosis and vascular entrapment.

Four patients had undergone previous removal of Mc Call sutures, three by vaginal way, one by laparoscopic way, and one by both ways without any improvement of pain. Laparoscopic exploration showed persistence of a suture-induced fibrosis involving the nerve in all four patients, in combination with vascular entrapment.

After laparoscopic nerves decompression, the mean-VAS-score of 8.9 (±0.96; 6-10) preoperatively decreased to 2.9 (±2.77; 0-6) at one-year follow-up. Eighty-eight (92%) patients had reported, after a few days primary period of pain relief, the appearance of severe allodynia in corresponding dermatomes, which disappeared again after a period of 6 months in average (2-18 months). Seven patients (8%) reported significant, permanent and durable improvement of pain after the procedure without recurrence of any allodynia.

Five further patients had undergone a sacral LION procedure. In three of them, neuromodulation was not necessary because significant improvement in pain even with the temporary neurostimulator turned off; the leads were left subcutaneously in both patients, so that in situation of reappearance of pain, neuromodulation could be still feasible without need of a reimplantation. In the two further patients, a LION procedure was indicated not only for control pain but also for the treatment of bladder hypotonia with residual volume greater > 150ml. In both patients, neuromodulation permitted control to pain with a VAS reduction > 50%. In one, optimal micturition with residuals< 50ml could be obtained, while the second still presented residual varying between 80 and 120ml.
Discussion

Real rates on pelvic nerves injuries secondary to pelvic surgeries are unknown due to database limitations underdiagnosing or underreporting[3]. As a proof of that, all the patients reported in this series came from many European and some non-european services and none patients reported in present manuscript or in our previous series [4] have been reported elsewhere.

The fact that a significant portion of the evidence available on pelvic organ prolapse surgery is based on cases studies produced by the manufacturers could play a role on the underreporting; but the main reasons are obviously the lack of declarations and reports because of difficulties of acceptance of such complications, lack of diagnosis or follow up patients with such lesions, and probably the lack awareness that such lesions may exist at all.

Although sacral nerves roots damages secondary to laparoscopic rectopexies are the most frequent injuries in our series, this kind of complications has, to our knowledge, never been reported in the literature, where, to our knowledge, only damages to the superior hypogastric plexus are mentioned[13].

This leads us to suppose that nerves lesions are either not reported or not diagnosed. In PNI, since pain and dysfunction develop right after the procedure, a possible surgical complication is early evocated by both the surgeon and the patient. This usually leads to re-intervention that can possibly result in etiologic treatment. Improvement in pain makes then declaration of complication unfortunately “superfluous”.

In SNE, the situation is much more complex. Since pain appears after an interval of several months or years, relationships between both the intervention and the apparition of pain is not evident. Diagnosis are even more difficult as neuropathic pain are not located into the pelvis, but on distance in the lower back, the buttock, the pudendal areas or in the lower extremities; all these pain locations are usually correlated with orthopedic or neurosurgical conditions.

So only few reports are found in current literature. Hamilton Boyles had reported about neurologic complications after transobturator tape systems implantation, but omitted proper neurologic diagnosis and only listed unsuitable symptoms such as “neuropathies”, “difficulties ambulating”, “numbness in the lateral calf foot and posterior thigh” and “unspecified neuropathy” [14]. Flynn and al. had also reported about nerve damage after uterosacral ligament suspension [15]. Because patients had presented only troubles of sensitivity, he suspected lesions of the posterior cutaneous nerve of thigh and proposed removal of the suture as treatment of choice. We report here about the same neurologic complication after uterosacral ligament suspension, but laparoscopic exploration of pelvic nerves showed in all patients’ lesions of the sacral nerve root S2. An isolated lesion of the posterior femoral cutaneous nerve during vaginal surgery is, in our opinion, anatomically impossible since this nerve
is a distal, extrapelvic, branch of the inferior gluteal nerve. Moreover, this last nerve arises from the lateral aspect of the sacral nerves roots L5-S2, which makes its isolated lesion – without any damages to the sacral nerve roots – by vaginal approach quite impossible. Flynn rejected lesions of the sacral nerves roots because of lack of motor dysfunctions; this is not in contradiction to our findings since only axonal lesions induce motor dysfunctions while extrinsic nerve irritations induce mostly troubles of hypersensitivity or hyperactivity of the pelvic visceral organs but no hypo/atonyn. Moreover, axonal lesions of the second sacral nerve root induce difficulties for motion the big toe, not for deambulation.

While these interventions exposed patients for both primary and secondary nerves damages, interventions with mesh implantation by vaginal approach for vaginal prolapses seems to expose patients more for SNE. Especially when they involve new devices developed for vaginal implantation by technique of blind needle driving and minimal dissection, because, when any bleeding occurs, hematomas cannot drain and tend to dissect in retroperitoneal spaces, even at supracleavatoric compartments.

The most common previous interventions observed in our series were laparoscopic rectopexies – more than laparoscopic sacrocolpopexy – which produced PNI associated with the step of suturing the mesh to the sacral bone, as well as for SNE due to fibrosis and vascular entrapment. The second sacral nerve root on the right side is the most exposed nerve: left-sided position of the surgeon and middle position of the rectosigmoid make the fixation on the right side more lateral that in turn expose the patient for nerve injury. S2-lesion – especially on the left side – after vaginal uterosacral ligament suspension was the second most frequent lesion, and seems to be correlated with exaggerated deepness at the placement of the sutures on the left sacrouterine ligament, reaching the left pelvic sidewall especially when the surgeon is right-handed.

The logical treatment of such nerve damages would be the removal of sutures and/or mesh, but our findings show that the results are depending from time of this reintervention. When diagnosis is made early after the procedure, the chances of cure the patient are realistic and high. On the contrary, if surgical indication is made after a long period of several months or years, because dense fibrosis and/or atypical vessels (vascular entrapment) tend to develop, simple removal of the suture or mesh usually do not resolve the problem. Our approach is therefore not based on primary removal of sutures or meshes, but on the primary exposure and decompression of injured nerves, with partial removal of sutures or meshes when these are in direct contact with the nerves. LION procedures are only indicated in cases of axonal damage.

All these neurological considerations should motivate pelvic surgeons to acquire proper knowledge’s about clinical “pelvic neurology”, which we name “neuropelveology”. Early diagnose offers patients the best chances for pain improvement and protect surgeons against medicolegal troubles. This is even more important in cases of
chronification of pain, where it is more probable that the patients will consider nerve damage as a true surgical complication and will develop strong aversion again medical community. To avoid such dramatic evolutions, major symptoms for somatic pelvic nerves damages should be recognized.

Neuropathic pain by lesions of pelvic somatic nerves are reported as “burning pain” (allodynia) or “electrical pain” located in the dorsal face of the thigh (S1, S2), the perianal/genital and perineal dermatomes (S3, S4 – pudendal pain), the buttock (S1, S2, S3), the lower back dermatomes (L5, S1), the internal (obturator nerve) or the anterior (femoral nerve) dermatomes of the thigh. A lesion of a pudendal nerve itself induce a isolated pudendal pain, usually unilateral and without any incontinence - as long as pudendal destruction is not bilateral - while sacral radiculopathies induce same pudendal pain (S3,S4) but in combination with a sciatica (L5,S1,S2), pain in the buttock (S1,S2,S3) or low back pain (L5,S1,S2). Injuries of S2 can induce sexual dysfunction, while lesions of the S3 and S4 will induce hyperactivity or hypersensitivity of bladder and/or rectum, when extrinsic damages had occurred, or detrusor hypotonia or even a bladder/rectum atonia, in cases of axonal lesions.

When a diagnosis of a pelvic nerve injury is evocated, meticulous clinical evaluation and precise preoperative topographic diagnosis is mandatory. When the exact injured nerve(s) is(are) clinically and urodynamically determined, laparoscopic exploration must be then considered as the first step in management of patients, since it results not only in a proper etiological diagnosis but also allows for decompression of the nerves and or implantation of electrodes for neuromodulation in axonal damages. Laparoscopic exploration must be then indicated as soon as possible, before nerve damages become irreversible and before the process of chronification of the pain begins. According to our findings, risk procedures for pelvic nerves damages are the rectopexy (PNI S2 on the right side), the vaginal uterosacral ligament suspension (PNI S2 on the left side) and the dorsal mesh implantation (SNE of pelvic nerves).

Our findings highlight the importance of long term follow up of patients after surgeries for pelvic organ prolapse, not only focused anatomical and functional outcomes but also on nerve(s) damages that can appear months or even years after the primary procedures.

References


Figure 1: algorithm for treatment by laparoscopy
### Table 1: Somatic pelvic pain: Correlation between the type of procedures, nerve(s) damages and the corresponding symptoms.

<table>
<thead>
<tr>
<th>Surgical Procedure</th>
<th>Injured Nerve</th>
<th>Symptoms</th>
<th>PNI</th>
<th>SNE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abdominal/laparoscopic</td>
<td>S2 right</td>
<td>Pudendal pain, S2 sciatica, neuralgia of Cutaneous Femoralis Posterior Nerve.</td>
<td>37</td>
<td>22</td>
</tr>
<tr>
<td>Rectopexy/Sacrocolpopexy</td>
<td></td>
<td>Bladder hyper-activity/sensitivity Detrusor hypotonia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>McCall procedure</td>
<td>S3/S4 (left&gt;right)</td>
<td>Pudendal pain, S2-S4 sciatica neuralgia of Cutaneous Femoralis Posterior Nerve.</td>
<td>14</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bladder hyper-activity/sensitivity Detrusor hypotonia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transobturator sling</td>
<td>Pudendal nerve</td>
<td>Pudendal pain</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Prolift®</td>
<td>Sacral Plex and/or obturator nerve</td>
<td>Pudendal pain, sacral radiculopathy obturator neuralgia Bladder hyper-activity/sensitivity Detrusor hypotonia</td>
<td>2</td>
<td>11</td>
</tr>
</tbody>
</table>

*PNI: primary nerve injury; SNE: secondary nerve entrapment*