Short Communication

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Regenerative Medicine

GOLDIC therapy in degenerative lumbar spinal stenosis: randomized, controlled trial

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Aim: Comparison of the efficacy of conservative treatment methods: epidural GOLDIC serum, epidural steroid injections, manual therapy. **Materials & methods:** A randomized, controlled trial. Three groups, each containing 30 patients. GOLDIC or steroid injections (dexamethasone) epidural versus manual therapy. Assessment: initial assessment and 4 (T1), 12 (T2) and 24 (T3) weeks after the last intervention. Primary outcomes: Pain intensity in numeric rating scale, Oswestry disability index, Zurich claudication questionnaire, EQ-5D-5L questionnaire. **Results:** GOLDIC has shown the highest mean differences and number of cases with minimal important difference among groups for every primary outcome. **Conclusion:** GOLDIC therapy could be a new option for the nonoperative, symptomatic treatment of degenerative lumbar spinal stenosis and is not inferior to epidural steroid injections and manual therapy.

Plain language summary: This paper presents a comparative study of three methods of nonoperative treatment used in stenosis (narrowing) of the spinal canal in the lumbar region. The study was performed on 90 people with this kind of disease, which usually causes low back pain, combined with weakening of the muscle strength of the lower limbs and a significant shortening of walking distance. It turned out that autologous serum GOLDIC administered by epidural injection (into the vertebral canal) showed a stronger and longer-lasting analgesic effect and helped patients maintain better mobility during the 24-week follow-up period.

Clinical Trial Registration: NCT04492774 (ClinicalTrials.gov)

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Keywords: biological products • injections • musculoskeletal manipulations • spinal stenosis • steroids

Degenerative lumbar spinal stenosis (DLSS) is a serious health problem for elderly patients. In the USA alone it affects about 200,000 patients, causing significant impairment of their quality of life and social costs [1].

A widely accepted, cause-oriented approach in DLSS therapy is decompression of the neural structures by the surgical widening of the spinal canal; however, this type of management is not always possible due to the specific risks associated with surgical intervention, especially in elderly patients. In symptomatic DLSS therapy, the treatment of choice is to alleviate pain by means of anti-inflammatory agents, not only by systemic but also by local administration, especially epidural steroid injections (ESIs). Numerous studies confirm the temporary reduction of pain through the anti-edema and anti-inflammatory effects of steroids; however, in addition to the well-known side effects of steroid drugs, there is a risk of microembolism using crystalline steroids; thus, ultimately, noncrystalline steroids into the epidural space are recommended [2–4].

An alternative to the usage of steroid drugs may be an autologous serum named GOLDIC (gold-induced cytokines), introduced in 2014 by Ulrich Schneider. By using the phenomenon of anti-inflammatory cytokine proliferation occurring during a long incubation of whole blood in tubes coated with gold particles, serum with very strong anti-inflammatory properties can be obtained. At the same time, a large amount of plasma gelsoline (pGSN) – an actin-depolimerizing protein – is being synthesized, which promotes the migration and activation of stem cells available locally in damaged tissue, joints or even in the spinal canal [5].

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A suboptimal level of pGSN is associated with an increased risk of cellular apoptosis, and its production protects the cell from degeneration and damage [6,7].

Another equally important product of incubation on gold particles is granulocyte-colony stimulating factor (G-CSF), which can stimulate the bone marrow to produce granulocytes and stem cells, which are secondarily released into the bloodstream.

GOLDIC therapy was invented and introduced by Arthrogen GmbH (Germany). It was registered as a medical product with CE 0481; in Poland it was registered at the Office for Registration of Medical Products in 2018 under the number 1Z903Y6R0440931291.

Referring to the premise of the beneficial effect of any anti-edematous treatment, it can be assumed that manual therapy (MT) based on venous-lymphatic drainage of the vertebral plexus may be justified. The concept of the release of venous stasis inside the spinal canal by manual decompression of the thoracic outlet, diaphragm and pelvic floor and improvement of chest mobility allows the pressure gradient above and below the diaphragm to be changed [8]. The meta-analysis of Kirker *et al.* [9] proved the superiority of rehabilitation, multimodal, patient-centered management over placebo/nonintervention in pain reduction where all other comparisons with no treatment/placebo revealed nonsignificant findings.

Clinical rationale for the study

Taking into consideration the hypothesis that at least some symptoms of DLSS are of inflammatory origin, the main objective of this study is to determine whether epidural administration of GOLDIC would be at least as effective as ESIs or MT.

Materials & methods

The study design was a single-center, open, prospective, randomized, controlled trial for outpatients. The protocol of the trial was approved by the Bioethics Committee at the Faculty of Health Sciences of the Jan Kochanowski University in Kielce (reference no. 14/2020, 18 May 2020). All procedures performed in the study were in compliance with the ethical standards of the Bioethics Committee and with the 1964 Helsinki Declaration and its later versions. Written informed consent was obtained from all participants prior to any intervention. The study was performed in Sutherland Medical Center, Warsaw, Poland, and all data were collected and are stored and available there. The trial was registered on ClinicalTrials.gov (NCT04492774) on 30 July 2020 (initial release) and last updated on 3 November 2021 (Unique Protocol ID: SMC20200021; brief title: Degenerative Lumbar Stenosis Conservative Treatment [GOLDSTEN]).

The study was conducted in accordance with the protocol presented to the ethics committee. Three groups of patients, each containing 30 participants, were enrolled. Patients meeting the inclusion criteria were allocated randomly according to the computer-generated randomization list (block randomization; block size: 6). No changes in allocation and no changes in the methodology of the study took place throughout the study. The three groups were as follows: group A: GOLDIC – four injections at 3-day intervals, each containing 3 ml of serum, interlaminar approach, epidural under ultrasound control by the same operator, above the level of dominant stenosis; group B: ESIs with dexamethasone (Dexaven 4 mg/1 ml) – two injections at weekly intervals containing a single dose of dexamethasone, the technique of injections as above; and group C: MT according to the concept of venous-lymphatic drainage, a reproducible protocol for each patient delivered by the same therapist, thoracic outlet decompression, diaphragm release, sacroiliac joint mobilization, rib-sternum release, four sessions (one time weekly, ~40 min) and all patients were instructed on how to continue self-management by respiratory exercises in drainage-friendly positions. The concept of this therapy was born from the experience of osteopathic medicine, in which the milestone is the attempt to normalize the pressure gradient above and below the diaphragm (usually to reduce raised intra-abdominal pressure) as a factor that promotes the venous-lymphatic outflow from the retroperitoneal space and indirectly from the spinal canal thanks to the connection of the venous spinal plexus with the system of vena azygos [8].

The inclusion criteria were as follows:

1. Clinical signs of DLSS;
2. Radiological signs of DLSS confirmed by imaging;
3. No contraindications to steroids;
4. Mental status allowing cooperation during MT;

5. An adult who consents to participate in the study.

The exclusion criteria were as follows:

1. The presence of serious neurological deficits;
2. Stenosis of another origin such as post-traumatic, spondylolisthesis, cancer, infection;
3. Previous lumbar spine surgery;
4. Mental status being an obstacle during MT;
5. Lack of consent to participate in the study.

Primary outcomes were: pain intensity in the numeric rating scale (NRS: 0–10), Oswestry disability index (ODI: 0–50), modified (without section evaluating postoperative status) Zurich claudication questionnaire (ZCQ: 12–55), EQ-5D-5L index (EQ index: -0.590–1.00), EQ-Visual Analog Scale (EQ VAS: 0–100) and EQ-5D-5L-based level sum score (EQ LSS: 5–25). Secondary outcomes were the number of cases with minimal important difference (MID) and mean differences between the initial assessment (IA) and T3 (MD – IA/T3) for the questionnaires. Assessment was done as follows: baseline – IA and 4 (T1), 12 (T2) and 24 (T3) weeks after the last intervention.

Statistical method

In order to obtain comparable values between the groups, delta values were calculated for each patient and each primary outcome, between IA and T3, as were the number of cases achieving MID values at T3. On the basis of previous publications [10,11], MID values were determined for each measurement scale.

MID values were established as follows: MID for NRS: 3/10, MID for ODI: 10/50, MID for ZCQ: 10/55, MID for EQ-5D-5L index: 0.05 (no MID for EQ-5D-5L VAS and LSS).

A power analysis was used to estimate the minimum sample size required for an experiment, given the desired significance level, effect size and statistical power. The power of the test was set at 0.8 and the significance level at 0.05, assuming that the effect size was f = 0.35. This allowed the authors to establish that the research sample for the three compared groups should not be smaller than 90 subjects (each group with 30 participants).

Descriptive statistics for demographic data, an analysis of variance test to prove initial comparability of the groups regarding age, NRS, ODI, ZCQ, EQ-5D-5L index, EQ-VAS, the number of cases that achieved MID in specific groups and differences in mean value between the baseline IA and the T3 point for every patient were calculated. Also, Chi-square probability was calculated to see if the dropout rate in group B and group C was significantly higher than in group A (risk level: 0.05). All calculations and graphics were performed using IBM SPSS version 27.

Results

150 patients were screened for eligibility. 31 patients were ineligible because of lumbar spine comorbidities. Out of 119 patients meeting the inclusion criteria, 29 patients refused to participate in the trial, and 90 patients were enrolled. During the follow-up process, 22 (24%) patients dropped out: (n = 2 [7%], 11 [37%] and 9 [30%] in groups A, B and C, respectively). The Chi-square test did not reveal any statistical significance for dropouts between groups A, B and C (Chi-square: 1.971; [df]:= 2; p = 0.373).

The enrollment and follow-up process is presented in Figure 1.

The treatment was accomplished by 87 patients (96.7%). All checkup visits were passed by 68 patients (75.6%). There was no participant crossover (Table 1).

The mean NRS values' evolution in specific groups is presented in Figure 2. A reduction in pain intensity was very similar in the first month of observation; in the steroid group, pain level continued to diminish but was less intense than in the serum group, especially between T1 and T2, opposite the MT group, where there was a plateau and since T2 even regression. MD – IA/T3 values for the NRS were as follows: A: 3.14, B: 2.47, C: 1.38. The results were statistically significantly different (p = 0.030).

The mean ODI values' evolution in a specific group was of a similar pattern; reduction was observed mainly between IA and T1 (Figure 3). The serum group revealed a very rapid reduction of ODI in the first month of observation, then slowed down but did continue up to T3. In the steroid group ODI values' evolution was less dynamic, especially in the middle period of observation; the MT group again regressed after T2. MD – IA/T3 were A: 9.39, B: 7.16, C: 1.86. The results were statistically significantly different (p = 0.005).

The mean ZCQ values' evolution in the groups revealed another pattern for the steroid group (Figure 4). While the serum group again revealed the most prominent reduction of claudication index within 3 months of observation,

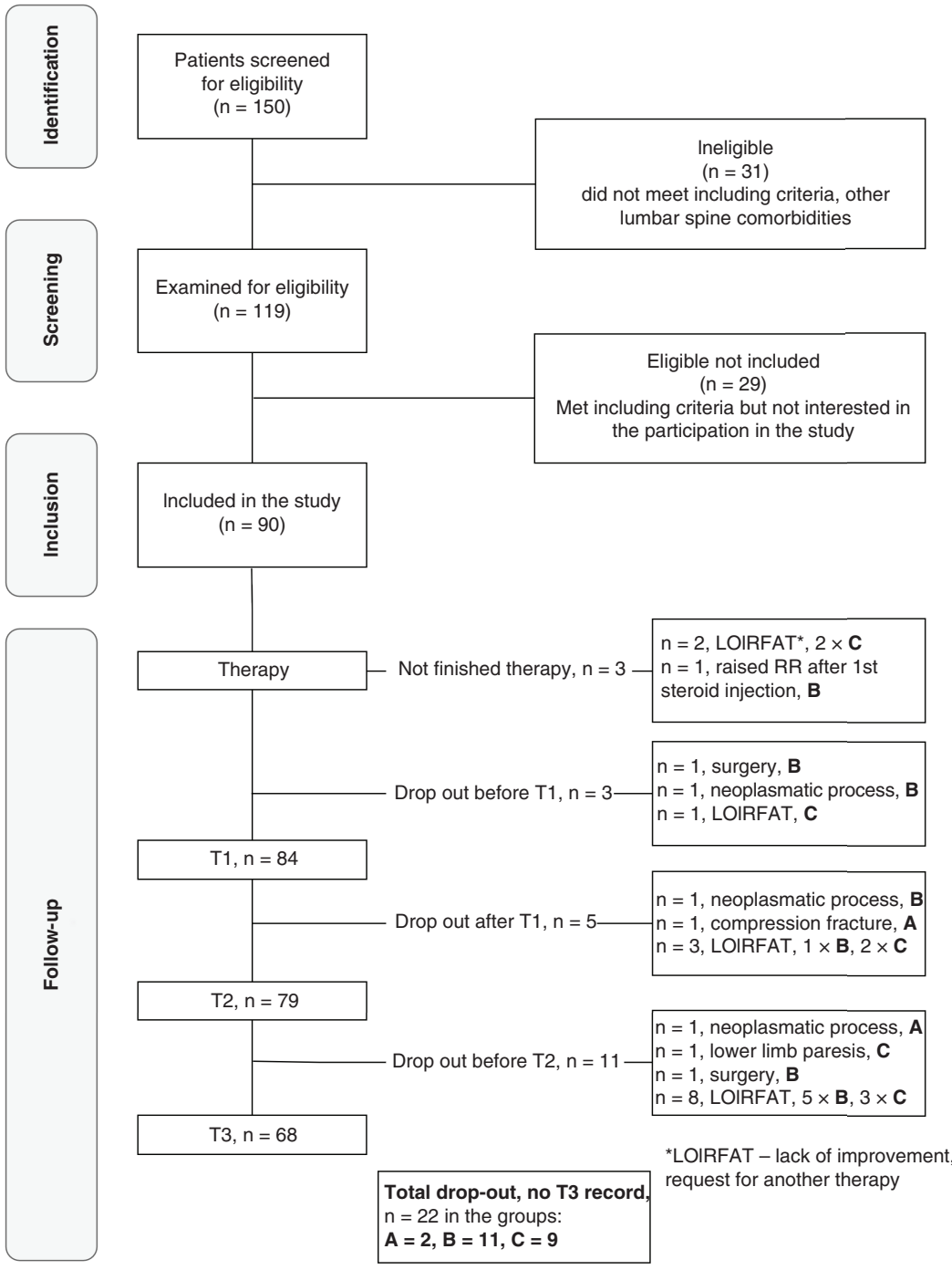

Figure 1. The enrollment and follow-up process.

the steroid group revealed a steady, 'lazy' drop of index throughout the whole follow-up. Again, after T1 no changes or even regression in the MT group could be noted. MD – IA/T3 were A: 7.75, B: 6.32, C: 2.90. The results were nonstatistically significantly different (p = 0.20).

The EQ-5D-5L index, strongly associated with quality of life, rose most prominently within the first month of observation in the serum group, which is parallel to the reduction of LSS score in the same period, whereas the EQ-5D-5L VAS continued to rise throughout the whole period of observation in this group. MD – IA/T3 for the EQ-5D-5L index were A: 0.18, B: 0.11, C: 0.06; for the EQ-5D-5L LSS they were A: 3.46, B: 2.94, C: 1.05; and

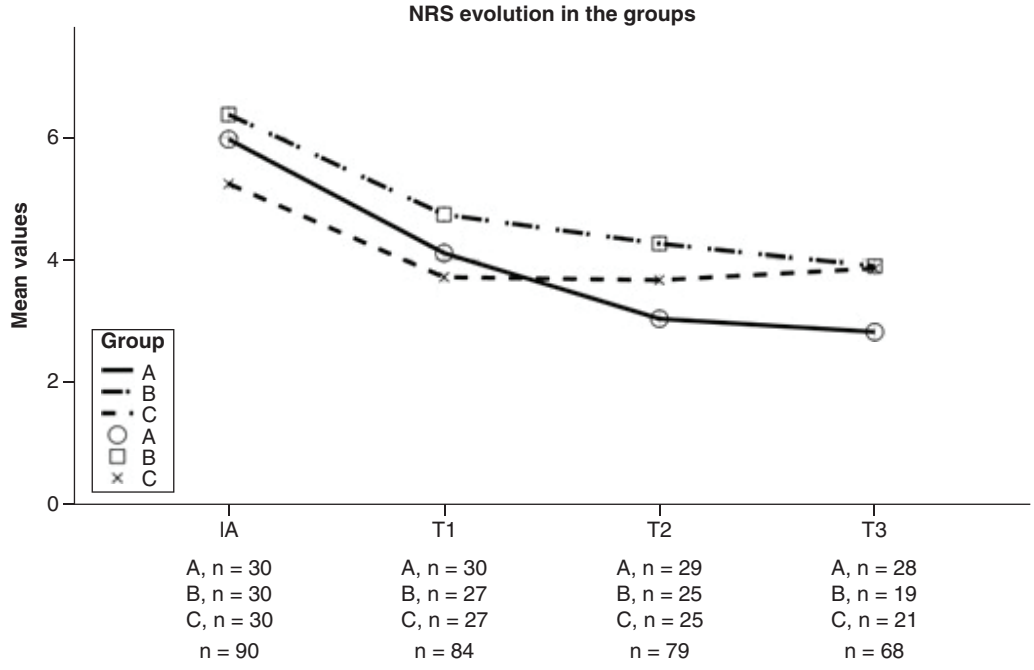

Figure 2. Numeric rating scale mean values' evolution in specific groups.
IA: Initial assessment; NRS: Numeric rating scale.

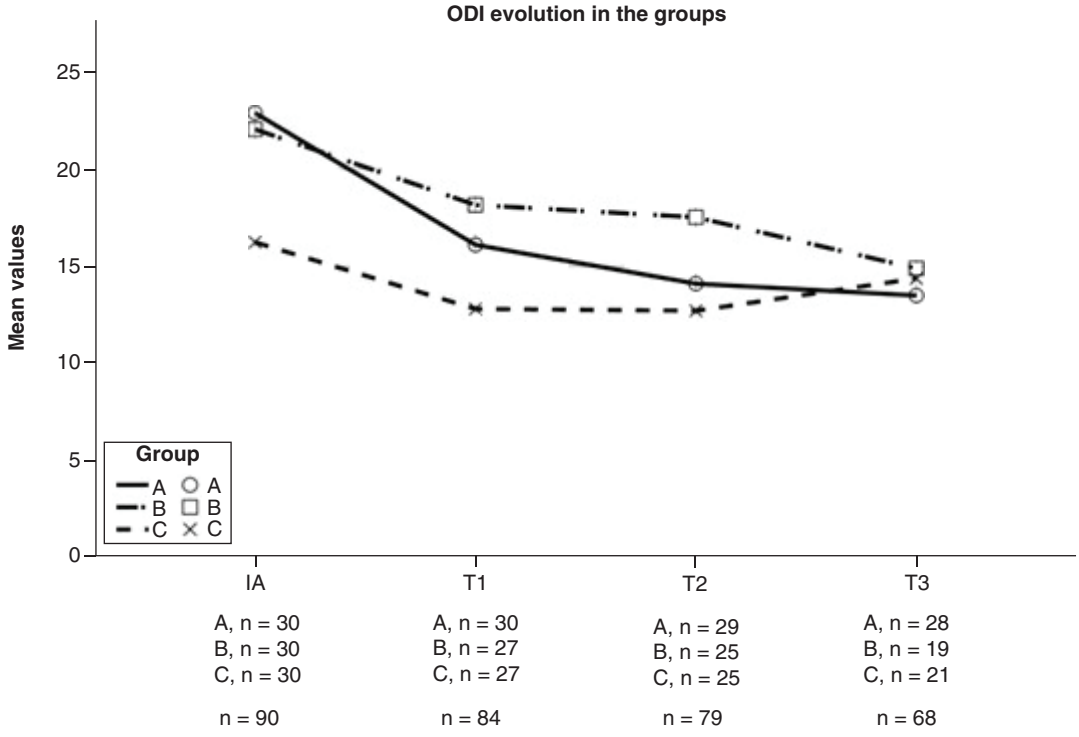

Figure 3. Mean Oswestry disability index evolution in specific groups.
IA: Initial assessment; ODI: Oswestry disability index.

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Table 1. Demographic and clinical characteristics.

Total number of patients, n	**90**
Female, n (%) Men, n (%)	65 (72.2) 25 (27.8)
Age, years, mean ± standard deviation (range)	70.1 ± 10.03 (40–95)
Duration of complaints weeks, mean ± standard deviation (range)	33.62 ± 39.32 (2–250)
Degenerative lumbar spinal stenosis phase, n	
Acute phase patients	6 (6.7)
Subacute phase patients	27 (30.0)
Chronic phase patients	57 (63.3)
Type of degenerative lumbar spinal stenosis, n (%)	
Single-level	42 (46.7)
Multilevel	49 (53.3)
Dominant level, n (%) L1/L2 L2/L3 L3/L4 L4/L5 L5/S1	 1 (1.1) 3 (3.3) 29 (32.2) 54 (60.0) 3 (3.3)
Side of complaints, n (%)	
Right	31 (34.4)
Left	19 (21.1)
Both	40 (44.4)

Analysis of variance did not reveal any significant statistical difference according to age, pain intensity in the numeric rating scale, Oswestry disability index, Zurich claudication questionnaire and EQ-5D-5L index mean values in the initial assessment between groups.

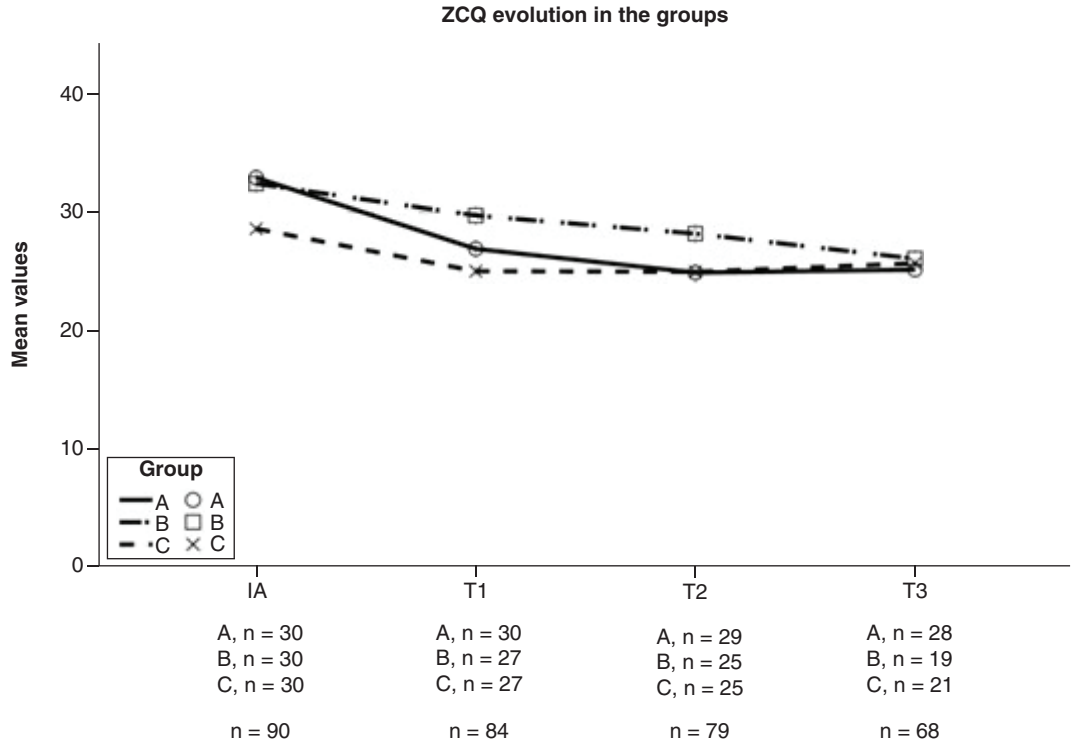

Figure 4. Zurich claudication questionnaire evolution in specific groups.
IA: Initial assessment; ZCQ: Zurich claudication questionnaire.

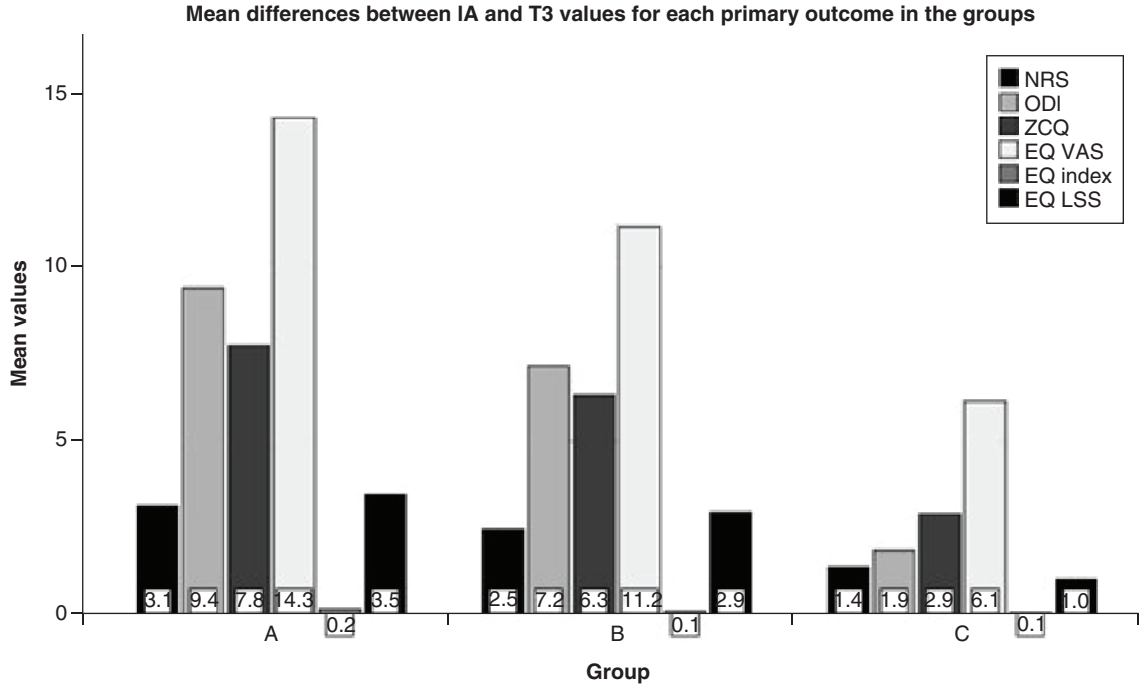

Figure 5. Mean differences between initial assessment and T3 values for each primary outcome in the groups.
EQ index: EQ-health state; EQ-LSS: EQ-5D-5L-based level sum score; EQ-VAS: EQ-Visual analog scale; IA: Initial assessment; NRS: Numeric rating scale (pain intensity); ODI: Oswestry disability index; ZCQ: Zurich claudication questionnaire.

Table 2. The number of cases that achieved minimal important difference in the groups.

Group	MID numeric rating scale	MID Oswestry disability index	MID Zurich claudication questionnaire	MID EQ-5D-5L index
A	20	12	9	3
B	9	7	6	2
C	6	2	2	4

MID: Minimal important difference.

for the EQ-5D-5L VAS they were A: 14.3, B: 11.2, C: 6.1. In all comparisons, the results did not differ statistically significantly ($p > 0.05$).

Mean differences between IA and T3 values for each primary outcome turned out to be the greatest in the serum group (Figure 5 & Table 2).

Deterioration of primary outcomes among the cases that arrived at T3 in a specific group is presented in Table 3.

Despite the predominance of patients analyzed in the T3 end point in the serum group, the percentage of cases with deterioration of the NRS did not rise and ODI scores were even the lowest in the serum group. Deterioration of mean values by no means is the same as adverse effects or complications. Some adverse effects but no serious complications were noted during follow-up. Three cases of transient headache were reported in the serum group. In the steroid group, a significant increase of blood pressure (BP; two cases; one quit therapy after the first dose) was reported, and one case reported deterioration after the fourth MT session. No infections were reported.

Discussion

Since the late 1980s, there has been a continuously growing interest in the field of biological active therapies, both of the cellular type (platelet-rich plasma, mesenchymal stem cells) and of the acellular type (autologous conditioned serum). The rationale for this kind of approach is to enhance the innate recovery capabilities of the tissue, slowing down the course of the degenerative process or even regenerating lost fragments of cartilage, tendons, ligaments and even intervertebral disc. The theoretical potential of biological active therapies was confirmed in a myriad of

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Table 3. Deterioration of primary outcomes in the groups.

Primary outcome	Group			
	A n (% of T3)	B n (% of T3)	C n (% of T3)	Total n (% of T3)
Numeric rating scale deterioration	3 (10.7)	2 (10.5)	3 (14.3)	8 (11.8)
Oswestry disability index deterioration	1 (3.6)	4 (21.1)	7 (33.3)	12 (17.6)
Zurich claudication questionnaire deterioration	5 (17.9)	5 (26.3)	2 (9.5)	12 (17.6)
EQ-5D-5L visual analog scale deterioration	5 (17.9)	3 (15.8)	5 (23.8)	13 (19.1)
EQ-5D-5L index deterioration	6 (21.4)	2 (10.5)	7 (33.3)	15 (22.1)

% of T3: % of cases that arrived at T3 in a specific group; n: Number of cases.

papers, mostly in the fields of sports medicine, plastic surgery and esthetic medicine. However, in the field of spine disorders, the outcomes of biological active therapies are very ambiguous; therefore, the recommendations for their use range from enthusiastic to skeptical [12–14].

No reports of the use of autologous conditioned serum in the symptomatic treatment of DLSS have been found in the literature, and the only study confirming the higher efficacy of serum compared with ESIs is provided by Becker *et al.*; however, in that study, autologous conditioned serum was administered for lumbar radiculopathy and not for DLSS [15].

In the steroid group of the present study, the results were similar to those in the study conducted by Friedly *et al.*, in which the improvement obtained in the first weeks after ESI administration was maintained until the end of the follow-up; nevertheless, a large proportion of patients crossed over between groups during the 12-month follow-up (in the present study, they fell out of the observation because of no improvement) [16].

MT according to the lymph-venous drainage concept has not been analyzed in the literature available so far. In a meta-analysis on various rehabilitation protocols in DLSS, its evaluation is ambiguous (moderate-quality evidence), although there are also randomized, controlled trial studies, where higher effectiveness of the individual rehabilitation and therapy protocol has been demonstrated compared with ESIs and group exercises [17,18]. It was not confirmed, however, in the present study.

The most important limitation of this study, besides the paucity of the sample (only 90 patients), is a significant patient dropout rate during the follow-up process, mainly because of ineffective pain management in groups B and C. Potential bias is associated also with the medical initial evaluation made by the same doctor who made interventions (injections), so potentially the patients in the groups of intervention could feel more comforted than patients examined and then referred for rehabilitation. The strength of the study is its randomization, beyond the control of the interventionist, and also the reproducible protocol not only of injections but also of manual therapy with supplementary instructions for home self-managment.

These observations confirm that the long-term efficacy of any conservative intervention for DLSS is difficult to achieve, but the GOLDIC therapy gives a unique opportunity to maintain at least moderate improvement, taking into account no dropout because of therapy inefficacy or intolerance. In the light of the information brought by the meta-analysis of Zaina *et al.* [19], the relatively high rate of side effects ranged from 10% to 24% in the surgical management of DLSS, while no side effects were reported in the case of any conservative treatment; the GOLDIC therapy seems to be a new, interesting option.

Conclusion

GOLDIC therapy could be a new option for the nonoperative, symptomatic treatment of DLSS and is not inferior to ESIs and MT. The significant dropout in the groups has caused potential bias, which further studies should clarify. Based on the obtained results, it is worth carrying out further multicenter studies with a control group (placebo) using objective measurement methods.

Clinical implications & future perspective

A 6-month-long follow-up period with a dropout of only two patients (not related to any unfavorable response to the GOLDIC serum) confirms the safety of multiple injections of autologous serum under ultrasound guidance.

Compared with the ESI and MT groups, it also proves that the GOLDIC procedure maintains and even reinforces the initial anti-inflammatory effect accomplished by each analyzed therapy, which suggests its regenerative potential. Further research lines could include the use of this method in lumbar or cervical radiculopathy to test the anti-inflammatory and anti-edematous potential of serum in the symptomatic treatment of nerve root impingement.

Summary points

- Degenerative lumbar spinal stenosis is a major health problem for aging populations, resulting in chronic pain and disability.
- Surgical treatment, although the only one considered to be causal, is not without risk and is not always available for patients with multiple comorbidities.
- GOLDIC, autologous conditioned serum incubated on gold particles, is an injectable with a high concentration of anti-inflammatory cytokines and a potential for an anti-edematous effect.
- GOLDIC can be safely used epidural as a symptomatic treatment in patients with a high risk of surgical treatment and has been proven not to be inferior to epidural steroid injections and manual therapy.
- The clinical effect of a series of injections is maintained for months and the treatment can be repeated, offering an interesting option for patients with degenerative lumbar spinal stenosis.

Financial & competing interests disclosure

The authors have no relevant affiliations or financial involvement with any organization or entity with a financial interest in or financial conflict with the subject matter or materials discussed in the manuscript. This includes employment, consultancies, honoraria, stock ownership or options, expert testimony, grants or patents received or pending, or royalties.

No writing assistance was utilized in the production of this manuscript.

Ethical conduct of research

The authors state that they have obtained appropriate institutional review board approval or have followed the principles outlined in the Declaration of Helsinki for all human or animal experimental investigations. In addition, for investigations involving human subjects, informed consent has been obtained from the participants involved.

References

Papers of special note have been highlighted as: • of interest; •• of considerable interest

1. Lurie J, Tomkins-Lane C. Management of lumbar spinal stenosis. *BMJ* 352(h6234), doi: 10.1136/bmj.h6234 (2016).

• **Consistent information with a review of ways of degenerative lumbar spinal stenosis management.**

2. Tagowski M, Lewandowski Z, Hodler J, Spiegel T, Goerres GW. Pain reduction after lumbar epidural injections using particulate versus non-particulate steroids: intensity of the baseline pain matters. *Eur. Radiol.* 29(7), 3379–3389 (2019).
3. Bensler S, Sutter R, Pfirrmann CWA, Peterson CK. Is there a difference in treatment outcomes between epidural injections with particulate versus non-particulate steroids?. *Eur. Radiol.* 27(4), 1505–1511 (2017).
4. Mehta P, Syrop I, Singh JR, Kirschner J. Systematic review of the efficacy of particulate versus nonparticulate corticosteroids in epidural injections. *PM R.* 9(5), 502–512 (2017).

• **Important information about the risks of using particular steroids.**

5. Feldt J, Schicht M, Garreis F, Welss J, Schneider UW, Paulsen F. Structure, regulation and related diseases of the actin-binding protein gelsolin. *Exp. Rev. Mol. Med.* 20(e7), doi: 10.1017/erm.2018.7 (2019).
6. Ohtsu M, Sakai N, Fujita H *et al.* Inhibition of apoptosis by the actin-regulatory protein gelsolin. *EMBO J.* 16(15), 4650–4656 (1997).
7. Piktel E, Levental I, Durnaś B, Janmey PA, Bucki R. Plasma Gelsolin: indicator of inflammation and its potential as a diagnostic tool and therapeutic target. *Int. J. Mol. Sci.* 19(9), 2516 (2018).
8. Meert GF. *Venolymphatic Drainage Therapy.* Churchill Livingstone, London, UK, 239–290 (2012).
9. Kirker K, Masaracchio MF, Loghmani P, Torres-Panchame RE, Mattia M, States R. Management of lumbar spinal stenosis: a systematic review and meta-analysis of rehabilitation, surgical, injection, and medication interventions. *Physiother. Theory Pract.* doi: 10.1080/09593985.2021.2012860 (2022) (Epub ahead of print).

10. Ostelo RW, Deyo RA, Stratford P *et al.* Interpreting change scores for pain and functional status in low back pain: towards international consensus regarding minimal important change. *Spine (Phila.)* 33(1), 90–94 (2008).

11. Marra CA, Woolcott JC, Kopec JA *et al.* A comparison of generic, indirect utility measures (the HUI2, HUI3, SF-6D, and the EQ-5D) and disease-specific instruments (the RAQoL and the HAQ) in rheumatoid arthritis. *Soc. Sci. Med.* 60(7), 1571–1582 (2005).

12. Desai MJ, Mansfield JT, Robinson DM, Miller BC, Borg-Stein J. Regenerative medicine for axial and radicular spine-related pain: a narrative review. *Pain Pract.* 20(4), 437–453 (2020).

13. Demetriades AK, Orpen NM. Unproven regenerative medicine 'therapies' in spine. *Pain Pract.* 21(5), 607 (2021).

14. Sanapati J, Manchikanti L, Atluri S *et al.* Do regenerative medicine therapies provide long-term relief in chronic low back pain: a systematic review and meta-analysis. *Pain Physician* 21(6), 515–540 (2018).

15. Becker C, Heidersdorf S, Drewlo S, de Rodriguez SZ, Krämer J, Willburger RE. Efficacy of epidural perineural injections with autologous conditioned serum for lumbar radicular compression: an investigator-initiated, prospective, double-blind, reference-controlled study [published correction appears in Spine. 2007 Nov 15;32(24):table of contents. Dosage error in article text]. *Spine (Phila.)* 32(17), 1803–1808 (2007).

•• **First-ever-done comparative study of steroids versus autologous serum efficacy.**

16. Friedly JL, Comstock BA, Turner JA *et al.* Long-term effects of repeated injections of local anesthetic with or without corticosteroid for lumbar spinal stenosis: a randomized trial. *Arch. Phys. Med. Rehabil.* 98(8), 1499–1507.e2 (2017).

17. Bussières A, Cancelliere C, Ammendolia C *et al.* Non-surgical interventions for lumbar spinal stenosis leading to neurogenic claudication: a clinical practice guideline. *J. Pain* 22(9), 1015–1039 (2021).

18. Schneider MJ, Ammendolia C, Murphy DR *et al.* Comparative clinical effectiveness of nonsurgical treatment methods in patients with lumbar spinal stenosis: a randomized clinical trial. *JAMA Netw. Open* 2(1), e186828 (2019).

19. Zaina F, Tomkins-Lane C, Carragee E, Negrini S. Surgical versus non-surgical treatment for lumbar spinal stenosis. *Cochrane Database Syst. Rev.* 2016(1), CD010264 (2016).

•• **Encouraging study for further research in the field of nonoperative treatment of degenerative lumbar spinal stenosis in the light of significant side effects of surgery.**