

Percutaneous Treatment of Lumbar Intervertebral Disk Hernias With Radiopaque Gelified Ethanol

A Preliminary Study

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Study Design: Prospective clinical trial.

Objective: Demonstrate the safety and efficacy of gelified ethanol in the percutaneous treatment of lumbar disk hernias.

Summary of Background Data: After the commercial withdrawal of Chymopapain, the need for new substances to treat intervertebral disk hernias was evident. Good results were obtained with pure ethanol, but this substance was difficult to handle. We decided to use a similar substance mixed with ethylcellulose to increase its viscosity and enhanced with radiopaque material.

Methods: Two hundred seventy-six consecutive patients sent to be treated of a lumbar intervertebral disk hernia percutaneously were included in this preliminary study and treated with radiopaque gelified ethanol (RGE) and intra-articular steroids. Three groups were set, group A for patients to be treated only with RGE and groups B and C for difficult cases presenting a narrow canal, foraminal hernia, or hiperalgic sleepless hernia, treated with RGE plus another intradiscal technique, automated percutaneous discectomy for group B and radiofrequency nucleoplasty for group C.

Results: Very good or good results were obtained in 202 (91.4%) of the 221 patients in group A. Of the 44 patients in group B, 37 patients (84%) presented very good or good results and in 9 (82%) of the 11 patients of group C, we obtained similar results. There was no allergic complication in any of our patients. Short-term follow-up with magnetic resonance showed little or no changes in the intervertebral disk but there was discordance with clinical signs. Long-term follow-up magnetic resonance showed a dramatic reduction in hernia volume.

Conclusions: This preliminary study shows the efficacy and inocuity of this new substance that could take over the Chymopapain therapeutic field.

Key Words: disk hernia, percutaneous, radiopaque gelified ethanol, back pain, Chymopapain, discectomy, nucleoplasty

(*J Spinal Disord Tech* 2007;20:526–532)

The commercial withdrawal of Chymopapain^{1,2} has induced a radical modification in the way we treat intervertebral disk hernias (IDH). Following the experience of Riquelme et al,³ we have used pure ethanol (PE) for this purpose, with satisfactory and comparable results with the ones achieved by them. However, the diffusion of PE remains hardly controllable and we have experienced a few cases of transient burning radicular pain of the leg on the side of the injection. Also, we are reluctant to use PE in IDH with epidural leaks at discography or IDH at cervical or thoracic levels. This led us to modify PE, enhancing it with ethylcellulose, as was performed for the treatment of venous malformations,^{4,5} to increase its viscosity and hopefully allow better control of its diffusion; we added an inert radiopaque metal powder (tungsten or tantalum) to improve its visualization under fluoroscopy⁵ (Fig. 1).

This is a preliminary study where we used radiopaque gelified ethanol (RGE) as a therapeutic substance for nucleolysis in patients with lumbar IDH, aiming to show its efficacy and safety.

METHODS

To investigate the efficacy of RGE in lumbar IDH, a prospective preliminary study was set up. Approval of the hospitals' Ethic Committee was obtained. Patients who were sent to be treated of an IDH percutaneously were asked to participate in this study, using RGE as the therapeutic substance for nucleolysis. An informed consent was obtained.

For treatment purposes, we kept the basis of our original therapeutic concept used for numerous years, when nucleolysis was performed with Chymopapain⁶:

1. The association of a concomitant injection of intra-articular steroids in the adjacent facet joints in all patients.
2. The use of a second therapeutic intradiscal technique, in patients where nucleolysis with Chymopapain is

Received for publication July 14, 2006; accepted January 8, 2007.

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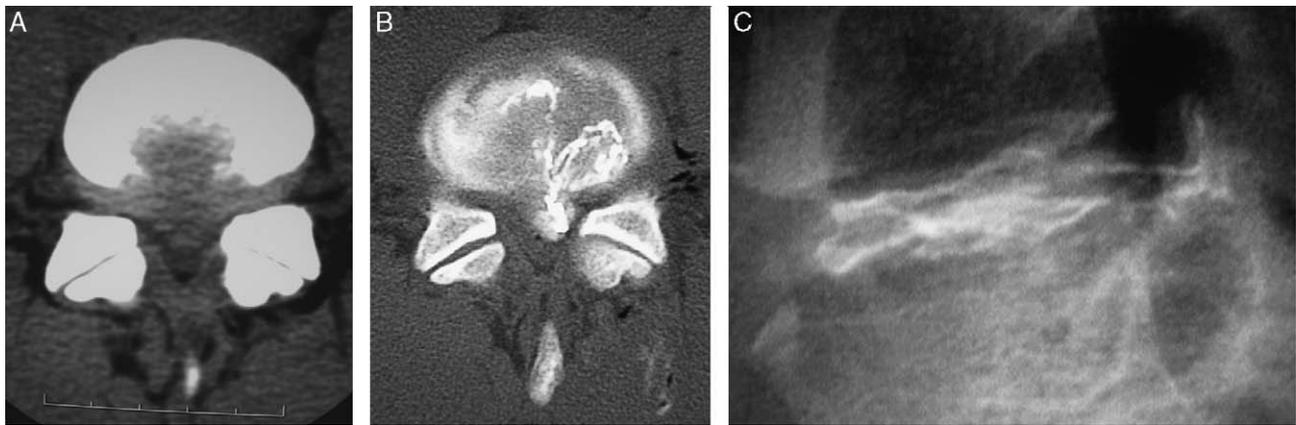


FIGURE 1. Lumbar disk hernia treated with RGE. A, CT before treatment. B, Disco-CT after treatment, modified windows showing the RGE after the intradiscal fissures and concentrating in the extruded hernia. C, Plain lateral x-rays after treatment showing the RGE in the disk and extruded hernia.

known to be less effective (eg, foraminal hernias, narrow spinal canal, hyperalgetic hernia). This technique could be either automatized percutaneous discectomy (APD)⁷ with which we have the experience of over 1500 patients treated alone or in combination with Chymopapain with good results, or radiofrequency nucleoplasty (RFN).⁸

Patients were divided into 3 groups depending on the techniques used (Table 1).

Procedures were performed with local anesthesia, in surgical conditions and under controlled digital fluoroscopy, on right lateral decubitus. A discography was performed before RGE nucleoplasty for group A and group B. In cases of group C, we preferred to perform discography after RGE nucleoplasty because the presence of contrast and RGE seem to reduce the radiofrequency effect, at least in vitro.

The dose of RGE was 0.4 to 0.8 mL. Intradiscal injection of 1 to 3 mg of gentamicin was systematically performed in all the cases at the end of the procedure to prevent infection. At least one facet joint at level treated was injected with 20 mg of intra-articular triamcinolone acetonide to help reduce inflammation; in case of bilateral symptomatology, the injection was administered in both facet joints (20 mg each).

All the patients had a thin slice computed tomography (CT) of the treated level performed 3 hours after injection. Modified windows allowed visualizing better the metallic powder mixed with the gel.

Patients were left on anti-inflammatory drugs and analgesic drugs until the follow-up consultation at 15 days. Medical treatment was eventually modified depending on the residual symptoms. All patients have been seen in

consultation again 6 weeks after treatment and eventually later on depending on their symptoms.

RESULTS

A total of 276 consecutive patients sent to be treated of a lumbar IDH percutaneously were included in this study. One hundred and sixty males (58%) and 116 females (42%), age ranging from 19 to 83 years old (mean 45.9) were treated. The patients' symptoms are summarized in Table 2. All patients had clinical symptoms for over 3 months, except for 8 patients with acute symptoms of sleepless hyperalgetic hernia, and had received conservative management (anti-inflammatory drugs, local steroid infiltrations,...) without improvement.

Two hundred twenty-one patients were included in group A (Figs. 1–4). In 148 patients, only one disk level was treated (L2/L3, 7 cases; L3/L4, 19 cases; L4/L5, 56 cases; L5/S1, 66 cases) and in 73 patients, 2 or more disk levels were treated (L4/L5 and L5/S1 60 cases, 82%).

Forty-four patients were included in group B and 11 in group C. Of these 2 groups, 41 presented with narrow canal, 6 with foraminal hernia, and 8 with sleepless hyperalgetic hernia all of them at lumbar level and only one level was treated in all cases (L4/L5 47 cases, 85%) (Fig. 5). The decision to include a patient in groups B or C was made depending if intervertebral disk space was enough to safely introduce the APD kit or not.

The results were classified according to pain reduction, degree of disability, and ability to return to usual activities (Table 3).

TABLE 1. Classification of Patients

Group A	Only intradiscal injection of RGE + IAS
Group B	Intradiscal injection of RGE + APD + IAS
Group C	Intradiscal injection of RGE + RFN + IAS

TABLE 2. Patients' Symptomatology

Lumbago + RP	195 (70%)
Lumbago alone	54 (20%)
RP alone	19 (7%)
Hyperalgetic hernia	8 (3%)
Total 276 patients.	
RP indicates radicular pain.	



FIGURE 2. Lumbar disk hernia responsible for a left lumbo-radiculalgia resisting medical treatment. Patient treated by intradiscal injection of RGE. A, CT before treatment. B, CT after treatment showing the RGE after the intradiscal fissure and penetrating the hernia. C, Complementary 2 levels intra-articular injection of steroids (see text), preliminary contrast injection in 4/5, 5/1 joints. D, MR before treatment. E, MR 1 year after treatment showing the dramatic reduction of the hernia volume.

In group A at lumbar level, the results were very good (VG) in 46 cases, good (G) 156 cases (VG + G 202 cases, 91.4%), fair (F) in 16 cases, and bad (B) in 3 cases (F + B 19 cases, 8.6%).

In group B, we had 8 cases with very good outcome, 29 cases were good (VG + G 37 cases, 84%), a fair outcome was seen in 6 cases, and a bad in 1 case (F + B 7 cases, 16%). And in group C, the results were very good in 2 cases, good in 7 cases (VG + G 9 cases, 82%), fair in 2 cases, and we had no cases with a bad outcome (F + B 2 cases, 18%).

Only 2 cases with a bad outcome at lumbar level went to surgery, 1 of group A and 1 of group B.

The patients who showed improvement did so in a period of 1 to 3 weeks after the procedure, except for the

8 patients with acute hyperalgic hernia, which presented with resolution of their symptomatology within the day of the procedure or the next one.

There was no allergic reaction during or after the intradiscal injection of RGE. There was no infection in any of the patients. A slight discomfort was frequently noticed by the patient at the level of the injected disk at the beginning of the injection and was attributed to the rate of injection because of the fact that it presented when it was performed fast. This discomfort went away in the course of the injection. None of the patients presented radicular burning pain during or after the procedure. There has been no pathologic event related to the RGE treatment noticed with more than 4-year follow-up for the first patients.

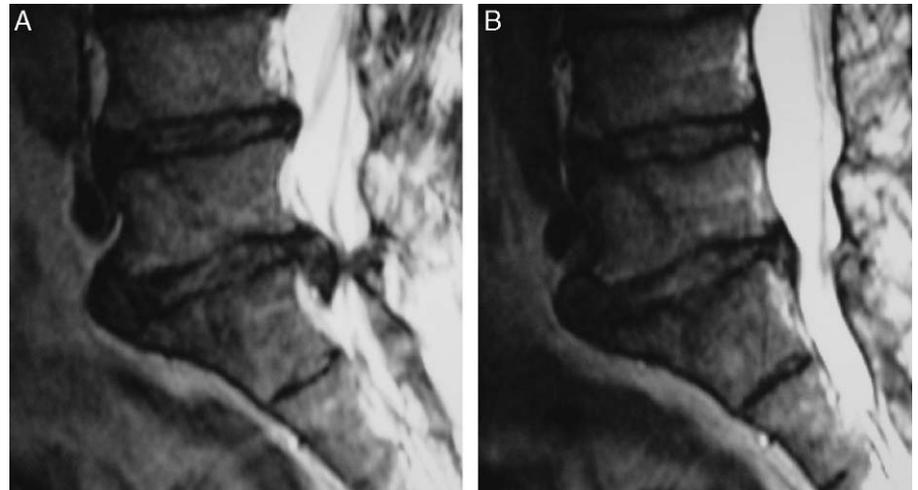


FIGURE 3. Lumbar disk hernia. The patient is asymptomatic after treatment; however, MR shows a hernia with reduced volume. A, MR before treatment. B, MR 3 months after treatment.

DISCUSSION

It seems progressively for us and others that the therapeutic solutions respecting the integrity of the spine should be preferred to treat disc hernias. Nucleolysis with Chymopapain had demonstrated its efficiency but it was always blamed for the risks of allergic reaction, relatively infrequent but incontestable, that it could produce.^{1,2}

Following the commercial withdrawal of the Chymopapain, some replacement techniques were sought. Decompressive intradiscal techniques based on the physical processes have been used such as disk vaporization in nucleoplasty with radiofrequency or mechanical reduction of the disk pressure by manual or APD.^{7,8} Nucleolysis

with PE has been proposed by Riquelme et al³ with good results for the treatment of lumbar disc hernias.

Our personal experience with PE confirmed to us that this substance had an indisputable therapeutic effect but that it presented inconveniences, such as its use at the cervical or thoracic level and also in the hernias with epidural leak at discography, which seemed to us relatively risky, and also to Riquelme et al³ who did not select this type of patients in their published series, because of the hardly controllable diffusion of the product. Also some of our patients presented burning radicular pain of the lower limb on the side of the disc puncture at the moment of injection of PE, which fortunately regressed in a few days or weeks and were

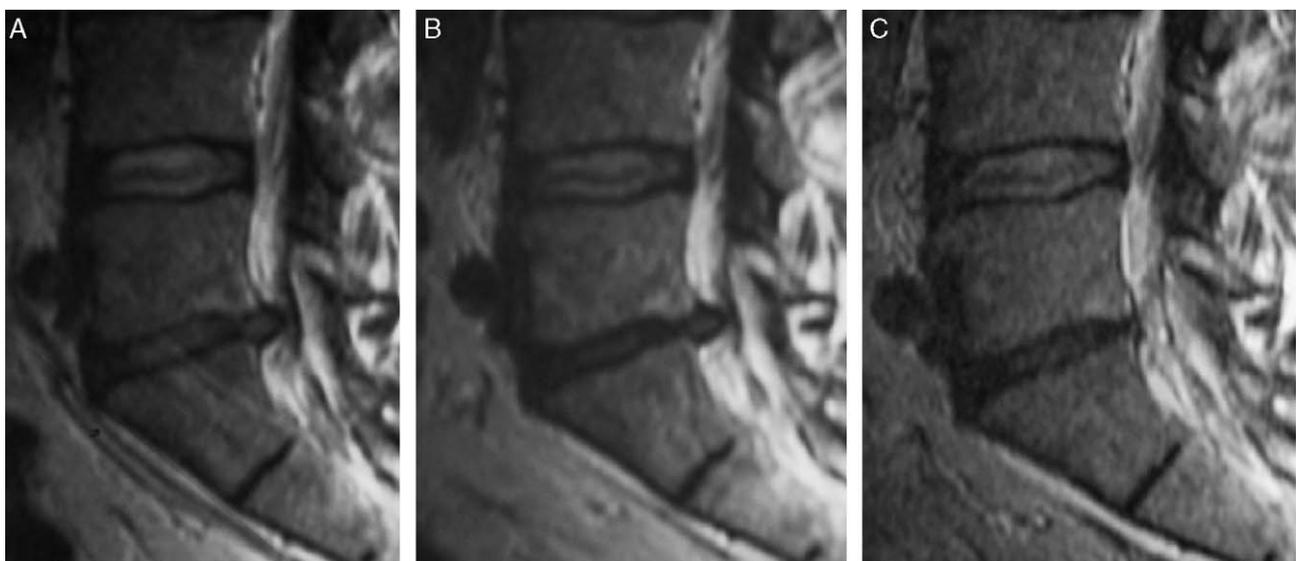


FIGURE 4. Lumbar disk hernia. Patient cured by intradiscal injection of RGE. Short-term and long-term follow-up MR. A, Pretreatment MR. B, Three months posttreatment MR, slight reduction of the hernia, the patient is asymptomatic. C, Long-term follow-up MR after 4 years, the hernia is not demonstrated anymore, persistent good clinical result.

TABLE 3. Classification of Results

Absence of pain, no limitation, returns to work	VG
Intermittent pain, minimal limitation, returns to work	G
Decrease in pain but requires medication, some limitation, returns to work or not	F
No improvement or aggravation of pain, limitation of activity, cannot work	B

very probably in relation with a reflux of the product onto the nervous root.

Because the therapeutic efficacy was obvious, it seemed interesting to us to improve PE by the adjunction of 2 types of modifications:

1. To permit a better control of the product, we used a mixture of PE and ethylcellulose. We had developed experience with this mixture for the treatment of venous angiomas.^{4,5,9} The addition of ethylcellulose

permits to get a viscous product but nevertheless injectable in a needle. At contact with the disk, it changes quickly into a substance of a consistence close to a piece of cotton moistened with alcohol. This modification succeeded in the creation of a kind of soft intradiscal prosthesis that permits to deposit the product in the disk without significant leak toward the epidural space or the nerve root. It also allowed us to get a more concentrated action of PE staying in the place for a minimal quantity of injected substance.

2. To document precisely the injection achieved, we have added in the product an inert metallic powder (tungsten or tantalum). The injection of the radiopaque powder in the disk can be followed on high definition fluoroscopy but the most interesting feature appears on the disco-CT achieved after the treatment: the topography of the gel is documented in a very precise way. It seems that the gel follows the

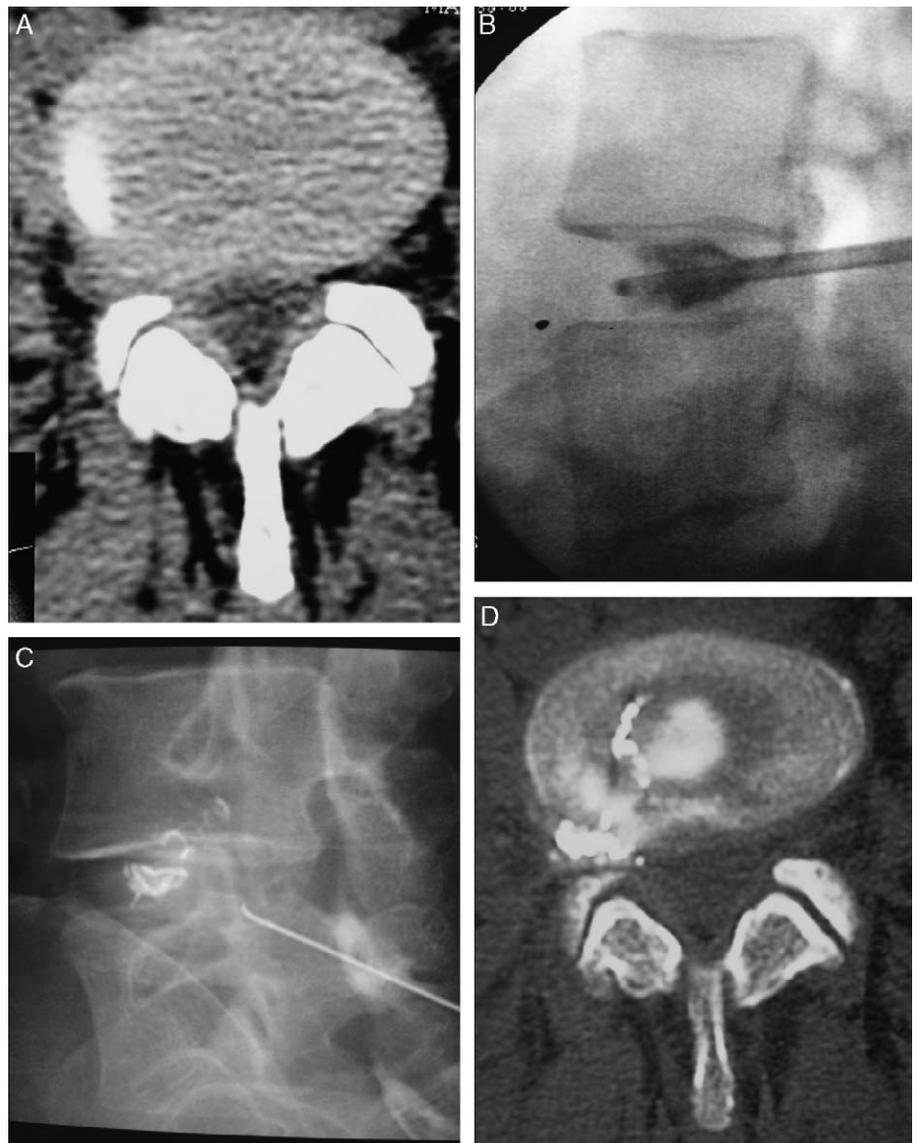


FIGURE 5. Foraminal hernia treated by "triple therapy" (RGE, APD, intra-articular steroid injections) very good clinical result. A, CT before treatment. B, Intradiscal treatment (RGE+APD). C, Intra-articular steroid infiltration. D, CT after treatment: RGE concentrated in the hernia.

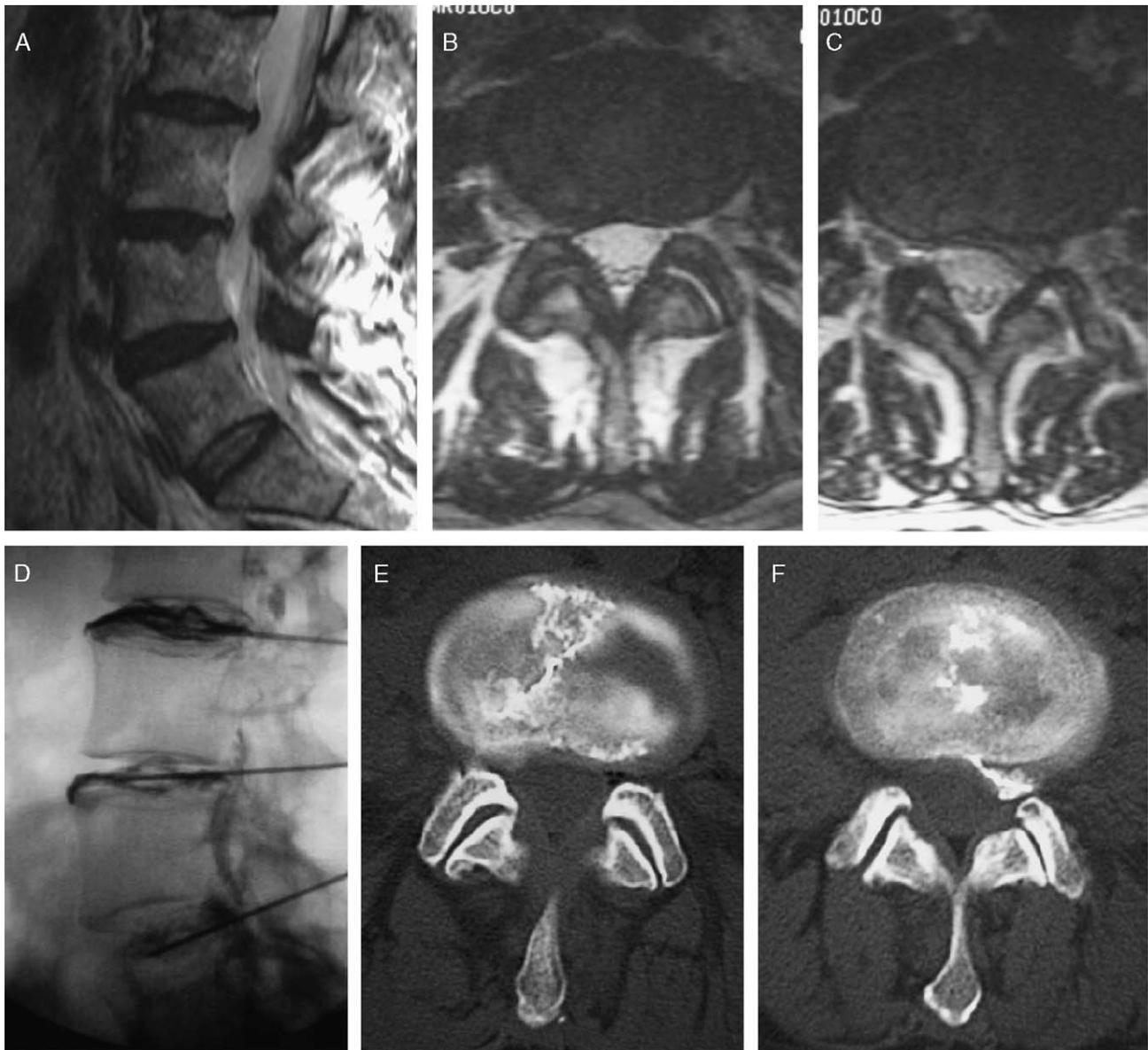


FIGURE 6. A 53-year-old woman who presented an invalidating lumbago for 1 year, stopping her from working. After the treatment of symptomatic levels at discography with good clinical result, the patient returned to work. A, Lumbar MR imaging. Several minimal disk bulges are demonstrated on the sagittal sequence. B, L2/L3 CT, minimal right foraminal bulging. C, L3/L4 CT, left foraminal bulging. D, Discography of the last 3 lumbar disks. The 3 disks are degenerated. An epidural leak is visualized at the L3/L4 level. A pain is only demonstrated at contrast injection of L2 /L3 and L3/L4 disk levels. An injection of RGE is achieved in L2/L3 and in L3/L4. E, Disco-CT posttreatment, L2/L3 disk level. RGE is demonstrated in intradiscal fissures oriented toward and in the right disk bulging. F, Disco-CT posttreatment, L3/L4 disk level. RGE is demonstrated in intradiscal fissures oriented toward and in the left disk bulging.

zones of fragility of the disk and in particular the intradiscal fissures (Figs. 1, 2, 5, 6). In the extruded hernias it was usual, but nonconstant, to see the gel penetrating and concentrating into the extruded fragment. Posttreatment disco-CT appeared especially interesting among those patients presenting atypical symptoms where the usual investigations did not give the full anatomic explanation of their problem (Fig. 6).

By showing various fissures in the disc, this product brings another vision of the disk pathology and it is likely that in this type of pathology, considering its good tolerance, it can be injected on several symptomatic disc levels during the same procedure.

RGE was used experiencing neither immediate allergic complication nor other type of secondary pathologic reaction. The product is easily injectable

through regular lumbar discography needles. The treatment can be achieved on an out patient basis, under local anesthesia or light sedation. There was no radicular burning pain similar to the one felt by the patients treated with PE. The only noted discomfort was at the level of the injected disc on some patients at the beginning of the injection of the RGE when the rate of injection had been started too quickly. This corresponds probably to an irritation of the nerve endings of the disk at the start of the therapeutic action; this sensation always lulled in the course of injection and disappeared at the end of this one.

Because of the regular good clinical results, follow-up magnetic resonance (MR) or CT was only performed in a few cases of this series to document the anatomic changes of the treated disk. However, these cases have been very instructive. MR performed 1 or more years after the treatment have shown dramatic reduction of the hernia volume (Figs. 2C, 4D), but MR performed a few weeks after the treatment showed a clear discordance between the clinical signs and the radiologic picture: the disappearance of all clinical signs and symptoms could come with an IDH unaltered or modified very little (Figs. 3B, 4B). This confirms that the most important type of intradiscal therapeutic reaction is not the immediate reduction of the hernia volume but the reduction of the intradiscal pressure: clearing of the symptoms precedes the reduction of the hernia, which will occur in the following months or years.

We decided not to alter the protocol we used with Chymopapain,⁶ associating an injection of corticosteroids systematically in the adjacent joints. The intradiscal hyper pressure treated by nucleolysis (or another intradiscal therapeutic technique) comes with constant associated inflammatory phenomena of the surrounding tissue, and more importantly of the facet joints, of mechanical origin but also chemical. We know that this intra-articular injection improves the immediate tolerance of the intradiscal treatment and also probably the final result while treating the regional pathologic process more completely.

In the cases presenting a lesion known to give less good results with Chymopapain or when a rapid decrease of the pain was mandatory (eg, foraminal hernias, narrow spinal canal, hyperalgiec hernias) (Fig. 5), we associated a second intradiscal technique (APD or RFN) to accelerate

the therapeutic effect. We called this association of 2 intradiscal techniques and the intra-articular injection of corticosteroids a "triple therapy." This series shows that RGE gives results as satisfactory as triple therapy with Chymopapain in these difficult lesions.

CONCLUSIONS

We think that this preliminary study has shown that the efficacy of this new substance is comparable with our experience with Chymopapain in the treatment of disk hernias. More especially, it demonstrated the absence of all allergic reaction and the absence of other type of reaction in the immediate and long-term follow-up for more than 4 years for the first cases. Although more evidence will be needed to confirm the efficacy of RGE alone or in the association of other techniques as intra-articular steroids, APD, or RFN, and also its safety in other areas (such as cervical or thoracic), we think this study shows the feasibility of RGE as a new choice in the percutaneous treatment of lumbar IDH.

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