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Role of Radiofrequency in the Management of Chronic Low Back Pain

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ABSTRACT

Background: low back pain (LBP) is related to disability and work absence and accounts for high economical costs. The management of LBP comprises a range of different intervention strategies including surgery, drug therapy, and non-medical interventions. Failed back surgery syndrome is a common problem with enormous costs to patients, insurers, and society, defined as persistent back and/ or leg pain after spine surgery. The etiology of failed back surgery can be poor patient selection, incorrect diagnosis, suboptimal selection of surgery, poor technique, failure to achieve surgical goals, and/or recurrent pathology. **Aim of the Work:** to evaluate the efficacy, safety and outcome of radiofrequency as a method for management of patients with chronic low back pain. **Subjects and Methods:** this prospective study was conducted at El Galaa Military Hospital starting from January 2017. Twenty-five patients with chronic low back pain with mal-response to medical treatment justified for receiving interventional pain management as a conservative method of treatment of low back pain. They were subjected to radiofrequency neurotomy as a method for managing low back pain. **Results:** there was highly statistically significant decrease in pain score immediately, 1 week, 1 month and 3 months than pain score before RF with p-value < 0.01and there was highly statistically significant difference between daily living activities before RF and daily living activities at different times of measurement with p-value < 0.01. **Conclusion:** low back pain is a medical, social and economical problem. Radiofrequency neurotomy had advantage regarding the long term follow up but the costs and equipment-wised problem still make it less prevailed. **Recommendations:** longer follow up and randomized study if could be conducted the results may indicate much clues.

Keywords: radiofrequency, management low back pain.

INTRODUCTION

Low back pain is extremely prevalent, and is the second most common reason for people to seek medical attention [(1)]. Low back pain accounts for 15% of all sick leaves from work, and is the most common cause of disability for persons less than 45 years age [(2)].

A major proportion of the adult population has low back pain at some stage of life. Although most patients are treated successfully with conservative treatment or without treatment, a substantial group of patients develop chronic pain symptoms (lasting longer than three months). Patients with chronic low back pain account for most reported healthcare and socioeconomic costs [(3)].

Schmörl and Junghanns [(4)] introduced the concept of mobile lumbar segment in 1968 to refer to the junction between two lumbar vertebrae formed by the intervertebral disc, intervertebral ligaments, articular facets and muscles of the lumbar spine. Therefore, low back pain may arise from several structures such as the discs, ligaments, musculature, sacroiliac joints and articular facets as there may be discogenic pain, facet arthropathy, sacroiliac pain.

Conservative treatment options for chronic low back pain may include pharmaceuticals, manual therapy (eg, massage, physiotherapy, spinal manipulation), exercise therapy (eg, aerobic activity, muscle strengthening), and educational or psychological therapies (eg, cognitive behavioral therapy, support groups, educational sessions). If conservative treatments are unsuccessful, more invasive methods, such as steroid injections, nerve blocks, cryoablation, radiofrequency ablation (RFA) or surgery, can be attempted[(5)].

Radiofrequency denervation of medial branches is one of the treatment options for patients with chronic low back pain. In radiofrequency denervation, a radiofrequency generator produces an alternating current through an electrode, thereby inducing ionic movements in the tissue directly surrounding the active tip. This leads to molecular friction and heating of the tissue within a limited distance of the electrode [(6)]. Since **Shealy**[(7)] published his article on radiofrequency denervation of the lumbar facet joint in 1976, radiofrequency denervation procedures have been modified by many authors including **Dasselaar *et al.*** [(8)], **Sluijter *et al.*** [(9)], **Dreyfuss *et al.*** [(10)] **and Cohen** [(11)].

Many observational studies of patients whose low back pain was treated with facet joint radiofrequency denervation have reported

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improvement, as assessed by the patient or physician. Improvement of 60% to 80% has been reported in studies excluding patients with previous back surgery [12, 13]. Whereas studies including patients with back surgery have reported approximately 40% improvement[14] **.**

Aim of the study

The aim of this study is to evaluate the efficacy, safety and outcome of radiofrequency as a method for management of patients with chronic low back pain.

SUBJECTS AND METHODS

Study design:

This is a prospective study that was conducted at El Galaa Military Hospital starting from January 2017. **The study was approved by the Ethics Board of Ain Shams University.**

Patients:

Twenty five patients with chronic low back pain with mal-response to medical treatment justified for receiving interventional pain management as a conservative method of treatment of low back pain. They were subjected to radiofrequency neurotomy as a method for managing low back pain.

METHODOLOGY

A. Patient selection

a) Patient population

i. Inclusion criteria

1. Chronic and debilitating low back pain leading to a diagnosis of a lumbar facet syndrome, not responding to conservative treatment for up to 3 months including various analgesics and physical therapy or steroid facet injections.
2. Patient with chronic sacroiliac joint pain.
3. Chronic lumbosacral radicular pain lasting ≥3 months and the previous failure of conservative management such as physiotherapy, exercise therapy, or analgesic medications.
4. Patient with chronic back pain due to degenerative spine disease.
5. Patients with failed back syndrome.
6. Patients who are indicated for back surgery but they are refusing surgery or not fit for surgery.

ii. Exclusion criteria

1. Patients with chronic back pain due to chronic inflammatory joints diseases and malignancy.
2. Patients having an acute or chronic uncontrolled medical illness or mental illness.
3. Patients with infectious diseases or bleeding tendency and pregnancy.
4. Patients with back pain with radicular pain associated with progressive neurological deficit.

b) Patient assessment

- ***Clinically:***
  - **1-** Full neurological examination.
  - **2-** Visual analogue score. [15]
  - **3-** The patient daily activities.
- ***Investigation:***
  - 1- X-ray lumbosacral spine: anteroposterior, lateral and dynamic views**.**
  - 2- MRI lumbosacral spine.

c) Procedure:

Was performed in an operating room equipped with radiofrequency generator (STOCKERT NEURO N50, 05/2011, INOMED, GERMANY) [16] and fluoroscopy:

1- The patient is in the prone position.
2- Sterilization of the lower back.
3- Injection of local anesthesia for skin and subcutaneous anesthesia.
4- Implantation of the RF probe after confirmation of the position under fluoroscopy.
5- The electrodes were placed at the site of the dorsal ramus medial branches of the relevant facet joints. The electrode tip was placed parallel to the nerves at the angle between the superior articular process and the transverse process.
6- In case of sacroiliac joint the electrodes were placed at the site of lateral branches of S1 and S2.
7- We included both continuous and pulsed RF.
8- General sedation not used to provide adequate feedback during the procedure and to prevent some complications as a result of improper needle positioning.
9- The patients were discharged after 3 hours recovery.

B. Outcome Assessment

Patients included in this study; all of them were assessed immediately after the procedure, after one week, after one month and after three months for:

1- Pain: clinically and by visual analogue score [15].
2- The improvement of the daily activities.
3- The safety of the procedure.

C. Statistical Analysis

Data were collected, revised, coded and entered to the Statistical Package for Social Science

(IBM SPSS) version 23. The quantitative data were presented as mean, standard deviations and ranges when their distribution found parametric and median, (IQR) when distribution found non parametric while qualitative data were presented as number and percentages.

The comparison between groups with qualitative data was done by using ***Chi-square test.***

The comparison between independent groups with quantitative data and non-parametric distribution was done by using ***Mann-Whitney test***. The comparison between paired groups with quantitative data and non-parametric distribution was done by using ***Wilcoxon-Rank test***.

The confidence interval was set to 95% and the margin of error accepted was set to 5%. So, the p-value was considered significant as the following:

P > 0.05: Non significant.
P < 0.05: Significant.
P < 0.01: Highly significant.

RESULTS

Table (1): Age and gender distribution among the studied patients:

		No.= 25
Age (Year)	Mean ± SD	58.28 ± 7.20
	Range	43 – 71
Sex	Female	17 (68.0%)
	Male	8 (32.0%)

Table (2): Diagnosis according to the affected level of the studied patients:

Diagnosis according to the affected level	**No.**	**%**
L3-L4	2	8.0%
L3-L4-L5	1	4.0%
L4	1	4.0%
L4-L5	17	68.0%
L4-L5-S1	2	8.0%
L5-S1	2	8.0%

Table (3): Diagnosis of the studied patients:

Diagnosis	**No.**	**%**
Adhesion post operation	13	52.0%
Facet arthropathy	8	32.0%
Spondylolithesis	1	4.0%
Stenosis	1	4.0%
Transpedicular fixation(TPF)	2	8.0%

Table (4): Pain score and daily living activities before procedure in the studied patients:

		No.= 25
Pain score before	Median (IQR)	8 (7 – 8)
	Range	6 – 10
Daily living activities before	Normal	3 (12.0%)
	Unsupported	13 (52.0%)
	Supported	9 (36.0%)

Table (5): Symptoms and history of previous operation among the studied patients:

		No.= 25
LBP	No	0 (0.0%)
	Yes	25 (100.0%)
Sciatica	No	15 (60.0%)
	Yes	10 (40.0%)
Operation done	No	9 (36.0%)
	Yes	16 (64.0%)

Table (6): Comparison between pain score before and pain score at different time of measurement after radiofrequency neurotomy

Pain score		No.= 25	Wilcoxon Rank test	
			Z	P-value*
Before RF	Median (IQR) Range	8 (7 – 8) 6 – 10	-	-
Immediately	Median (IQR) Range	1 (0 – 3) 0 – 7	4.386	0.001
1 week	Median (IQR) Range	1 (1 – 3) 0 – 8	4.310	0.001
1 month	Median (IQR) Range	3 (2 – 5) 1 – 8	4.136	0.001
3 months	Median (IQR) Range	3 (2 – 6) 0 – 9	4.030	0.001

* P-value comparing different times with pain score before RF.
P > 0.05: Non significant P < 0.05: Significant P < 0.01: Highly significant

Table (6) shows that there was highly statistically significant decrease in pain score immediately, 1 week, 1 month and 3 months than pain score before RF with p-value < 0.01.

Table (7): Comparison of daily living activities before with daily living activities at different time of measurement after radiofrequency neurotomy:

Daily living activities before	Before	1 week	1 month	3 months
Normal	3 (12.0%)	18 (72.0%)	14 (56.0%)	13 (52.0%)
Unsupported	13 (52.0%)	6 (24.0%)	9 (36.0%)	10 (40.0%)
Supported	9 (36.0%)	1 (4.0%)	2 (8.0%)	2 (8.0%)
Bed ridden	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Chi-square test (X^2)	-	19.693	12.299	11.096
P-value	-	0.000	0.002	0.004

Table (7) shows that there was highly statistically significant difference between daily living activities before RF and daily living activities at different times of measurement with p-value < 0.01.

Table (8): Relation of age with pain score after radiofrequency neurotomy

Pain score		Age < 60 No.= 16	Age > 60 No.= 9	Test value•	P-value	Sig
Immediately	Median (IQR) Range	1 (0 – 4) 0 – 7	1 (0 – 1) 0 – 3	-1.155	0.248	NS
1 week	Median (IQR) Range	3 (1 – 5.5) 0 – 8	1 (1 – 2) 1 – 3	-1.335	0.182	NS
1month	Median (IQR) Range	4 (1.5 – 6) 1 – 8	2 (2 – 3) 1 – 5	-1.439	0.150	NS
3months	Median (IQR) Range	5 (1.5 – 8) 0 – 9	3 (2 – 5) 2 – 8	-0.544	0.586	NS

•: Mann-Whitney test HS: Highly significant; S: Significant; NS; Non significant

Table (8) shows that there was no statistically significant relation found between age of the studied patients and pain score after procedure.

Table (9): Relation of age with daily activity after radiofrequency neurotomy:

Daily activity		Age < 60		Age > 60		Test value*	P-value	Sig
		No.	%	No.	%			
1 week	Normal	11	68.8%	7	77.8%	0.646	0.724	NS
	Unsupported	4	25.0%	2	22.2%			
	Supported	1	6.2%	0	0.0%			
	Bed ridden	0	0.0%	0	0.0%			
1month	Normal	9	56.2%	5	55.6%	1.404	0.496	NS
	Unsupported	5	31.2%	4	44.4%			
	Supported	2	12.5%	0	0.0%			
	Bed ridden	0	0.0%	0	0.0%			
3months	Normal	8	50.0%	5	55.6%	1.229	0.541	NS
	Unsupported	6	37.5%	4	44.4%			
	Supported	2	12.5%	0	0.0%			
	Bed ridden	0	0.0%	0	0.0%			

*: Chi-square test HS: Highly significant; S: Significant; NS; Non significant

Table (9) shows that there was no statistically significant relation found between age of the studied patients and daily activity after procedure.

Table (10): Relation of gender with pain score after radiofrequency neurotomy:

Pain score		Female	Male	Test value•	P-value	Sig
		No.= 17	No.= 8			
Immediately	Median (IQR)	1 (0 – 4)	0.5 (0 – 2)	-0.914	0.361	NS
	Range	0 – 7	0 – 3			
1 week	Median (IQR)	2 (1 – 5)	1 (0.5 – 2)	-2.076	0.038	S
	Range	1 – 8	0 – 3			
1month	Median (IQR)	3 (2 – 6)	2 (1 – 3.5)	-1.570	0.116	NS
	Range	1 – 8	1 – 4			
3months	Median (IQR)	5 (2 – 8)	3 (1.5 – 5.5)	-1.091	0.275	NS
	Range	0 – 9	1 – 6			

•: Mann-Whitney test HS: Highly significant; S: Significant; NS; Non significant

Table (10) shows that there was no statistically significant relation found between gender and pain score at different time of measurement after procedure except after 1 week pain score was found higher in females than males with p-value = 0.038.

Table (11): Relation of gender with daily activity after radiofrequency neurotomy:

Daily activity		Female		Male		Test value*	P-value	Sig
		No.	%	No.	%			
1 week	Normal	13	76.5%	5	62.5%	1.511	0.470	NS
	Unsupported	3	17.6%	3	37.5%			
	Supported	1	5.9%	0	0.0%			
	Bed ridden	0	0.0%	0	0.0%			
1month	Normal	9	52.9%	5	62.5%	0.782	0.676	NS
	Unsupported	7	41.2%	2	25.0%			
	Supported	1	5.9%	1	12.5%			
	Bed ridden	0	0.0%	0	0.0%			
3months	Normal	8	47.1%	5	62.5%	1.209	0.546	NS
	Unsupported	8	47.1%	2	25.0%			
	Supported	1	5.9%	1	12.5%			
	Bed ridden	0	0.0%	0	0.0%			

*: Chi-square test HS: Highly significant; S: Significant; NS; Non significant

Table (11) shows that there was no statistically significant relation found between gender and daily activity at different time of measurement after procedure.

Table (12): Relation of sciatica with pain score after radiofrequency neurotomy

Pain score		No Sciatica No.= 15	Sciatica No.= 10	Test value•	P-value	Sig
Immediately	Median (IQR) Range	1 (0 – 3) 0 – 7	0.5 (0 – 3) 0 – 7	-0.522	0.602	NS
1 week	Median (IQR) Range	1 (1 – 5) 0 – 7	1.5 (1 – 3) 0 – 8	-0.262	0.794	NS
1month	Median (IQR) Range	2 (1 – 6) 1 – 8	3 (2 – 5) 2 – 8	-0.959	0.338	NS
3months	Median (IQR) Range	3 (1 – 8) 0 – 8	5 (2 – 6) 2 – 9	-0.758	0.448	NS

•: Mann-Whitney test HS: Highly significant; S: Significant; NS; Non significant

Table (12) shows that there was no statistically significant relation found between sciatica and pain score at different time of measurement after procedure.

Table (13): Relation of sciatica with daily activity after radiofrequency neurotomy:

Daily activity		No Sciatica		Sciatica		Test value*	P-value	Sig
		No.	%	No.	%			
1 week	Normal	12	80.0%	6	60.0%	2.778	0.249	NS
	Unsupported	2	13.3%	4	40.0%			
	Supported	1	6.7%	0	0.0%			
	Bed ridden	0	0.0%	0	0.0%			
1month	Normal	9	60.0%	5	50.0%	0.265	0.876	NS
	Unsupported	5	33.3%	4	40.0%			
	Supported	1	6.7%	1	10.0%			
	Bed ridden	0	0.0%	0	0.0%			
3months	Normal	8	53.3%	5	50.0%	0.096	0.953	NS
	Unsupported	6	40.0%	4	40.0%			
	Supported	1	6.7%	1	10.0%			
	Bed ridden	0	0.0%	0	0.0%			

*: Chi-square test HS: Highly significant; S: Significant; NS; Non significant

Table (13) shows that there was no statistically significant relation found between sciatica and daily activity at different time of measurement after procedure.

Table (14): Relation of operation with pain score after radiofrequency neurotomy:

Pain score		Non Operation done No.= 9	Operation done No.= 16	Test value•	P-value	Sig
Immediately	Median (IQR) Range	0 (0 – 1) 0 – 7	1 (0 – 3) 0 – 7	-0.829	0.407	NS
1 week	Median (IQR) Range	1 (1 – 3) 0 – 7	1.5 (1 – 4) 0 – 8	-0.445	0.656	NS
1month	Median (IQR) Range	1 (1 – 5) 1 – 8	3 (2 – 5) 1 – 8	-1.497	0.134	NS
3months	Median (IQR) Range	3 (1 – 8) 0 – 8	5 (2.5 – 6) 2 – 9	-1.089	0.276	NS

•: Mann-Whitney test HS: Highly significant; S: Significant; NS; Non significant

Table (14) shows that there was no statistically significant relation found between operation and pain score at different time of measurement after procedure.

Table (15): Relation of operation with daily activity after radiofrequency neurotomy

Daily activity		Non-Operation done		Operation done		Test value*	P-value	Sig
		No.	%	No.	%			
1 week	Normal	9	100.0%	9	56.2%	5.469	0.065	NS
	Unsupported	0	0.0%	6	37.5%			
	Supported	0	0.0%	1	6.2%			
	Bed ridden	0	0.0%	0	0.0%			
1month	Normal	6	66.7%	8	50.0%	1.438	0.487	NS
	Unsupported	3	33.3%	6	37.5%			
	Supported	0	0.0%	2	12.5%			
	Bed ridden	0	0.0%	0	0.0%			
3months	Normal	5	55.6%	8	50.0%	1.229	0.541	NS
	Unsupported	4	44.4%	6	37.5%			
	Supported	0	0.0%	2	12.5%			
	Bed ridden	0	0.0%	0	0.0%			

*: Chi-square test HS: Highly significant; S: Significant; NS; Non significant

Table (15) shows that there was no statistically significant relation found between operation and daily activity at different time of measurement after procedure.

DISCUSSION

Low back pain is extremely prevalent, and is the second most common reason for people to seek medical attention [(1)].Low back pain accounts for 15% of all sick leaves from work, and is the most common cause of disability for persons less than 45 years age [(2)].

A major proportion of the adult population has low back pain at some stage of life. Although most patients are treated successfully with conservative treatment or without treatment, a substantial group of patients develop chronic pain symptoms (lasting longer than three months). Patients with chronic low back pain account for most reported healthcare and socioeconomic costs [(17)].

Schmörl and Junghanns [(4)] introduced the concept of mobile lumbar segment in 1968 to refer to the junction between two lumbar vertebrae formed by the intervertebral disc, intervertebral ligaments, articular facets and muscles of the lumbar spine. Therefore, low back pain may arise from several structures such as the discs, ligaments, musculature, sacroiliac joints and articular facets as there may be discogenic pain, facet arthropathy, sacroiliac pain.

Conservative treatment options for chronic low back pain may include pharmaceuticals, manual therapy (eg, massage, physiotherapy, spinal manipulation), exercise therapy (eg, aerobic activity, muscle strengthening), and educational or psychological therapies (eg, cognitive behavioral therapy, support groups, educational sessions). If conservative treatments are unsuccessful, more invasive methods, such as steroid injections, nerve blocks, cryoablation, radiofrequency ablation (RFA) or surgery, can be attempted [(5)].

Radiofrequency denervation of medial branches is one of the treatment options for patients with chronic low back pain. In radiofrequency denervation, a radiofrequency generator produces an alternating current through an electrode, thereby inducing ionic movements in the tissue directly surrounding the active tip. This leads to molecular friction and heating of the tissue within a limited distance of the electrode [(6)]. Since **Shealy**[(7)] published his article on radiofrequency denervation of the lumbar facet joint in 1976, radiofrequency denervation procedures have been modified by many authors including **Dasselaar *et al.*** [(8)]**, Sluijter *et al.*** [(9)]**, Dreyfuss *et al.*** [(10)]**, Cohen** [(11)]**.**

Many observational studies of patients whose low back pain was treated with facet joint radiofrequency denervation have reported improvement, as assessed by the patient or physician. Improvement of 60% to 80% has been reported in studies excluding patients with previous back surgery [(12, 13)]. Whereas studies including patients with back surgery have reported approximately 40% improvement[(14)].

Pain score decreases after intervention then re-raises after. Also, daily activity grade improves after intervention then re-worsens after then. Pain scores at different times of follow up were significantly decreased than that before intervention that agrees with the results obtained by **Manchikanti *et al***. [18].

A comprehensive narrative review of lumber medial branch neurotomy was presented by **Bogduk *et al.*** [19] Two main problems in the assessment of studies were described: first, a technique without parallel needle placement, and second, an inconsistent patient selection.

Considering the historical development of the radiofrequency neurotomy, it is obvious that different techniques were used, which cannot be compared with one another. The position of the electrode plays an essential role. For optimal coagulation of the medial branch, the electrode should be placed parallel to the nerve. The earliest studies used the technique described by **Shealy** [20] in 1974 to 1976. Good success was claimed even if it was not possible to coagulate the nerve with the Shealy technique. The study of **Gallagher *et al.*** [21] also used the Shealy technique. In the later study of **Leclaire *et al.*** [22] the operative technique wasn't described, the outcome was poor. Negative results were also found in the study of **van Wijk *et al.*** [23] again, an inaccurate surgical technique was used [24].

In other studies, the patient selection was questionable. **Van Kleef *et al***. [25] did not select patients on the basis of controlled medial branch blocks but did require 50% pain relieve after single diagnostic blocks. A low success rate with a short duration was the result. Forty seven present of the treated patients achieved pain relief and improvement in disability and a reduction in pain medicine. **Nath *et al.*** [26] included patients with different pain sources controlled blocks and a correct technique were used complete and enduring pain relief was not reported, because patients still had other sources of persisting pain. However, for the pain for which patients were treated, the study showed significant improvements after radiofrequency neurotomy.

The first study with the appropriate selection criteria and correct surgical technique was the descriptive study of **Dreyfuss *et al.*** [10] Sixty percent of patients treated with radiofrequency neurotomy achieved 80% pain relief lasting at least 12 months and 80% achieved 60% pain relief. Similar outcomes were found in a study of **Gofeld *et al.*** [27] Sixty-eight percent of the patients maintained at least 50% pain relief for between 6 and 24 months. A third descriptive study of **Burnham *et al.*** [28] recorded high patient satisfaction.

The reviews of **Boswell** [29] **and Manchikanti *et al.*** [30] provide strong evidence for short-term relief and moderate evidence for long-term relief. **Manchikanti *et al.*** [31] provide a strong recommendation for lumbar radiofrequency neurotomy.

The procedure is effective, easy, and safe for the treatment of chronic low back pain. In conclusion, in selected patients, facet joint radiofrequency neurotomy appears to be more effective.

Certain patients had significant and reasonable pain relief and functional improvement which suggests the relative success of radiofrequency as a method for conservative management of chronic low back pain and also suggests that follow up for longer period will be helpful.

CONCLUSION

Low back pain is a medical, social and economical problem. The management of such problem has many ways of minimally invasive methods like radiofrequency neurotomy. The results obtained after three months of follow up were reasonable and indicated good results in the management of such problem.

RECOMMENDATIONS

Radiofrequency neurotomy had advantage regarding the long term follow up but the costs and equipment-wised problem still make it less prevailed. Longer follow up and randomized study if could be conducted the results may indicate much clues.

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