

Treatment of Hemorrhoids Using CO₂ (10600 nm) Laser

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Abstract: Background: Hemorrhoidal disease is a common condition for which several surgical treatment modalities are available, including carbon dioxide laser hemorrhoidectomy. Objective: To evaluate the clinical outcomes and safety of carbon dioxide laser hemorrhoidectomy. Methods: This interventional study included 40 patients with third- or fourth-degree hemorrhoids treated over a six-month period. Carbon dioxide laser treatment was performed at a wavelength of 10600 nm using continuous-wave mode and a power of 5 to 10 W. Clinical outcomes, patient satisfaction, postoperative pain, bleeding, wound infection, anal stenosis, and recurrence were assessed. Results: Complete satisfaction was reported by 60% of patients. Postoperative pain was absent in 20% and mild in 65%. No postoperative bleeding occurred in 90% of patients. Wound infection and mild anal stenosis each occurred in 10%, while recurrence occurred in 5%. Conclusion: Carbon dioxide laser hemorrhoidectomy showed favorable short-term clinical outcomes in this patient group, with generally mild postoperative pain and low frequencies of bleeding and recurrence. Larger controlled studies with longer follow-up are needed to confirm these findings.

Keywords: Hemorrhoidal disease, Hemorrhoidectomy, Carbon dioxide laser, Laser surgery, Postoperative outcomes

1. Introduction

The anastomoses that surround the distal rectum and anal canal between the superior rectal artery and the superior, middle, and inferior rectal veins are known as hemorrhoids. It is a venous distention and distal displacement of the hemorrhoidal cushions ⁽¹⁾. It is thought to impact about 4% of the population, and 50% of adults over 50 report having experienced symptoms at some point in their lives ^(2, 3). Straining accelerates the development of hemorrhoids by encouraging venous congestion; genetics also has a significant influence, as many cases are frequently seen in the same family. Pregnancy, weightlifting, and anything that increases intra-abdominal pressure contribute to vein dilation ⁽⁴⁾. Despite being a benign condition, it causes social burdens due to effects on lifestyle, financial burdens on health systems, and social security burdens due to lost work days or other consequences from the disease itself ⁽⁵⁾. Hemorrhoids can be classified anatomically as internal (beyond the dentate line) or external (below the dentate line). When there are issues or associated symptoms, the label HD is utilized ⁽⁶⁾. Keep in mind that HD can have one or several prolapses, be internal, external, or both, and that a patient may have hemorrhoidal tissue of varying diameters ⁽⁷⁾. Clinically, hemorrhoids are classified into four categories: first degree, which is characterized by bleeding only and no prolapse; second degree, which is characterized by prolapse but spontaneous reduction; third degree, which requires manual reduction; and fourth degree, which is characterized by hemorrhoids that are permanently prolapsed ⁽⁸⁾. Hemorrhoids are often treated conservatively; however, when conservative methods are no longer effective or complications like thrombosis arise, the surgeon is consulted ⁽⁹⁾. Hemorrhoids can be treated with a variety of techniques, including medical band ligation, electrocoagulation, stapled hemorrhoidectomy, photocoagulation, infrared laser, sclerotherapy, Doppler guided artery ligation, cryosurgery, and surgery, which is currently the foundation for conventional hemorrhoidectomy ⁽¹⁰⁾. One common alternative treatment option is CO₂ laser hemorrhoidectomy, which allows for the vaporization or

excision of the hemorrhoid, the sealing of tiny blood arteries to create a bloodless field, and the sealing of superficial nerve endings to minimize or eliminate post-operative discomfort for the patients ⁽¹¹⁾. Water on the surface of soft tissue absorbs CO₂ laser energy, vaporizing the tissue and causing heat to be transferred to neighboring tissues. This allows for precise surgery and unhindered healing ⁽¹²⁾. The aim of this study is to evaluate efficacy and safety of hemorrhoidectomy using CO₂ laser.

2. Patients and Methods

Study design, setting, and time: This was an interventional study conducted in Private Hospital, Baghdad, Iraq during a period of six months from (February to August 2022).

Study Population and sample size: The study included 40 patients attended the surgical casualty and presented with third and fourth degree hemorrhoids with no significant systemic disease, most of whom had been suffering from hemorrhoids for a long time (more than five years), previously used medical treatment but with partial relief for a short period of time and scheduled for laser treatment. All of them had a single session. They were prepared before the session with laxatives and oral antibiotics (erythromycin and metronidazole) and then instructed for medication after the session.

An informed consent was obtained from the patients after discussing all the procedure and possible outcomes which allowed us to record their information for research purposes as long as the patient anonymity and confidentiality of their medical records are maintained.

CO₂ Laser parameters:

- Wavelength 10600 nm.
- Continuous wave.
- Power density 5-10 watt.
- Exposure time according to no. and grade and size of the hemorrhoid ranging from 10-15 minutes.

- Aiming beam semiconductor diode laser.
- Spot size of the hand piece was 0.4 mm.

The laser used in this study is a class IV laser (which includes any continuous wave laser device with energy outputs above 5mW and less than or equal to 500mW). These lasers cause damage with direct intrabeam exposure and from specular or diffuse reflections. Additional performance requirements and safety measures were taken to provide protection from energy emissions of these lasers.

All persons were asked to wear protective glasses appropriate to eliminate the risk of eye damage, these glasses are designed with special wavelength and optical density for CO₂ laser. The smoke and vapor plume were carefully extracted using a vacuum system. This is necessary to minimize the hazards to the patient and staff as many types of infections can be present in the vapor of CO₂ laser.

Procedure: The procedure included the preparation of the patient before and after laser treatment. Before laser treatment, questionnaire was put for the patient to help assess and follow up the patient:

Age, occupation, chief complaint, systematic review, drug history (steroid, anticoagulants), past medical, past surgical history, history of photosensitivity. The anal area was examined for any skin lesion and a per rectal examination determined the grade of hemorrhoid.

The patient was asked to lie down on the couch with the anal region being on the end of the couch and both legs were held up by the patients hands as in the lithotomy position. The area was shaved then the area was cleaned by using povidone iodine antiseptic, then photographs were taken by digital camera to each patient (Sony, 14.1 mega pixels, Japan) before, immediately after completing the study for the sake of comparison. The perianal area was injected with 5% lidocaine with an insulin syringe and around the base of each hemorrhoid was injected with the local anesthesia too also an injection was made midline between the anal verge and the ischial tuberosity along the course of the pudendal nerve for good anesthesia. Then tissue forceps were applied 2 mm from the mucocutaneous junction to bring the pile into prominence, a hemostat applied to the base of the hemorrhoid with slight traction, the pile is then dissected using laser energy cutting across the skin, so the pile can be mobilized easily. A red light provided by low power laser diode, permits precise focusing of the therapeutic beam.

The laser was aimed directly and perpendicularly to the surface of the pathology. The mode was set as continuous wave and the power is set at 5 to 10 watts. When the operator steps on the pedal the laser light and energy are shot out close to the pile and made only at the skin. The pile is now pedunculated and attached only by its feeding vessels which are ligated with 3/0 absorbable suture (catgut), and then the pile is excised by laser beam. Hemostasis is achieved by defocusing beam of the laser. A small gauze soaked with xylocaine gel 2% was put in the anal canal after finishing. Patients were discharged within one hour.

Evaluation and follow up: All patients were examined per rectal before their treatment session, the grades of hemorrhoids included in this study was the third and fourth grade because of their prolapsed outwards and feasibility in treatment. The patients were routinely sent to the laboratory before hemorrhoidectomy to take blood tests for hemoglobin level and blood tests to detect hepatitis B and hepatitis C. All patients had one session and digital photographs were taken before, and immediately after the session, the patients were followed up 1 month after the session.

The improvement depended on the patient's pain post hemorrhoidectomy, quicker return to normal activities, less complications. The improvement depends on the patient satisfaction which was graded as follows:

- Grade 0 = not satisfied
- Grade 1 = moderately partially satisfied
- Grade 2 = greatly but not fully satisfied
- Grade 3 = fully or completely satisfied

Evaluation of side effects of treatment include burning sensation, bleeding, infection, edema, retention of urine, incontinence and anal stenosis.

Statistical analysis: The data analyzed using Statistical Package for Social Sciences (SPSS) version 26. The data presented as mean, standard deviation and ranges. Categorical data presented by frequencies and percentages.

3. Results

In this study, mean age was 44.61 ± 7.2 years; 65% of them were aged ≥ 40 years; 70% were females; half of them were overweighted; pain was the most common symptom (67.5); 72.5% of hemorrhoids were in third grade; and the operative time ranged from 10.5– 16.0 minutes (Table 1).

Table 1: Distribution of study patients by certain characteristics

Variable	No. (n= 40)	Percentage (%)
Age (Year)		
< 40	14	35.0
≥ 40	26	65.0
Gender		
Male	12	30.0
Female	28	70.0
BMI Level		
Normal	8	20.0
Overweight	20	50.0
Obese	12	30.0
Symptom		
Pain	27	67.5
Bleeding	22	55.0
Pruritus	15	37.5
Hemorrhoid grade		
Third	29	72.5
Forth	11	27.5
(Mean $\pm$ SD)		Range
Operative time	13.2 ± 2.4	10.5 – 16.0

Table 2 shows the evaluation parameters of procedure. We noticed that 60% of patients were completely satisfied (grade 3) and 5% of them were not satisfied (grade 0) due to pain and recurrence. Regarding pain, 20% of patients had no pain, 65%

had mild pain, and 15% had severe pain, those with mild pain received simple oral analgesia (non-steroidal anti-inflammatory drugs) while those whom suffered severe pain required more analgesia in the form of injection e.g. diclofenac, tramadol.

About bleeding, 90% had no bleeding, 5% had early simple bleeding, and 5% had late bleeding (10-14 days postoperatively) and all of them were treated conservatively in the form of pressure, laxatives, stool softeners, local creams, and suppositories.

Wound infection was noticed in 10% of patients which was simple and two of those patients were diabetics. Four patients (10%) developed mild anal stenosis which responded to finger dilatation.

Recurrence was occurred in two patients (5%) after two months which had a long history of chronic constipation.

Table 2: Evaluation parameters of procedure

Variable	No. (n= 40)	Percentage (%)
Satisfaction grade		
0	2	5.0
1	4	10.0
2	10	25.0
3	24	60.0
Pain		
No	8	20.0
Mild	26	65.0
Severe	6	15.0
Bleeding		
Yes	4	10.0
No	36	90.0
Wound infection		
Yes	4	10.0
No	36	90.0
Anal stenosis		
Yes	4	10.0
No	36	90.0
Recurrence		
Yes	2	5.0
No	38	95.0

4. Discussion

Laser ablation has created new frontiers for the minimally invasive therapy of hemorrhoids. Carbon dioxide, neodymium-doped yttrium aluminum Garnet, and argon lasers are commonly used lasers in surgery; however, diode lasers are now an integral part of lasers in surgery with high flexibility⁽¹³⁾. Compared to other modes of treatment, the advantage of laser coagulation of vessels is the preservation of the morphology and physiology of the anal canal, tissue vaporization, hemostasis, prevention of thermal lesions to adjacent tissue, accelerated healing, bactericidal features and decreased postoperative pain. It reduces postoperative impaired anal function as a result^(14, 15).

In this study, the main age group was between 31 - 52 years old and the mean was 44.6 years old. Although the female can be affected by hemorrhoids, we expected low hospital consultations because of shame. This is agreed with Bruscianno L et al study in 2020 when they found that the mean age for hemorrhoids was 42 ± 12.6 years⁽¹⁶⁾.

The most significant side effect that worries our patients and discourages them from having surgery is postoperative pain. In this study, postoperative pain was absent or mild in the majority of patients (85%). This result was consistent with previous studies conducted by Maloku H et al in 2014⁽¹¹⁾, Harvitkar RU et al in 2021⁽¹⁷⁾, and Albahadili M et al in 2021⁽¹⁸⁾. This reduction in pain following surgery may be due to the laser's ability to cauterize tiny nerve endings, as opposed to the cold scalpel's tendency to leave frayed edges. Additionally, the water present in all body cells absorbs the CO₂ laser's wavelength of 10600 nm, which cuts tissue or converts it to heat that coagulates the vessel and controls bleeding. The penetration of the CO₂ laser is limited to power users, and tissue damage is minimal due to the hand's speed, thin depth (0.4 mm), and collateral thermal zone (150 microns)⁽¹⁹⁾.

Additional benefits include less bleeding and operating time, a quicker healing period, a bactericidal impact, the preservation of nearby structures, and a lower risk of stenosis and this is confirmed by Maloku H et al study in 2014⁽¹¹⁾ and Abdulkarim A et al study in 2020⁽²⁰⁾. According to the low incidence of complications, this study demonstrated that CO₂ laser did not increase morbidity. These findings are consistent with those of Pandini LC et al study in 2006.⁽¹⁵⁾ In conclusion, CO₂ laser hemorrhoidectomy is a feasible and a safe procedure. when used carefully, it is associated with a reduced requirement for postoperative analgesia, caused minimal bleeding, and associated with shorter hospital stay. The CO₂ laser caused no significant alteration in anorectal physiology.

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