Patient reported outcome following incisional hernia repair: A survey on 163 patients at two maximum care hospitals

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ARTICLE INFO

Keywords:
Abdominal binder
Open incisional hernia repair
Physical rest
Postoperative pain
Return to work

ABSTRACT

Introduction: Incisional hernias of the abdominal wall are frequent complications following laparotomy (9–20%) and often need incisional hernia repair (IHR). In order to ensure wound healing and to therefore prevent postoperative short and long term morbidity carrying an abdominal binder (AB) and physical rest is frequently advised. However, there is a lack of evidence concerning clinical effects regarding these recommendations. Hence, we conducted a survey to analyze the patient reported outcome following IHR.

Methods: From December 2017 to May 2018, we conducted a survey among 270 patients who underwent open and laparoscopic IHR at two maximum care hospitals. They were interviewed about their type of operation, postoperative treatment, recommendations, and outcome.

Results: 163 patients replied to the questionnaire. The average age was 63.2 ± 12 years. 74 patients were female and 89 were male. 32.6% of the patients reported an AB-induced immobility and 71.2% reported that the AB reduced pain after IHR. A prolonged period of physical rest and the use of an AB had no statistical significance on postoperative morbidity.

Conclusions: Due to our findings we assume that the AB may induce immobility and reduce postoperative pain. A prolonged period of physical rest and wearing an AB does not seem to have an impact on the postoperative outcome following IHR. Therefore, a shortened duration of physical rest and wearing an AB following IHR should be taken under consideration. To reveal more evidence on this topic further clinical trials are essential.

1. Background

Incisional hernia is a common complication following abdominal surgery with an incidence of 9–20% [1]. Diabetes mellitus, obesity, coronary heart disease, smoking, and advanced age are described as risk factors for the development of incisional hernias [1,2]. These hernias frequently lead to chronic pain, respiratory dysfunction, discomfort, immobility, stranulation and incarceration. In these cases, hernia repair must be performed [3].

The recurrence rate with a mesh is lower and therefore it is strongly recommended when IHR is performed [2,4]. In addition, the International Endohernia Society (EHS) proposes that when a hernia has a gap of more than two cm in diameter, the placement of a mesh is necessary [3,5,6].

There is a large number of different surgical techniques varying both in their operative approach and in their positioning of mesh [7]. In case of recurrences, prolonged wound pain and infection, the open IHR with sublay or onlay mesh placement, as well as the laparoscopic intraperitoneal onlay mesh (IPOM) repair are described as being sufficient approaches for IHR [8–10].

Frequently in Western Europe, surgical departments are prescribing an AB and recommending physical rest as postoperative treatment following an IHR. Therefore, a shortened duration of physical rest and wearing an AB following IHR should be taken under consideration. To reveal more evidence on this topic further clinical trials are essential.
reurrence or damage to the mesh sutures. Moreover, in order to ensure the healing of the fascia and thereby preventing relapses, physical rest for several weeks postoperatively with the avoidance of heavy lifting is advised [11,12]. However, there is a lack of evidence concerning clinical effects of ABs and physical rest following an IHR. Therefore, postoperative recommendations of surgical departments all over Germany seem to be random, as investigated by our workgroup [11]. A shortened period of physical rest and wearing an AB may have a social-economic impact by reducing the individual capacity for work and mobility. Therefore, further investigations are necessary.

Due to the lack of evidence in postoperative treatment, we conducted a survey among 270 patients who underwent open and/or laparoscopic IHR.

2. Methods

From December 2017 to May 2018, we conducted a survey on 270 patients who underwent open and/or laparoscopic IHR in the Department of General, Visceral, and Cancer Surgery at Helios Klinikum Berlin-Buch (Germany) or in the Department of General, Abdominal, Vascular, and Transplant Surgery at the University Hospital, Magdeburg (Germany). The patients were operated on between March 2013 and December 2017.

In November 2017, the questionnaire was developed and designed by the authors of both departments. The questionnaire was sent out by mail. The patients were asked to complete the questionnaires anonymously and were advised to send them back to the hospital where they underwent the surgical procedure.

They were surveyed about their profession, age, gender, body mass index (BMI), the recommended time of physical rest (weeks), the actual time of wearing an AB (weeks), the patients were also asked about the postoperative incidence of hernia recurrence (yes/no), seroma formation (yes/no), pulmonary infection (yes/no), pain reducing effects of the AB (yes/no) and movement limitation induced by the AB after surgery (yes/no) (Table 1).

We define physical rest as a state of low activity, which includes the avoidance of lifting of heavy weight.

2.1. Inclusionary criteria

Patients undergoing open and laparoscopic incisional hernia repair were included.

Table 1
Summarized survey data.

| Variable                           | n = 163 |
|-----------------------------------|---------|
| Laparoscopic IHR                  | 80      |
| Open IHR                          | 73      |
| Age                               | 63.2 ± 12 |
| Gender male                       | 74      |
| Gender female                     | 89      |
| BMI < 25                          | 31      |
| BMI 25–30                         | 67      |
| BMI > 30                          | 60      |
| Pensioners                        | 90      |
| Invalids, Unemployed              | 10      |
| Working individual                | 63      |
| Average duration of physical rest | weeks   |
| Average duration of carrying an AB| weeks   |
| Hernia relapse                    | 25      |
| Seroma formation                  | 14      |
| Pulmonary infection               | 15      |
| AB induced immobility             | 50      |
| AB induced reduction of pain      | 115     |

AB: Abdominal binder; BMI: body mass index; IHR: Incisional hernia repair.

2.2. Exclusionary criteria

Patients who answered the questionnaire who were not anonymous were excluded.

2.3. Surgical approach

All patients gave informed consent prior to their operation. The surgical procedure consisted of the laparoscopic intraperitoneal onlay-mesh (IPOM) repair, open IPOM, open onlay or open sublay mesh placement. All patients received preoperative antibiotic prophylaxis with Cefuroxime and in cases of penicillin allergy they received Ciprofloxacin.

2.4. Postoperative recommendation

A physical rest of 4–6 weeks and wearing an AB during daytime for the same period was advised following an open IHR.

A physical rest of 4–6 weeks and wearing an AB during the daytime for the same period was advised following laparoscopic IHR.

The Department of General, Visceral and Cancer Surgery of the Helios Klinikum Berlin-Buch prescribed the AB named ‘Verba’ (Company: PAUL HARTMANN AG).

The Department of General, Abdominal, Vascular and Transplant Surgery of the University Hospital, Magdeburg prescribed the AB named ‘HELIOS Leibbandage Economy’ (Company: med.kontex GmbH).

2.5. Univariate analysis

For more detailed analyses we subdivided the cohort of all patients into the following subgroups:

2.5.1. Abdominal binder

Group I consists of patients who wore the AB.

Group II consists of patients who did not wear the AB (Table 2).

2.5.2. Abdominal binder; age related

Depending on median age of the questioned patients (> median; < median) two analysis were conducted.

a) Group I consist of patients (< median age) who wore the AB

Group II consist of patients (< median age) who did not wear the AB.

b)

Table 2
Univariate analysis of the abdominal binders on incisional hernia repair.

| Variable                           | No Abdominal binder n = 17 | Abdominal binder n = 146 | p value |
|-----------------------------------|---------------------------|--------------------------|---------|
| Laparoscopic IHR                  | 14                        | 66                       | 0.003   |
| Open IHR                          | 2                         | 71                       |         |
| Age years 63.6 ± 9.9               | 63.2 ± 12                 | 0.814                    |
| Gender male                       | 9                         | 65                       | 0.6095  |
| Gender female                     | 8                         | 81                       |         |
| BMI < 25                          | 4                         | 29                       | 0.946   |
| BMI 25–30                         | 5                         | 57                       |         |
| BMI > 30                          | 5                         | 55                       |         |
| Average duration of physical rest weeks 3.9 ± 2.7 | 6.5 ± 4.2     | 0.1302                   |
| Average duration of carrying an AB weeks 7.6 ± 4.2 | 25                       |     |         |
| Hernia relapse                    | 1                         | 24                       | 0.4676  |
| Seroma formation                  | 0                         | 14                       | 0.3637  |
| Pulmonary infection               | 0                         | 15                       | 0.999   |

IHR: Incisional hernia repair.
Group I consists of patients (> median age) who wore the AB.

Group II consists of patients (> median age) who did not wear the AB.

2.5.3. Duration of physical rest

Group I consists of patients with a postoperative duration of physical rest between 0 and 4 weeks.

Group II consists of patients with a postoperative duration of physical rest between 5 and > 14 weeks (Table 3).

2.5.4. Load-dependent work according to the definition by Rohmert and Rutenfranz 1983 [12].

Group I consists of professions with light and heavy manual labor with hands and arms.

Group II consists of professions with light, heavy and very heavy physical labor (Table 4).

2.5.5. Surgical approach

Group I consists of patients who underwent open IHR.

Group II consists of patients who underwent laparoscopic IHR (Table 5).

2.6. Statistics

The results of the questionnaire were entered into Microsoft® Excel. The statistical analysis was done by using R 3.5.0.

In order to compare the baseline data (age, gender, BMI) and outcome between the groups as defined above, the mean, the standard deviation, the minimum, the maximum, and the median were calculated for continuous variables. For categorical variables, cross-tables were calculated.

The normality of continuous variables was tested with the Shapiro-Wilk test. In the case of normally distributed continuous variables, t-tests for independent groups were used to compare groups, otherwise Wilcoxon-tests were used. In the case of categorical variables, Fisher's exact test was used. A p-value of less than 0.05 was regarded as statistically significant.

For all analyses only available data was used, no imputation of missing values was done. Hence for some variables less than 163 data points were available.

Since this is an exploratory study, no adjustment of the type-I error was done.

The work has been reported in line with the STROCSS criteria [14].

Ethical approval

The survey at hand was approved by the medical ethical committee of the Otto von Guericke University in Magdeburg, Germany.

2.6.1. Study registration

The study has been registered in the German clinical trial registry (DRKS, Deutsches Register klinischer Studien; https://www.drks.de/) with the ID DRKS00016634.

3. Results

163 patients applied the questionnaire anonymously (Berlin: n = 115; Magdeburg: n = 48).

| Table 3 | Univariate analysis of survey data among individuals with different durations of physical rest. |
|---------|--------------------------------------------------------------------------------------------------|
| Variable | Group I n = 33 | Group II n = 46 | p value |
| Laparoscopic IHR | 26 | 23 | 0.0084 |
| Open IHR | 6 | 22 | |
| Age year | 61.8 ± 10 | 52.9 ± 11.1 | 0.0037 |
| Gender female | 12 | 19 | 0.8156 |
| | male | 21 | 27 | |
| BMI | < 25 | 7 | 3 | 0.4482 |
| | 25–30 | 10 | 18 | |
| | > 30 | 16 | 20 | |
| Abdominal binder average duration of carrying 5.8 ± 4.1 | 8.3 ± 4.4 | 0.0158 |
| carried less than recommended | 2 | 7 | 0.5904 |
| carried like recommended | 13 | 18 | |
| carried longer than recommended | 8 | 14 | |
| No Abdominal binder | 5 | 4 | 0.4792 |
| Hernia relapse | 3 | 4 | 0.9999 |
| Seroma formation | 1 | 4 | 0.6427 |
| Pulmonary infection | 1 | 4 | 0.6427 |
| Abdominal binder induced immobility | 10 | 18 | 0.4627 |
| Abdominal binder induced reduction of pain | 25 | 33 | 0.3379 |

Group I consists of patients with postoperative duration of physical rest between 0 and 4 weeks.

Group II consists of patients with postoperative duration of physical rest between 5 and > 14 weeks.

IHR: Incisional hernia repair.

| Table 4 | Univariate analysis of survey data among individuals with different load-dependent work. |
|---------|--------------------------------------------------------------------------------------------------|
| Variable | Group I n = 30 | Group II n = 33 | p value |
| Laparoscopic IHR | 17 | 22 | 0.7897 |
| Open IHR | 11 | 11 | |
| Age year | 59 ± 9.6 | 51.8 ± 12.4 | 0.0185 |
| Gender female | 14 | 13 | 0.6164 |
| | male | 16 | 20 | |
| BMI | < 25 | 4 | 7 | 0.7485 |
| | 25–30 | 11 | 12 | |
| | > 30 | 14 | 13 | |
| Physical rest average duration of carrying | 5.6 ± 2.5 | 7.8 ± 4.4 | 0.1006 |
| less than recommended | 4 | 4 | 0.7719 |
| like recommended | 9 | 14 | |
| longer than recommended | 6 | 6 | |
| Abdominal binder average duration of carrying 6.7 ± 4.1 | 8.5 ± 4.2 | 0.1280 |
| carried less than recommended | 5 | 2 | 0.0767 |
| called like recommended | 13 | 13 | |
| called longer than recommended | 14 | 9 | |
| No Abdominal binder | 2 | 2 | 0.9999 |
| Hernia relapse | 5 | 1 | 0.9933 |
| Seroma formation | 2 | 3 | 0.9999 |
| Pulmonary infection | 2 | 3 | 0.9999 |
| Abdominal binder induced immobility | 8 | 17 | 0.0667 |
| Abdominal binder induced reduction of pain | 25 | 25 | 0.4770 |

Group I consisted of professions w/light and heavy manual labor w/hands and arms.

Group II consisted of professions w/light, heavy and very heavy physical labor. IHR: Incisional hernia repair.

were calculated.

The normality of continuous variables was tested with the Shapiro-Wilk test. In the case of normally distributed continuous variables, t-tests for independent groups were used to compare groups, otherwise Wilcoxon-tests were used. In the case of categorical variables, Fisher's exact test was used. A p-value of less than 0.05 was regarded as statistically significant.

For all analyses only available data was used, no imputation of missing values was done. Hence for some variables less than 163 data points were available.

Since this is an exploratory study, no adjustment of the type-I error was done.

The work has been reported in line with the STROCSS criteria [14].

Ethical approval

The survey at hand was approved by the medical ethical committee of the Otto von Guericke University in Magdeburg, Germany.
3.1. Baseline characteristics

73 (47.7%) patients underwent open IHR. 80 (52.3%) patients were operated on laparoscopically. 10 patients did not apply the questionnaire in terms of their surgical approach. The average age was 63.2 ± 12 years. 74 (45.4%) patients were female and 89 (54.6%) patients were male. 31 (19.6%) patients had a BMI below 25 kg/m², 67 (41.1%) between 25 and 30 kg/m² and 60 (36.8%) above 30 kg/m² (Table 1).

3.1.1. Patients professions

7 patients did not answer the question concerning their professions. 90 patients were retired. Two patients were invalid patients and one individual (0.6%) was unemployed at the time of the survey conduct. 63 patients were working, when they replied to the questionnaire.

3.2. Postoperative recommendations

79 patients answered the questions regarding physical rest after surgery. The average duration of physical rest was 6.2 ± 4.2 weeks. 6 patients did not comply with physical rest postoperatively. 7 individuals had physical rest for two weeks, 10 patients had physical rest for three weeks, 10 patients had physical rest for 4 weeks, 5 patients had physical rest for 10 weeks, 9 patients had physical rest for 6 weeks, two patients had physical rest for 7 weeks, 7 patients had physical rest for 8 weeks, two patients had physical rest for 10 weeks, 5 patients had physical rest for 12 weeks, 1 patient had physical rest for 13 weeks, and 10 patients had physical rest for 14 weeks or more than 14 weeks. 61 patients answered the questions concerning conducted and advised physical rest. 13 (21.1%) patients physically rested less than recommended, 37 (60.7%) rested as recommended, and 11 (18.1%) rested longer than recommended.

163 patients replied to the questionnaire concerning the use of an AB. 17 patients did not use the AB and 146 patients used an AB after surgery. The average duration of wearing an AB was 7.6 ± 4.2 weeks. 68 used an AB.

17 patients did not wear an AB. 146 used an AB.

In the “No Abdominal binder” group, 14 patients were operated on through a laparoscopic technique IHR and two (12.5%) patients received open IHR. The average age was 63.6 ± 9.9 years. 9 patients were female and 8 were male. 4 patients had a BMI below 25 kg/m², 8 between 25 and 30 kg/m², and 5 above 30 kg/m². The average duration of physical rest was 3.9 ± 2.7 weeks. One patient suffered from a hernia recurrence. No patient suffered from a seroma formation or a pulmonary infection.

In the “Abdominal binder” group, 66 patients were operated on through a laparoscopic technique and 71 patients were operated on through an open technique. The average age was 63.2 ± 12 years. 65 patients were female and 81 were male. 29 patients had a BMI below 25 kg/m², 8 between 25 and 30 kg/m², and 55 above 30 kg/m². The average duration of physical rest was 6.5 ± 4.2 weeks. 24 patients suffered from a hernia recurrence. 14 patients suffered from a seroma formation and 15 individuals suffered from a pulmonary infection.

Regarding the average duration of physical rest (p = 0.1302), the postoperative incidence of pulmonary infections (p = 0.9999), relapses (p = 0.4676), and seroma formations (p = 0.3637), no statistically significant differences were detected between the two groups after univariate analysis. Concerning the surgical approaches, a statistical significance with p = 0.003 was revealed (Table 2).

3.3. Postoperative outcome

Among the 163 analyzed individuals, 25 (15.3%) patients suffered from a relapse, 14 (8.6%) from a seroma formation and 15 (9.2%) from a pulmonary infection. 50 (34.2%) patients reported of immobility caused by the AB. 115 (78.8%) patients reported that the AB reduced postoperative pain (Table 1).

3.4. Univariate analysis of the abdominal binders on incisional hernia repair

3.5. Age related univariate analysis of the abdominal binders on incisional hernia repair

3.5.1. Two univariate analysis were conducted related to median age (64 years)

Concerning patients below median age 5 patients did not wear an AB. 68 used an AB.

In the “No Abdominal binder” group, 4 patients were operated on through a laparoscopic technique IHR and no patients received open IHR. The average age was 52.8 ± 7.98 years. 3 patients were female and 2 were male. The average BMI was 33.6 ± (7.10). No patient suffered from a hernia recurrence. 7 patients suffered from a seroma formation. 24 patients (35.8%) reported that the AB limited mobilization. 54 patients reported that the AB reduced pain.

Regarding biometric baselines (age: p = 0.646; gender: p = 0.396; BMI: p = 0.351), treatment (p = 0.124) and outcome (seroma and

| Variable | Open hernia repair n = 73 | Laparoscopic hernia repair n = 80 | p value |
|-------------------------|---------------------------|---------------------------------|---------|
| Physical rest weeks | 8.2 ± 4.3 | 5.2 ± 3.8 | 0.0009 |
| less than recommended | 2 | 8 | 0.4899 |
| like recommended | 14 | 22 | | |
| longer than recommended | 3 | 10 | | |
| Abdominal binder weeks | 9 ± 4.1 | 6.2 ± 4.2 | < 0.0001 |
| carried less than recommended | 8 | 4 | 0.5515 |
| carried like recommended | 28 | 30 | | |
| carried longer than recommended | 20 | 18 | | |
| No Abdominal binder | 2 | 14 | 0.0030 |
| Abdominal binder induced immobility | 30 | 20 | 0.2129 |
| Abdominal binder induced reduction of pain | 54 | 55 | 0.2505 |
patients were female and 21 were male. 7 patients had a BMI below 25 kg/m², 18 between 25 and 30 kg/m², and 32 above 30 kg/m².

Regarding biometric baselines gender (p = 1.000) and BMI (p = 0.797), treatment (p = 0.124) and outcome (seroma and relapse p = 1.000) no statistical significance was revealed. The groups statistical significant differed in terms of age (p = 0.042).

3.6. Univariate analysis of survey data among individuals with different durations of physical rest

Group I (n = 33) consists of patients with a postoperative duration of physical rest between 0 and 4 weeks. 26 patients were operated on through a laparoscopic technique and 6 patients were operated on through an open technique. The average age was 61.8 ± 10 years. 12 patients were female and 21 were male. 7 patients had a BMI below 25 kg/m², 11 between 25 and 30 kg/m², and 15 above 30 kg/m². 33 patients replied to the questionnaire concerning the use of an AB. 5 patient did not use an AB, and 28 patients used an AB after surgery. The average duration of wearing an AB was 5.8 ± 4.1 weeks. Two (6.7%) patients wore the AB less than recommended, 12 (52.2%) wore the AB as recommended, and 8 (34.8%) wore the AB longer than recommended. Three patients suffered from hernia recurrence. One patient suffered from a seroma formation, and two patients suffered from a pulmonary infection. 10 individuals reported that the AB induced immobility. 25 patients reported that the AB reduced pain.

Group II (n = 46) consists of patients with a postoperative duration of physical rest between 5 and > 14 weeks. 23 patients were operated on through a laparoscopic technique and 22 patients were operated on through an open technique. The average age was 52.9 ± 11.1 years. 19 patients were female and 27 were male. 5 patients had a BMI below 25 kg/m², 18 between 25 and 30 kg/m², and 20 above 30 kg/m². 46 patients replied to the questionnaire concerning the use of an AB. 42 patients used an AB after surgery. The average duration of wearing an AB was 8.3 ± 4.4 weeks. 7 patients carried the AB less than recommended, 12 (52.2%) wore the AB as recommended, and 8 (34.8%) wore the AB longer than recommended. Of the 30 patients who replied to the questionnaire, 28 patients wore an AB postoperatively. Two patients did not use an AB. The mean duration of carrying an AB was 6.7 ± 4.1 weeks. 26 patients indicated how long they used the AB. 5 patients (19.2%) wore the AB less than recommended, 7 (26.9%) wore the AB as recommended, and 14 (53.8%) wore the AB longer than recommended. 5 patients suffered from a hernia recurrence, two patients suffered from a seroma formation, and two patients suffered from a pulmonary infection. 8 individuals reported that the AB induced immobility. 25 patients reported that the AB reduced pain.

Among the patients of group II (light, heavy and very heavy physical labor; n = 33), are two butchers, two caretakers, one cleaner, one construction worker, four cooks, one farmer, two housewives, one kindergarten teacher, one locksmith, nine mechanics, four nurses, three sellers, and two storekeepers. 22 patients were operated on through a laparoscopic technique and 11 patients were operated on through an open technique. The average age was 51.8 ± 12.4 years. 13 patients were female and 20 were male. 7 patients had a BMI below 25 kg/m², 12 between 25 and 30 kg/m² and 14 above 30 kg/m². The average duration of physical rest was 7.8 ± 4.4 weeks. 4 patients physically rested less than the recommended duration, 14 rested as recommended, and 6 rested longer than recommended. 33 patients replied to the questionnaire regarding the use of an AB. 31 patients used an AB after surgery. The mean duration of wearing an AB was 8.5 ± 4.2 weeks. Two patients did not use an AB. 2 patients wore the AB less than recommended, 13 wore the AB as recommended, and 9 wore it longer than recommended. One Patient suffered from a hernia recurrence, three patients suffered from a seroma formation, and three patients suffered from a pulmonary infection. 17 individuals reported that the AB induced immobility. 25 patients reported that the AB reduced pain.

In terms of the surgical approach (p = 0.7897), gender (p = 0.6164), BMI (p = 0.7485), duration of postoperative physical rest (p = 0.7719), duration of wearing the AB (p = 0.0767), AB induced immobility (p = 0.0667), AB induced reduction of postoperative pain (p = 0.4770) and postoperative morbidity such as incidence of pulmonary infections (p = 0.999), recurrences (p = 0.093), seroma formations (p = 0.999), AB induced immobility (p = 0.0667), and reduction of pain (p = 0.4770), no statistical significant differences were detected between the two groups after univariate analysis.

Concerning the age a statistical significance with p = 0.0185 was calculated (Table 4).

3.8. Univariate analysis of survey data concerning the surgical approach

10 patients were excluded as they did not answer which surgical technique was performed.

Among the patients who underwent open IHR (n = 73), the average age was 64.3 ± 10.4 years. 31 patients were female and 42 were male. 15 patients had a BMI below 25 kg/m², 21 between 25 and 30 kg/m², and 33 above 30 kg/m². Among the patients who were operated on through IPOM-technique (n = 80), the average age was 61.8 ± 13.7 years. 39 patients were female and 41 were male. 16 patients had a BMI below 25 kg/m², 31 between 25 and 30 kg/m², and 32 above 30 kg/m².
Regarding the age (p = 0.2419), the gender (p = 0.5162), and the BMI (p = 0.5276), no statistical significant differences were detected between the two groups after univariate analysis.

19 patients answered the questions concerning advised and actually conducted physical rest after surgery. The average duration of physical rest was 8.2 ± 4.2 weeks. Two patients physically rested less than recommended, 14 rested as recommended, and three rested for longer than recommended. 73 patients replied to the questionnaire concerning the use of an AB. Two patients did not use the AB. The average duration of wearing an AB was 9 ± 4.1 weeks. 8 patients wore the AB for less than the recommended duration, 28 wore the AB for the duration recommended, and 20 wore the AB for longer than recommended.

Among the patients who underwent laparoscopic IHR (n = 80), 5 patients suffered from a relapse, 6 from a seroma formation and 8 from a pulmonary infection. 20 patients reported that the AB induced immobility. 55 patients reported that the AB reduced pain after surgery. 40 patients answered the questions concerning physical rest after surgery. The average duration of physical rest was 5.2 ± 3.8 weeks. 8 patients physically rested less than recommended, 22 patients rested as recommended, and 10 patients rested longer than recommended. 80 patients replied to the questionnaire concerning the use of an AB. 14 patients did not use the AB after surgery. The average duration of wearing an AB was 6.2 ± 4.2 weeks. 4 patients wore the AB less than recommended, 30 wore the AB as recommended, and 18 wore the AB longer than recommended. Among the patients who underwent open IHR (n = 73) 16 patients had a recurrence, 8 patients had a seroma formation, and 6 had a pulmonary infection. 30 patients reported that the AB induced immobility. 54 patients reported that the AB reduced pain following IHR Regarding the recommendations of physical rest following IHR, 54 patients reported that the AB reduced pain after surgery, especially among patients who underwent laparoscopic IHR (p = 0.0428). These results confirm the assumptions of several authors that the AB has a pain reducing effect [12,13].

As negative effects, it is possible that the AB may induce atrophy due to the lack of using the abdominal muscles [12]. Moreover, Vailas et al. demonstrated that ambulation significantly enhances the healing process of tissue compared to the tissue in an immobilized state [17]. During our survey, at least 50 of 163 questioned patients reported that the AB induced immobility. In contrast, Cheifetz et al. (2010) performed a RCT analyzing the usefulness of an AB following major abdominal surgery. The authors postulated that the AB may enhance the speed of postoperative recovery of walking and physical performance [18]. But these trials did not focus on incisional hernias like the publication at hand.

In conclusion, the evidence for using an AB following ventral hernia repair is very low. Positive effects are not proven yet. Moreover, negative effects are supposed in literature. The survey at hand revealed for the first time an AB induced immobility as a negative effect. Therefore, we assume that the prescription of an AB may not be necessary. The avoidance of an AB may reduce the individual incapacity of working and the time of immobility, and would therefore have a positive socioeconomic impact. However, the evidence level of a survey, naturally, is low. Due to a small number of questioned individuals and the study design, our results should not be over-interpreted. Two different types of ABs were prescribed among the two survey conducting hospitals. With an average price of 30 euros for one AB, costs should not heavily impact hospital budgets in Western Europe.

4. Discussion

4.1. Abdominal binder

After laparotomies in Western Europe, it is often advised to wear an AB to reduce the rate of seroma formations, pain, to facilitate wound healing, and thereby to prevent recurrences [11,12]. A survey that was conducted by Bouvier et al. among French surgeons revealed that 94% of 50 surgical departments were prescribing an AB following laparotomies in France. The expected benefit was the prevention of abdominal-wall complications [12]. In addition, we performed a survey among surgical departments in Germany. As a result, 70.5% of the surgical departments in Germany prescribed an AB as postoperative treatment [11]. Throughout literature, the evidence for wearing an AB is low. Rothman et al. conducted a systematic review and revealed a poor quality of the literature on this topic. The authors suggested that wearing an AB after a major abdominal surgery may reduce pain and improve physical function [13]. To our knowledge in terms of wearing ABs after hernia repair, only two relevant articles were published. Christoffersen et al. performed a randomized clinical trial (RCT) on the postoperative use of an AB after laparoscopic umbilical and epigastric hernia repair. Data from 56 patients (AB, n = 28; no binder, n = 28) were analyzed [15]. No significant effects on pain, movement limitations, seroma formation, fatigue, general well-being, or quality of life were revealed. Kaafarani et al. conducted a RCT of 145 patients undergoing open and laparoscopic IHR to investigate factors leading to seroma formation. The trial revealed that the duration of wearing an abdominal binder had no statistical significant impact on seroma formation [16].

Due to the lack of evidence concerning IHR, we performed a survey among German surgical departments. No correlation between the prolonged wearing of an AB and the recurrence rate was revealed [11]. Additionally, we conducted the survey at hand among 163 patients undergoing IHR. Possible positive effects of the AB were analyzed. No statistical significant differences were detected between the AB group (n = 146) and the non-AB group (n = 17) after univariate analysis (Table 4) regarding the postoperative incidence of pulmonary infections (p = 0.9999), recurrences (p = 0.4676), and seroma formations (p = 0.3637). In addition we further univariate analyzed the possible effects of the AB comparing patients above and below median age (64 years). In terms of biometric baseline, treatment and outcome these 4 groups mainly did not statistical differ from each other. But due to the sample size both groups were hardly comparable.

However, the majority of the questioned patients (n = 109) reported that the AB reduced pain after surgery, especially among patients who underwent laparoscopic IHR (p = 0.0428). These results confirm the assumptions of several authors that the AB has a pain reducing effect [12,13].

4.2. Physical rest

Recommending physical rest as well as avoidance of lifting heavy weights has been part of the postoperative-treatment after hernia repair for a long time. Bassini already (1890) recommended a period of physical rest for 6 weeks after inguinal hernia repair [19]. The rationale for recommending physical rest is unclear, however, physical rest is commonly attributed to beliefs about wound healing and the possible benefits of a prolonged period of inactivity in order to prevent recurrences. The clinical impact of physical rest on the postoperative outcome following hernia repair is unclear. To that, Lichtenstein published the results of 6321 cases of herniorrhaphies. Despite immediate resumption of activity postoperatively, a recurrence rate of only 0.7% was revealed [20]. In regards to IHR, no correlation was detected between prolonged physical rest and the recurrence rate after reviewing the literature and questioning surgical departments in Germany about their postoperative outcome following IHR [11]. Therefore, it is perceivable that shortened physical rest may have no negative impact on the postoperative results after IHR. To add more evidence on this topic, we conducted the survey at hand.

To further analyze the effect of a prolonged duration of physical rest, we differentiated the individuals into two groups (Group I
(n = 33): postoperative duration of physical rest for 0–4 weeks, Group II (n = 46) 5 > 14 weeks). Concerning the postoperative incidence of a relapse, a seroma formation, and a pulmonary infection, no statistical significance was detected between the two groups. These findings may confirm our previous results that there is no correlation between prolonged physical rest and a rate of recurrence [11]. However, as mentioned above, the evidence level of a survey, naturally, is low. Due to a small number of individuals and the study design, our results should not be over-interpreted. Moreover, as far as the age and the surgical approach go, the two groups statistically differ from one other (Table 3).

We assume that a shortened period of physical rest can be recommended following IHR. This can reduce the time of immobility and would therefore have a positive social-economic impact. The publication by Vailas et al. demonstrated in an animal model that ambulation significantly enhances the healing process by inducing a rapid return of tissue DNA and collagen synthesis compared to the animal’s tissue in an immobilized state, which would support our hypothesis. Furthermore, in literature, early ambulation and return to work is not described as being a risk factor for recurrence [3,5,6]. Additionally, Majercik performed a prospective animal study involving 12 female pigs. They received an IHR with a laparoscopic mesh placement. The animals were put to sleep at different time and the strength of the tissue attachment to the mesh was measured. The authors revealed, that 74% of strength that was seen after 12 weeks was already achieved two weeks after surgery. The number of samples in the mentioned animal study was low, but it confirms our assumption, that a shortened period of physical rest after IHR should be recommended.

To further prove our mentioned assumptions concerning an unproven positive impact of an AB and a prolonged period of physical rest after IHR we univariate analyses our survey data among individuals with different load-depended work. The patients of group II, who perform heavy physical labor (Table 4) wore the AB and physical rested not statistical significant longer than the patients of group I (light physical labor). Concerning the surgical approach, no statistical significance was detected between the two groups (p = 0.7897). The patients of group II were even younger (p = 0.0185). In literature, physical rest and wearing an AB are advised to improve wound healing. One could postulate that the heavy workload of the individuals of group II leads to more recurrences and seroma formations. In contrast, the postoperative incidence of recurrences (p = 0.093) and seroma formations (p = 0.9999) did not statistically differ between the two groups after univariate analysis. Yet again, due to a small number of questioned individuals and the study design, our results should not be considered as significant.

As survey limitations concerning a larger sample size would determine more valuable data. In terms of biometric data’s we asked about the present age, BMI and profession. Revealing this data at the time of operation would determine more valuable data. On the other hand, we focused on a time period of only five years. The revealed data’s may be similar. The questionnaire neither did ask for the exact time of a possible recurrence, pulmonary infection, seroma formation nor for the exact level of pain reduction and movement limitation following surgery.

For a more valuable analysis the width of the treated hernia should be known. On the other hand at the participating hospitals the open procedure naturally was mostly performed after diagnosing a width around 7 cm. Therefore we assume that the open procedure group contains patients suffering from a more large IHR.

Analyzing the questionnaires revealed that the patient’s frequent physical rest and wearing the AB are recommended. Apparently, some questions were not answered correctly because we never recommend 3, 5 and 12 weeks as postoperative treatment. It appears that some patients may not properly remember the recommendations or did not want to admit a noncompliant behavior. This would then decrease the value of our findings.

The majority of our patients were retired. The role of being on sick leave naturally plays a smaller role with these individuals. The main aim of investigations and definitions of postoperative treatment may be to shorten the period of being on sick leave. By reducing the individual incapacity for work and immobility, this would have a social-economic impact. Therefore, further clinical trials may focus on actual working patients.

Further studies should also analyze the impact of different postoperative recommendations on the rate of postoperative wound infections.

We did not use a hernia-related quality of life questionnaire like the ‘Carolina Comfort Scale (CCS)’. But in order to receive a high number of patients who would reply to questionnaires, we focused on a small number of simple questions.

5. Conclusions

Due to our findings, we assume that an AB may induce immobility but also may reduce postoperative pain. A prolonged period of physical rest does not seem to have an impact on the postoperative outcome following an IHR.

Therefore, a shortened duration of physical rest and wearing an AB following an IHR may be advised. This would have a social-economic impact in reducing the individual incapacity to work.

Further investigations with randomized clinical trials focusing on different durations of physical rest and the effect of wearing an AB including a long-term follow-up are mandatory to elevate our hypothesis.

Ethical approval

Ethical approval received.

Sources of funding

All authors have no source of funding.

Author contribution

Dr. med. Christoph Paesch (corresponding author):
Contribution to the paper: author, data collection, data analysis and interpretation, writing the paper, examination and treatment of the patient.

Dr. Gianluca Desanto (co-author):
Contribution to the paper: data analysis, examination and treatment of the patient.

Dr. med. Stefan Anders (co-author):
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Prof. Dr. Martin W. Strik (co-author):
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Ethical approval

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Conflicts of interest

None.
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