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# Efficacité et sécurité de l'analgésie péridurale dans le service de chirurgie digestive au CHU de Rouen

Simon Herpers-Renard

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**UFR DE SANTÉ DE ROUEN NORMANDIE**

**ANNÉE 2023**

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DOCTORAT EN MÉDECINE**

(Diplôme d'État)

Par

**HERPERS--RENARD Simon**

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**Efficacy and safety of epidural analgesia in visceral and digestive  
unit at university hospital of Rouen, a before-after study.**

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# Serment d'Hippocrate

« Au moment d'être admis à exercer la médecine, je promets et je jure d'être fidèle aux lois de l'honneur et de la probité.

Mon premier souci sera de rétablir, de préserver ou de promouvoir la santé dans tous ses éléments, physiques et mentaux, individuels et sociaux.

Je respecterai toutes les personnes, leur autonomie et leur volonté, sans aucune discrimination selon leur état ou leurs convictions. J'interviendrai pour les protéger si elles sont affaiblies, vulnérables ou menacées dans leur intégrité ou leur dignité. Même sous la contrainte, je ne ferai pas usage de mes connaissances contre les lois de l'humanité.

J'informerai les patients des décisions envisagées, de leurs raisons et de leurs conséquences.

Je ne tromperai jamais leur confiance et n'exploiterai pas le pouvoir hérité des circonstances pour forcer les consciences.

Je donnerai mes soins à l'indigent et à quiconque me les demandera. Je ne me laisserai pas influencer par la soif du gain ou la recherche de la gloire.

Admis dans l'intimité des personnes, je tairai les secrets qui me seront confiés. Reçu à l'intérieur des maisons, je respecterai les secrets des foyers et ma conduite ne servira pas à corrompre les mœurs.

Je ferai tout pour soulager les souffrances. Je ne prolongerai pas abusivement les agonies. Je ne provoquerai jamais la mort délibérément.

Je préserverai l'indépendance nécessaire à l'accomplissement de ma mission. Je n'entreprendrai rien qui dépasse mes compétences. Je les entretiendrai et les perfectionnerai pour assurer au mieux les services qui me seront demandés.

J'apporterai mon aide à mes confrères ainsi qu'à leurs familles dans l'adversité. Que les hommes et mes confrères m'accordent leur estime si je suis fidèle à mes promesses ; que je sois déshonoré et méprisé si j'y manque. »

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**Efficacy and safety of epidural analgesia in visceral and digestive unit at university hospital of Rouen, a before-after study.**

## **Abstract :**

**Background :** Epidural analgesia is a well-established analgesic technique mostly used in post operative intensive care unit at Rouen University Hospital, especially for major abdominal surgery as part of enhanced recovery protocols. The objective of this study was to evaluate the efficacy and safety of epidural analgesia in visceral and digestive unit at Rouen University Hospital.

**Materials and methods :** This was a retrospective, monocentric, before-after study in which 117 patients were analyzed. Efficacy was evaluated via cumulative morphine consumption in the first 24 hours in the surgery unit. Safety was evaluated via mean pain score, epidural adverse effects, gastrointestinal complications, time to first rise, length of stay, and outcome at 30 days.

Every patient who has had an epidural analgesia for major abdominal surgery between 2021 and 2023 was included. Our protocol for epidural analgesia management changed at the beginning of 2022 leading to the possibility of monitoring patients with epidural analgesia into the digestive surgery unit. All the data collected was consigned to an online database.

**Results :** We analysed 117 patients, of which 48 had an epidural analgesia in 2021 (Before change of protocol) and 69 had an epidural analgesia in 2022 (After change of protocol). Comparing the Before versus After groups in the multivariate analysis we observed a reduction of morphine consumption in cumulative dose in the first 24 hours into the surgery unit in the After group (-12.1 [-23.6 – -0.5]; p= 0.041).

**Discussion :** Our study shows a reduction in morphine consumption in patients with epidural analgesia in the digestive surgery unit. There were no safety concerns for epidural analgesia. However, with the rise of peripheral locoregional anesthesia for major surgeries, we should compare epidural analgesia to those techniques.

**Key words :** Epidural analgesia, major abdominal surgery, opioid use, post operative pain, locoregional anesthesia

## **Background:**

Pain management is a critical aspect of postoperative patient care and has always been one of the most challenging goals of anesthesiologists as inadequate pain control provides poor patient comfort and can also lead to prolonged hospital stays, delayed recovery, and increased susceptibility to complications. (1)

Major abdominal surgery represents a significant medical intervention, encompassing procedures such as oesophagectomy, abdominoperineal resection, colectomy, large bowel resection and pancreatic surgeries. While advances in surgical techniques have undoubtedly improved patient outcomes they remain often accompanied by intense postoperative pain(2).

In this context, epidural analgesia has emerged as a notable contender, offering a targeted and potentially transformative approach to pain control following major abdominal procedures.

Epidural analgesia involves the precise delivery of pain-relieving drugs, especially local anesthetic, into the epidural space surrounding the spinal cord via a catheter resulting in blocking nerve signals responsible for transmitting pain from the surgical site(3). This localized approach offers several advantages over systemic pain relief methods, including enhanced pain control, improving patient comfort during the critical early postoperative phase resulting in enhanced recovery(4), minimizing the reliance on opioids which are burdened with their own constellation of side effects and potential complications such as nausea, constipation, and respiratory depression. The excellent analgesic effect of epidural analgesia is well established(5–8) but also comes with known side effects(9) like neurological complications, hypotension or infectious complications and difficulty to manage(10), explaining the fluctuation of its use over time.

In recent years, there has been a strong interest in evaluating the efficacy and safety of epidural analgesia(11), particularly concerning its application in the context of major abdominal surgery(5,12,13). These researches will stand as a starting point for our study.

In France, the actual recommendation for epidural analgesia monitoring is a 24-hour stay in

post operative intensive care unit in case of epidural injection of more than 0.2 mg of morphine implying a potential early postoperative use in surgical ward.(3)

At Rouen University Hospital, before 2022, a patient who undergoes major abdominal surgery could have epidural analgesia if taken care of in post operative intensive care unit, but the catheter should be removed before being transferred to the visceral and digestive surgery department. The reason why epidural analgesia was only used in this specific unit is its high potential of complication if incorrectly supervised, this risk obviously increases with less trained teams.

Our rationale for an innovative way of epidural management is based on the hypothesis that those patients may have benefited more from this type of analgesia if not removed at discharge from post operative intensive care unit leading to potentially best outcomes while minimizing risks as suggested in previous studies. (14)

The aim of our study is to evaluate the efficacy and safety of epidural analgesia in the visceral and digestive unit of Rouen University Hospital.

## **Methods:**

### **Study design**

This study is a retrospective, monocentric, before-and-after study designed to evaluate the implementation of Epidural analgesia in digestive surgical unit at the University Hospital of Rouen. This study was conducted by the rules of RGPD.

Written informed consent was not required as the study related to an evidence-based institutional change of practice.

### **Setting and participants**

Rouen Hospital is a University Hospital in Normandy, France. The visceral and digestive surgical unit handles about 400 patients a year who are considered to have major abdominal surgery.

All patients who received epidural analgesia for planned major abdominal surgery were eligible for inclusion in the study. Exclusion applied to patients under 18 years of age, pregnant women, patients with limitations of care or patients who remained sedated after surgery without the possibility to assess pain.

Anesthesiologists specialized in abdominal surgery at Rouen Hospital established a program of paramedic training, the goal was to teach them how to manage patients with epidural anesthesia in visceral and digestive surgery service. This teaching program took place in 2021 in the form of short courses including nurses and caregivers.

Our protocol for epidural analgesia was the preoperative insertion of an epidural catheter at the level of the spinal cord which supplies the area of the operation wound according to standard protocols by anesthesiologists, administration of a test dose of a local anesthetic (usually 3mL Lidocaine 10mg/mL). The mixture for epidural infusion consisted mainly of local anesthetic (usually Ropivacaine 2mg/mL). Perioperative and postoperative use of epidural

analgesia was at the discretion of the anesthesiologist. Additional analgesics were administered as needed. In post operative intensive care unit epidural analgesia was used with patient-controlled epidural analgesia (PCEA) using Rythmic™ Evolution Organiser 501 and the patient was monitored for at least 24 hours.

Before January 2022, as explained before, our epidural analgesia protocol for post operative analgesia implied a stay in post operative intensive care unit and the ablation of the epidural catheter before discharge. After January 2022, paramedical team training made possible management of epidural analgesia in visceral and digestive unit if needed, after a stay of at least 24 hours in postoperative intensive care unit. The epidural analgesia catheter could be kept for a maximum of five days.

The study took place between January 2021 and January 2023, allowing a comparison period of 12 months before and after the change in the epidural analgesia management protocol.

### **Data collection**

Patient characteristics data collected about the study participants included gender, age at surgery, date of surgery, BMI, chronic use of analgesics, smoking or drinking habits, use of drugs, ASA score, anxiety history and past abdominal surgeries. All data was anonymized before statistical analysis.

The primary outcome was cumulated morphine consumption calculated in morphine equivalent dose in the first 24 hours in the visceral and digestive surgery department.

The secondary outcomes were mean pain score evaluated by numerated rating scale, occurrence of opioid adverse effect, occurrence of epidural analgesia adverse effect, nausea or vomiting, constipation, time to first rise, length of stay, and outcome at 30 days.

All those parameters were consigned to a local online database, using medical records, from which our data had been extracted.

## **Statistical analysis**

Continuous quantitative variables were described by their mean (standard deviation) or median [quartile 1 - quartile 3] depending on their distribution, which was evaluated graphically using data distribution histograms. Box plots were created for each quantitative variable.

Qualitative variables were described by their count (percentages).

Missing data were counted for each variable and then described. In cases of 'Missing at random' data and when the proportion of missing data was less than 20% per variable, a simple unconditional imputation strategy was employed: mean imputation for continuous quantitative variables, median imputation for discrete quantitative variables, and mode imputation for qualitative variables (using the 'Hmisc' library in R®).

Sensitivity analyses were conducted before and after imputation to verify the quality and robustness of the imputation.

Bivariate analyses were performed to assess raw associations between sociodemographic, clinical, and biological data and the study group using the Chi-square test (or Fisher's exact test) and the Student's t-test (or Mann-Whitney test) depending on the variable type and test validity conditions. The significance threshold for statistical tests was a p-value less than 0.05.

Multivariate analysis through multiple linear regression was conducted to study independent factors related to the cumulative consumption of morphine in the first 24 hours in the surgery department. Variables potentially impacting cumulative morphine consumption were selected after clinical reflection (knowledge derived from pathophysiology and literature) and statistical analysis (p-value < 0.20 in bivariate analyses) and then included in the multivariate analysis. The significance threshold was also a p-value less than 0.05.

All statistical analyses were performed using software R® 4.1.2.

## **Sample size**

No sample size was calculated a priori



## Results :

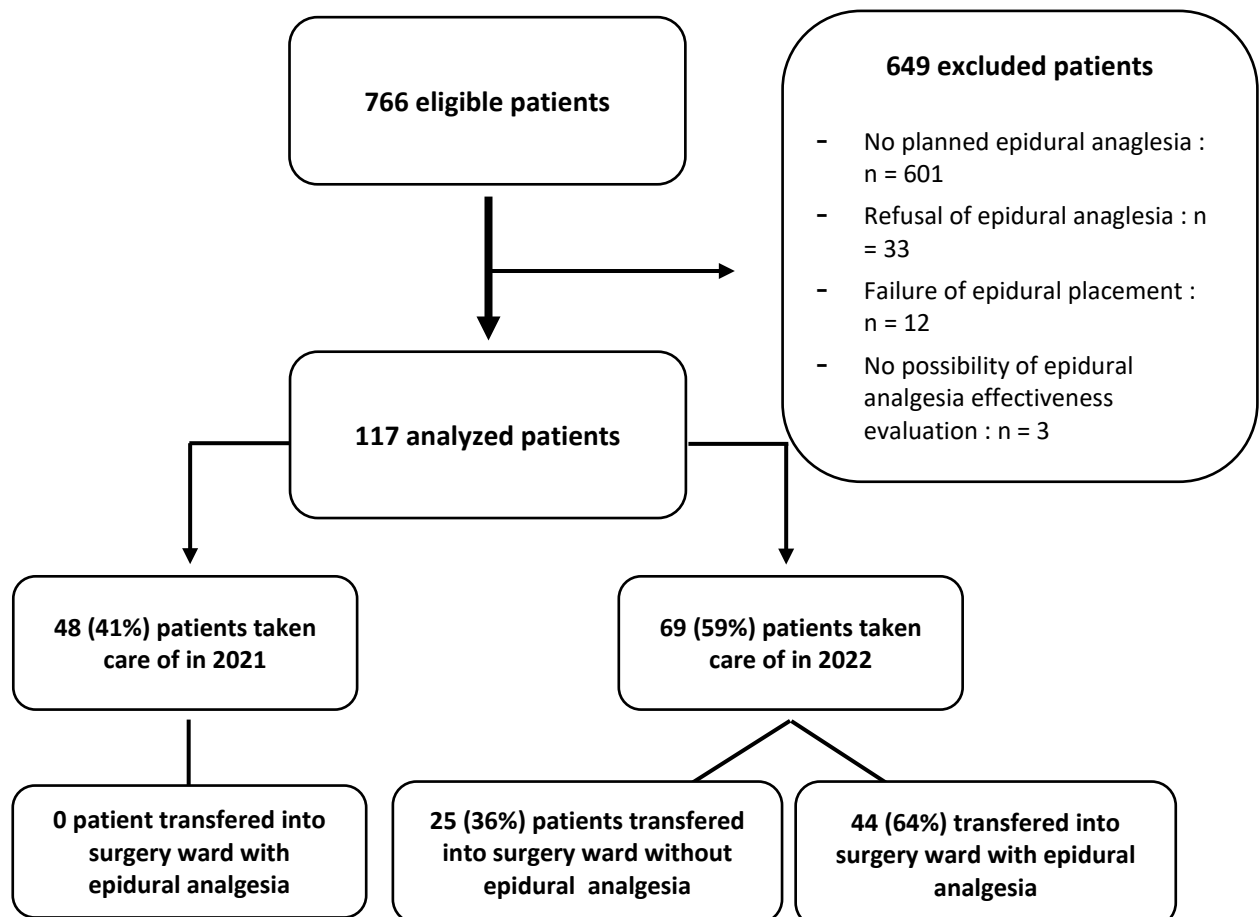
In our study, during a two years period, between January 1st, 2021 and January 1st,2023, 766 patients were programmed for major abdominal surgery of whom 117 patient (48 into the group « before » and 69 into the groupe « after ») were included and analyzed.

25 patient from the group « after » had their epidural analgesia catheter removed before discharge from postoperative intensive care unit. The flowchart is presented in Figure 1.

The baseline characteristics of the study participants are presented in Table 1.

There were no significant differences in these data between groups, except for BMI( $p=0.038$ ), post operative recovery room use of epidural analgesia( $p=0.006$ ), use of opioids in postoperative intensive care unit( $p=0.027$ ) and length of stay in post operative intensive care unit ( $p=0.003$ ).

**Figure 1 – Flowchart for study population**



**Table 1 : Baseline and Clinical Characteristics of the Population**

	<b>Cohort n = 117</b>	<b>Before (2021) n = 48 (41%)</b>	<b>After (2022) n = 69 (59%)</b>	<b>NA</b>	<b>P</b>
<b>Demographic data</b>					
Age (years)	62.2 (12.2)	60.7 (12.9)	63.2 (11.7)	0	0.268
Gender (woman)	61 (52%)	25 (52%)	36 (52%)	0	0.992
BMI (kg/m <sup>2</sup> )	25.4 (4.8%)	26.6 (4.9)	24.7 (4.6)	3	<b>0.038</b>
<b>Comorbidities</b>					
ASA score					
- 1	11 (9%)	5 (10%)	6 (9%)	0	0.691
- 2	83 (71%)	32 (67%)	51 (74%)		
- 3	23 (20%)	11 (23%)	12 (17%)		
Smoking	21 (18%)	7 (15%)	14 (20%)	0	0.429
Chronic alcoholism	6 (5%)	2 (4%)	4 (6%)	0	0.694
Drug addiction	2 (2%)	0	2 (3%)	1	-
Anxiety	4 (4%)	1 (2%)	3 (5%)	6	0.519
Chronic use of analgesic medication	13 (12%)	5 (11%)	8 (12%)	8	0.881
Postoperative nausea or vomiting history	3 (3%)	1 (2%)	2 (3%)	1	0.774
Abdominal surgery	56 (51%)	26 (60%)	30 (45%)	8	0.125
<b>Epidural analgesia</b>					
Site of insertion					
- Thoracic	109 (93%)	43 (90%)	66 (96%)	0	0.200
- Lumbar	8 (7%)	5 (10%)	3 (4%)		
Nombre of puncture					
- 1	93 (82%)	40 (87%)	53 (79%)	4	0.371
- 2	18 (16%)	6 (13%)	12 (18%)		
- ≥ 3	2 (2%)	0	2 (3%)		
Per operative use	25 (21%)	14 (30%)	11 (16%)	2	0.082
Post operative recovery room use	79 (69%)	39 (83%)	40 (59%)	2	<b>0.006</b>
Patient transferred into surgical ward with epidural analgesia	43 (37%)	0	44 (64%)	0	-
<b>Per operative and peri operative datas</b>					
Programmed surgery					
- Oesophagectomy	1 (1%)	1 (2%)	0	0	0.146
- Large intestinal résection	29 (25%)	9 (19%)	20 (29%)		
- Pancreatic resection	38 (32%)	13 (27%)	25 (36%)		
- HIPEC	49 (42%)	25 (52%)	24 (35%)		
Programmed surgery effectively performed	103 (89%)	41 (87%)	62 (90%)	1	0.660
Anesthesia using OFA protocol	108 (92%)	44 (92%)	64 (93%)	0	0.828
Use of per operative norepinephrine	91 (82%)	38 (86%)	53 (79%)	6	0.330
Maximum dose of norepinephrine (µg/kg/min)	0.22 (0.17)	0.26 (0.19)	0.20 (0.17)	25	0.457
Use of opioids in postoperative recovery room	10 (9%)	2 (5%)	8 (12%)	8	0.206
Use of norepinephrine in post operative intensive care unit	35 (31%)	13 (28%)	22 (32%)	3	0.642
Use of opioids in postoperative intensive care unit	75 (66%)	36 (78%)	39 (58%)	4	<b>0.027</b>
Length of stay in post operative intensive care unit (days)	2 [2 – 3]	3 [2 – 4]	2 [1 – 3]	0	<b>0.003</b>

**ASA = Physical status score established by the american society of anesthesiologists ; BMI = Body mass index ; HIPEC = Hyperthermic intraperitoneal chemotherapy ; OFA = Opioid free anesthesia Effective (Percent %) ; Mean (Standard deviation) ; Mediane [Quartile 1 – Quartile 2] NA = Missing datas ; P = p-value**

## Primary and secondary end points

The primary endpoint, cumulated morphine consumption in morphine equivalent dose in the first 24 hours into the visceral and digestive surgery department was significantly lower in the after group (-12.1 [-23.6 – -0.5];  $p= 0.041$ ) in the multivariate analysis (**Table 5**). Meanwhile, it did not differ between the before group (20 [0 – 40]) and after group (7 [0 – 21];  $p= 0.146$ ) in the intention to treat analysis(**Table 2**). The primary endpoint also did not differ between the without epidural analgesia group (20 [0 – 40]) and the with epidural analgesia group (0 [0 – 11];  $p=0.149$ ) in the per protocol analysis(**Table 3**).

Concerning the secondary endpoints, mean pain score was lower in the after group (4 [3 – 5]) compared to the Before group (6 [4 – 7];  $p= 0.006$ ) in the intention to treat analysis but also in the per protocol analysis between the with epidural analgesia group (3 [3 – 5]) and the without epidural analgesia group (6 [4 – 7]; $p= 0.003$ ).

We also observed a significant reduction in cumulative consumption in the first 48 hours in the digestive surgery department in the After group vs Before in multivariate analysis (-15.5 [-30.5 – -0.5] ; $p=0.042$ )

There was no difference between groups on the occurrence of opioid adverse effects in all analyses but the time to the resumption of transit was shorter in the group with epidural analgesia (4 [3 – 5] versus 6 [5 – 9];  $p= 0.011$ ) in the subgroup analysis.

There were no differences in the occurrence of epidural analgesia adverse effect, post operative nausea or vomiting, time to first rise, length of stay or outcome at 30 days between groups in all different analyses.

There was no serious epidural analgesia adverse effect in the surgery department.

The duration of epidural analgesia was longer in the group after (4 [2 – 4] versus 3 [2 – 3] ;  $p= 0.010$ ) in the intention to treat analysis.

The morphine consumption on day 2 and on day 3 in the digestive surgery unit is lower in the group with epidural analgesia than the group without epidural analgesia (12 (27%) versus 21 (44%) for day 2;  $p= 0.010$ ; 10 (23%) versus 21 (44%) for day 3;  $p= 0.033$ ) in the per protocol analysis.

We also highlight a trend of morphine consumption regression in the group After comparing to the group Before as seen in **Figure3**.

There were less surgical complications in the group After than Before as the Dindo Clavien classification is lower in the group After.

**Table 5 : Indépendants factor of cumulated morphine consumption in the digestive surgery department in the first 24hours.**

	Beta [IC95]	P
<b>Périod : After (2022)</b>	-12.1 [-23.6 – -0.5]	<b>0.041</b>
<b>Obésity</b>	-10.0 [-24.8 – 4.8]	0.182
<b>Anxiety</b>	18.5 [-11.9 – 48.8]	0.231
<b>Chronic use of analgesic medication</b>	9.8 [-7.8 – 27.5]	0.272
<b>History of abdominal surgery</b>	-10.1 [-21.6 – 1.4]	0.086

*Beta = Regression coefficient ; IC95 = 95% confidence interval ; P = p-val*

**Table 2 : Patient evolution into the digestive surgery department (intention to treat analysis)**

	<b>Cohort n = 117</b>	<b>Before (2021) n = 48 (41%)</b>	<b>After (2022) n = 69 (59%)</b>	<b>NA</b>	<b>P</b>
<b>Efficacy of epidural analgesia</b>					
Cumulative morphine dose in morphine equivalent in the first 24 hours into the surgery department (mg/day)	7 [0 – 30]	20 [0 – 40]	7 [0 – 21]	0	0.146
Cumulative morphine dose in morphine equivalent in the first 48 hours into the surgery department (mg/day)	10 [0 – 45]	20 [0 – 63]	7 [0 – 30]	0	0.146
Opioid administration in the surgery department at					
- Day 0	66 (56%)	30 (63%)	36 (52%)	0	0.268
- Day 1	46 (39%)	22 (46%)	24 (35%)	0	0.229
- Day 2	42 (36%)	21 (44%)	21 (30%)	0	0.140
- Day 3	40 (34%)	21 (44%)	19 (28%)	0	0.069
Use of opioids antagonists	0	0	0	0	-
Pain intensity (NRS)	5 [3 – 6]	6 [4 – 7]	4 [3 – 5]	77	<b>0.006</b>
<b>Epidural analgesia tolerance</b>					
Post operative nausea or vomiting in the surgery department					
- Day 0	18 (16%)	10 (22%)	8 (12%)	4	0.162
- Day 1	20 (18%)	7 (15%)	13 (19%)	4	0.567
- Day 2	15 (13%)	5 (11%)	10 (15%)	3	0.505
- Day 3	18 (16%)	6 (13%)	12 (18%)	3	0.458
Time to resumption of transit (days)	4 [3 – 6]	4 [3 – 6]	4 [3 – 6]	76	0.443
Time to first rise					
- Day 1	20 (45%)	5 (56%)	15 (43%)	73	0.747
- Day 2	14 (32%)	2 (22%)	12 (34%)		
- Day 3 or more	10 (23%)	2 (22%)	8 (23%)		
Epidural analgesia related complications	18 (16%)	10 (22%)	8 (12%)	4	0.162
<b>Epidural analgesia catheter removal</b>					
Cause of removal					
- Accidental	11 (10%)	3 (6%)	8 (12%)		
- Organisational	55 (47%)	39 (83%)	16 (23%)	1	<b>&lt; 0.001</b>
- Ineffectiveness	13 (11%)	3 (6%)	10 (14%)		
- Complication	3 (3%)	1 (2%)	2 (3%)		
- Day 5	34 (29%)	1 (2%)	33 (48%)		
Total duration of epidural analgesia (days)	3 [2 – 4]	3 [2 – 3]	4 [2 – 4]	0	<b>0.010</b>
<b>Post operatives complications</b>					
Dindo Clavien classification					
- 0	32 (33%)	6 (16%)	26 (45%)		
- 1	8 (8%)	3 (8%)	5 (9%)		
- 2	34 (36%)	18 (47%)	16 (28%)	21	<b>0.048</b>
- 3	13 (14%)	7 (18%)	6 (10%)		
- 4	4 (4%)	2 (5%)	2 (3%)		
- 5	5 (5%)	2 (5%)	3 (5%)		
Gastroparesis	20 (17%)	9 (19%)	11 (16%)	0	0.692
Ileus	17 (15%)	6 (14%)	11 (17%)	7	0.667
<b>Length of stay</b>					
Number of days hospitalized	19 [10 – 30]	21 [15 – 33]	14 [9 – 29]	2	0.119
Outcome at day 30					
- Death	2 (2%)	1 (2%)	1 (1%)		
- Hospitalization	29 (25%)	13 (27%)	16 (23%)	0	0.516
- Rehabilitation center	6 (68%)	4 (8%)	2 (3%)		
- Returned home	80 (5%)	30 (63%)	50 (73%)		

**NRS = numerated rating scale**

**Effective (Percent %) ; Mean (Standard deviation) ; Mediane [Quartile 1 – Quartile 2]**

**NA = Missing datas ; P = p-value**

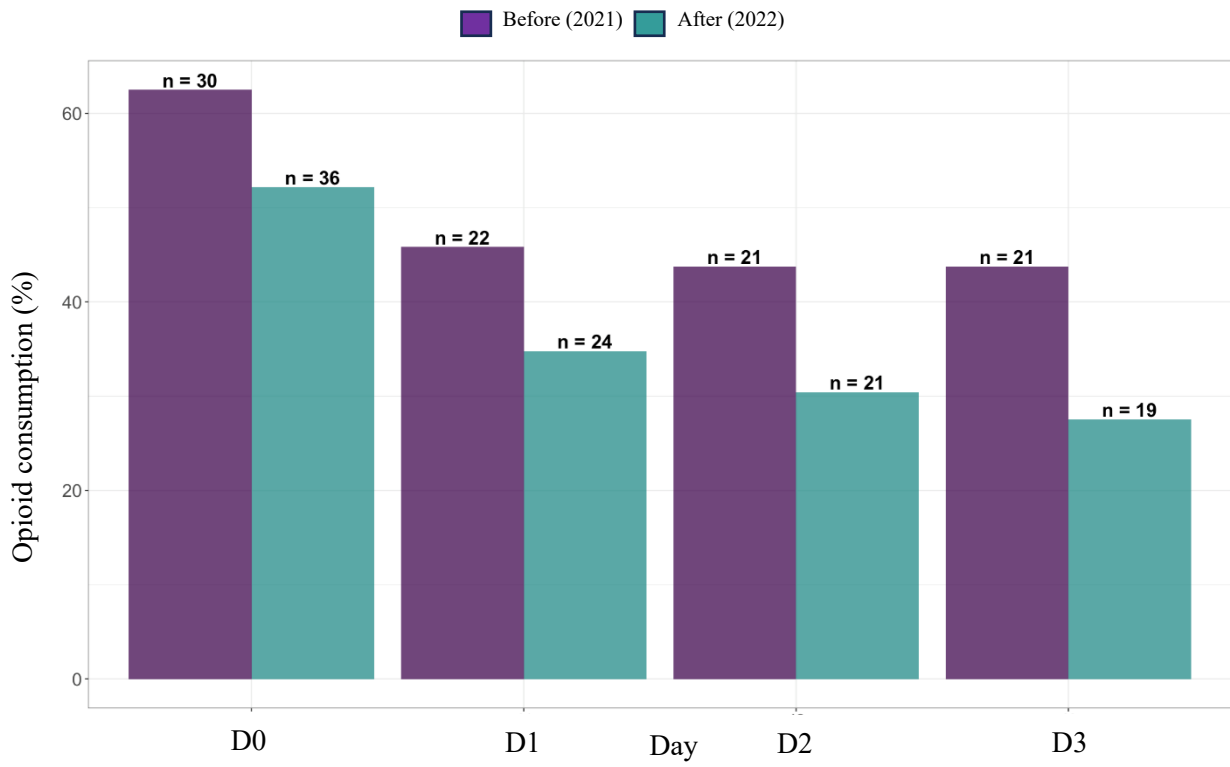
**Table 3 : Patient evolution into the digestive surgery department (per protocol analysis)**

	<b>Cohorte n = 92</b>	<b>Without epidural analgesia (2021) n = 48 (52%)</b>	<b>With epidural analgesia (2022) n = 44 (48%)</b>	<b>NA</b>	<b>P</b>
<b>Efficacy of epidural analgesia</b>					
Cumulative morphine dose in morphine equivalent in the first 24 hours into the surgery department (mg/day)	7 [0 – 40]	20 [0 – 40]	0 [0 – 11]	0	0.149
Cumulative morphine dose in morphine equivalent in the first 48 hours into the surgery department (mg/day)	10 [0 – 50]	20 [0 – 63]	7 [0 – 33]	0	0.135
Opioid administration in the surgery department at	51 (55%)	30 (63%)	21 (48%)	0	0.154
- Day 0	38 (41%)	22 (46%)	16 (36%)	0	0.357
- Day 1	33 (36%)	21 (44%)	12 (27%)	0	<b>0.010</b>
- Day 2	31 (34%)	21 (44%)	10 (23%)	0	<b>0.033</b>
- Day 3				0	
Use of opioids antagonists	0	0	0	0	-
Pain intensity (NRS)	5 [3 – 6]	6 [4 – 7]	3 [3 – 5]	58	<b>0.003</b>
<b>Epidural analgesia tolerance</b>					
Post operative nausea or vomiting in the surgery department	17 (19%)	10 (22%)	7 (17%)	4	0.547
- Day 0	16 (18%)	7 (15%)	9 (21%)	4	0.451
- Day 1	12 (13%)	5 (11%)	7 (17%)	3	0.406
- Day 2	15 (17%)	6 (13%)	9 (21%)	3	0.276
- Day 3					
Time to resumption of transit (days)	4 [2 – 5]	4 [3 – 6]	4 [3 – 5]	63	0.942
Time to first rise					
- Day 1	16 (49%)	5 (56%)	11 (46%)	59	0.876
- Day 2	9 (27%)	2 (22%)	11 (29%)		
- Day 3 or more	8 (24%)	2 (22%)	6 (25%)		
Epidural analgesia related complications	17 (19%)	10 (22%)	7 (17%)	4	0.547

**NRS = numerated rating scale**

**Effective (Percent %) ; Mean (Standard deviation) ; Mediane [Quartile 1 – Quartile 2]**

**NA = Missing datas ; P = p-value**



**Figure 3 : Évolution of morphine consumption proportion into the digestive surgery department**

## Discussion :

In this before-after study conducted at the University Hospital of Rouen, we aimed to evaluate the efficacy and safety of the continuation of epidural analgesia in the digestive surgery department in the postoperative period, as compared to the local previous standard of care, which involved removing epidural analgesia catheter before discharge from the postoperative intensive care unit. Our findings shed light on the benefits associated with the implementation of epidural analgesia in this specific surgical context.

Our study revealed that the revised approach of using epidural analgesia until a later stage in the postoperative course resulted in a diminution of cumulative morphine dose in the first 24 hours into the digestive surgery department but also in the first 48 hours.

This result is consistent with previous studies showing the efficacy of epidural analgesia over opioid-based analgesia, remaining the gold standard for major abdominal surgeries (5,15,16).

Meanwhile, our findings show that patients who had prolonged epidural analgesia reported lower pain scores in the surgery unit and required less rescue analgesia, such as opioids, compared to those managed with the previous standard of care on the second and third day into the surgery unit. Lower pain scores in the epidural group are consistent with previous meta analysis by Marret et al(17).

We also observed a more prolonged use of peridural analgesia with more frequent catheter removal on day five versus day three in the Before group.

As said in a previous meta analysis the maximum duration of an epidural catheter could be prolonged without major infectious risks implying a potential benefit notably for patients with chronic pain. (18)

This improvement in pain control can have several positive implications for both patients and healthcare providers. Effective pain management is key not only for patient comfort but also for facilitating early ambulation and reducing the risk of postoperative complications. Our findings support the idea that prolonging the use of epidural analgesia may enhance postoperative recovery as described by Carli et al (19) potentially leading to shorter hospital



stays and improved overall outcomes especially when supported by fast tracks protocols (20).

Moreover, the reduced need for opioids in the epidural group may contribute to a decreased risk of opioid-related adverse events, such as respiratory depression, the potential for addiction and gastrointestinal dysfunction even if opioid-based analgesia and epidural analgesia seemed to be equivalent in previous studies (13,21) and our study.

Furthermore, our study also addressed safety concerns associated with epidural analgesia. We observed no significant increase in the incidence of adverse events, such as epidural hematoma or infection, among patients who retained the epidural catheter compared to those in the control group.

At the beginning of the « after » period, we noted an increase in the number of accidental catheter removals, which led to a change in practice, with systematic catheter tunneling during insertion.

There were only two cases of epidural ablation because of lower limb motor weakness, which can lead to patient immobilization and discontinuation of epidural analgesics increasing patient discomfort, explained by the high rate of thoracic epidural analgesia as described by Königsrainer et al(22).

We observed few complications such as dislodgment or unilateral analgesia meaning anesthesiologists used an appropriate length of epidural catheter in the epidural space of 5cm as shown by Afshan et al(23).

These findings are reassuring and suggest that epidural analgesia can be safely incorporated into the postoperative care pathway for selected patients undergoing major digestive surgery. However, it is essential to underscore the importance of appropriate patient selection, meticulous catheter care, close monitoring by a multidisciplinary team to mitigate potential risks and appropriate team training as described by Lamprecht et al (24). This also requires regular paramedical training.

In terms of patient outcomes, our results are consistent with previous studies as it was shown to reduce post operative intensive care unit stays (25).

Concerning safety of morphine consumption our study showed no need for the use of opioid antagonists in all patients analyzed which is reassuring data, especially for patients without epidural analgesia.

There is a majority of anesthesia protocols including opioid free anesthesia in our study which tends to enhance recovery after surgery in accordance with previous studies (26).

This study also underlines the necessity of an adequate pain assessment, which inadequately done remains one of the most frequent causes of analgesia technique failures, especially in a postoperative context. (27) Our current approach to pain management still needs to be evaluated to perfectly balance efficacy and side effects of each technique as described by Pirie et al (28).

As said before, the French recommendation for epidural analgesia monitoring is a 24-hour stay in post operative intensive care unit in case of epidural injection of more than 0.2 mg of morphine(3).

With our results concerning its efficacy and safety for patients undergoing major abdominal surgeries, we could consider a prolonged stay in post operative recovery room and a transfer directly into the surgery unit with epidural analgesia, in the absence of any complication as did by Tan et al(29). However, in our center, post-operative intensive care unit is required for the surgery itself.

We had only one case of a patient undergoing oesophagectomy in double video technique who received epidural analgesia because, at Rouen University Hospital, for patients undergoing oesophagectomy other locoregional anesthesia techniques are used such as paravertebral block or serratus block.

We also tend to see fewer patients undergoing pancreatic surgeries having epidural analgesia at Rouen University Hospital because of the use of other locoregional anesthesia techniques and mini invasive surgical technics.

Recently studies showed an interest in TAP block for major abdominal surgery, versus epidural analgesia where Turan et al findings showed no clinical differences between the two methods, thus potentially opening the way for less epidural analgesia among those patients. (30)

With this consideration of non neuraxial locoregional anesthesia techniques, we should ask ourselves if epidural analgesia should still be a standard of care as Wagemans et al highlight the need for individualization of epidural analgesia for each patient (31).

Despite interesting results, our study has several limitations.

Firstly, the assessment of pain was based on a numeric rating scale which is a validated method(32) but we had a lack of data issued from the surgery unit, secondly, we know that morphine consumption is not linear(33) and we may have underestimated the analgesic effect of epidural analgesia.

Secondly, we had a lack of data concerning local anesthetic dose which could have indicated to us if the epidural analgesia was correctly used by comparing it to morphine consumption and pain score.

Thirdly, we lacked data concerning blood pressure in the surgery unit to truly assess hemodynamic variability that can be induced by epidural analgesia.

Fourthly as with every before-after design, our study inherently carries bias as it can not prove any causality, the lack of randomization introduces the potential for selection bias and limits the ability to control for confounding variables, the monocentric design limits the external validity of our study as we can not extend our findings as other hospitals or even surgical departments.

Finally, the absence of blinding can also introduce bias, if participants or researchers had any preconceived notions or expectations regarding the intervention, in our study maintaining epidural analgesia, these could have influenced their behavior and/or the reported outcomes.

In conclusion, our before-after study provides evidence supporting the efficacy and safety of retaining epidural analgesia in the postoperative period in the digestive surgery department. This approach seems to offer effective pain relief as it significantly reduces opioid consumption and has the potential to improve postoperative outcomes without a significant

increase in adverse events. However, the decision to maintain epidural analgesia in this context should be made on an individualized basis, considering patient characteristics, type of surgery, the need for analgesia at discharge from intensive care unit, and the availability of resources for monitoring and management. Further research is needed to refine patient selection criteria and optimize the use of epidural analgesia in digestive surgery.

**Acknowledgment:**

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**Abbreviations :**

- PCEA : patient-controlled epidural analgesia
- BMI : Body mass index
- TAP : Transverse abdominal plane
- NRS : Numerating rating scale
- ASA score : Physical status score established by the american society of anesthesiologists
- HIPEC = Hyperthermic intraperitoneal chemotherapy
- OFA = Opioid free anesthesia

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