Diplomarbeit

Side Effects After General and Regional Anaesthesia

eingereicht von

Simon Wilhelm Stöcklegger

Mat.Nr.: 0212650

zur Erlangung des akademischen Grades:

Doktor der gesamten Heilkunde

(Dr. med. univ.)

an der

Medizinischen Universität Graz

Durchgeführt an der

Universitätsklinik für Anästhesie und Intensivmedizin

unter der Anleitung von

Univ. Prof. Dr. Andreas Sandner-Kiesling

Graz, August 2008

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Graz, August 2008

Acknowledgement

First of all I would like to thank my family for their outstanding support, not only during my six years of medical education. They encouraged and supported me to go my way: my mum Aloisia, my dad Wilhelm and my brother Ulrich. Thank you for all!

My cordial and very respectful thank goes to Prof. Dr. Michael Zenz and his team of anaesthetists, for the initiating this exciting study and for collecting this incredible amount of data..

I very much appreciate Prof. Dr. Peter Rehak for his advice and help in performing the biostatistical analysis.

Another very special thank goes to my mentor, Prof. Dr. Andreas Sandner-Kiesling, for guiding me through this piece of work, for his patient and motivating scientific support. Thank you, Andreas, not only as my teacher but much more as a friend who showed me the right way!

Finally I would like to thank everyone else who is not mentioned here per name, but who has given me a helping hand whenever I needed one! Thank you so much!

Zusammenfassung

Ziel der Studie: Unzählige Studien setzen die sich mit allen Arten von schweren Komplikationen nach Narkosen auseinander, nur wenige beschäftigen sich jedoch mit leichten Komplikationen. Ziel dieser Studie war es, die Inzidenzen der 12 häufigsten Komplikationen bzw. Allgemeinreaktionen nach Allgemein-, Regional- oder kombinierter Anästhesie zu erheben.

Methodik: Über einen Zeitraum von 50 Monaten (Nov. 1996 – Dez. 2000) wurden 10200 Patienten an einem deutschen Krankenhaus mittels eines Fragebogens über die 12 häufigsten Komplikationen nach einer Narkose befragt. Alle Teilnehmer wurden innerhalb der ersten 24 Stunden nach ihrem Eingriff konsultiert.

Ergebnisse: 9245 Fragebögen wurden für die statistische Auswertung verwendet. Die Teilnehmer wurden in 5 anästhesiologische Subgruppen unterteilt (GA 1 [Allgemeinnarkose, Intubation], GA 2 [Allgemeinnarkose, alternativer Atemweg], CA [kombinierte regionale- und Allgemeinnarkose], RA_P [Regionalanästhesie, peripher], RA_C [Regionalanästhesie, zentral]). Sowohl bei Allgemein- als auch bei Regionalanästhesie traten alle Nebenwirkungen mit einer konstanten Häufigkeit auf. Die Gruppe mit der niedrigsten gemittelten Inzidenz an Komplikationen war die Gruppe RA_P mit 2,8%, die mit der höchsten gemittelten Inzidenz war GA 1 mit 5,4%. Die drei häufigsten Nebenwirkungen waren sekundäre Hyperalgesie (23,8%), primäre Hyperalgesie (13,5%) und Durst (11,7%). Die drei seltensten Nebenwirkungen waren Recall (0,8%), Harnverhalt (3,5%) und Kopfschmerzen mit 3,6%.

Diskussion: Unsere Ergebnisse zeigen, dass leichte Nebenwirkungen nach jeder Art von Anästhesie selten bis häufig auftreten können. Weiters zeigte sich, dass die Komplikationsraten bei Regionalanästhesieverfahren wesentlich geringer sind als bei Allgemeinnarkose. Anhand unserer Ergebnisse sind periphere Blockaden zu bevorzugen. Insgesamt traten die Nebenwirkungen zwar mit einer niedrigen Inzidenz auf, trotzdem sollten Patienten vor einem Eingriff darüber explizit aufgeklärt werden.

Abstract

Aim of this study: Many publications report about major side effects after anaesthesia, but only few surveys address minor side effects. The aim of this study was to evaluate the incidences of the 12 most common side effects after general, regional or combined anaesthesia.

Methods: Over a period of 50 months (Nov. 1996 – Dec. 2000), anaesthetists asked 10200 patients of one German hospital about the postoperative occurrence of the 12 most common side effects after anaesthesia. Participants were asked within the first 24 hours after their surgical procedure.

Results: For statistical analysis 9245 of 10200 questionnaires could be used. Patients were divided into 5 anaesthetic subgroups (GA 1 [general anaesthesia, tracheal intubation], GA 2 [general anaesthesia, alternative airway], CA [combined regional and general anaesthesia], RA_P [peripheral regional anaesthesia], RA_C [central regional anaesthesia]). All 12 side effects appeared quite frequently after general, regional, or combined anaesthesia. The lowest mean incidence of side effects was reported in group RA_P (2,8%), while the highest mean incidence was seen in group GA 1 (5,4%). The three most common side effects over all groups were secondary hyperalgesia (23,8%), primary hyperalgesia (13,5%) and thirst (11,7%). The three most rare side effects of all groups were recall (0,8%), urinary retention (3,5%) and headache (3,6%).

Conclusion: Our results show that minor side effects appear seldom to frequently after anaesthesia. Regional anaesthesia shows the lowest incidences of minor side effects, especially justifying the preferential use of peripheral blocks. In total, most of the minor side effects show low incidences. Nevertheless, patients should be informed about them with more favour.

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2. Introduction

Risks of anaesthetic administration were recognized soon after the advent of surgical anaesthesia [1]. There are huge numbers of surveys and papers in medical literature that report about the various kinds of anaesthesia-related complications.

Independently if general or regional anaesthesia, there are many studies that have defined, counted and reported the incidence of the main adverse events, that may happen under anaesthesia.

Since patient safety has received increased attention in recent years, also incident monitoring in anaesthesia is nowadays seen as a useful tool for quality improvement and maintenance of high safety standards in anaesthetic services [2]. As a result of all these efforts, anaesthesia becomes a more and more safe discipline with every new day.

Post anaesthetic complications are also a topic for various journals, but more often, the focus of these studies was laid on major complications of anaesthesia which may be life threatening or which may lead to serious injuries. There are only few authors, who have studied minor complications after anaesthesia.

Brindle and Soliman wrote one of the first studies about this in 1975. They evaluated anaesthetic complications in surgical patients that had received general anaesthesia [3]. In this study, the focus was laid on minor adverse events, like muscle pain, sore throat, headache, nausea, vomiting, cough, expectorations, dizziness or inability to concentrate. They also asked patients, how long it did last, until they had a feeling of complete recovery from the surgical procedure [3].

Other surveys do also report of minor complications after general or regional anaesthesia but in most of these studies, the focus is laid only on one side effect.

Postoperative nausea and vomiting for example, is one side effect that is reported of very often. Incidences, risk factors and treatment options are very well described for this one type of adverse event [4,5,6].

Also sore throat is a very well known topic in medical literature and cause, prevention and treatment are reported very well in some studies [7,8].

But if it comes to side effects like hoarseness, postoperative thirst, urinary retention, shivering or similar ones, the number of papers or studies decreases rapidly.

From studies, that evaluated the most undesirable side effects in anaesthesia out of the patient's point of view, we know that PONV, disorientation and sore throat are ranked under the five most undesirable side effects. Only pain and gagging on endotracheal tube are ranked higher [9]. This makes it clear that also minor complications always matter the patient and that we should have an eye on them, too!

The aim of this survey was to find out the most common minor side effects after anaesthetic procedures, whether regional or general anaesthesia, to report the incidences of those adverse events and to compare them to other investigations.

It was our intention, not to analyse only one type of anaesthetic procedure, like, for example general anaesthesia, and one special type of surgery for our study. The reason for this is that we wanted to give a general overview about the most common minor side effects and how often they appear under various anaesthetic procedures and various different types of surgical procedures in one hospital.

The authors think that it is necessary, to know about incidences from minor side effects as well as to know the incidences and risks for major complications in anaesthesia. For sure, no patient will die from postoperative thirst or hoarseness but he will suffer from it, and this is the crucial point.

3. Materials and Methods

3.1 Patients and Number of Cases

Over a period of 4 years and 2 months 10200 people, who were all patients at one University Hospital in Germany were included in the survey.
To take part in the survey, there existed no age limitations. Also gender specific differences have not been considered.
The survey included all kinds of anaesthetic procedures, whether regional or general anaesthesia, as they were applied at the several departments of this University Hospital.
All of the people, who took part in the survey, were interviewed within the first 24 postoperative hours.

3.2 Design of the Survey

This survey was designed as a retrospective, not randomised and not blinded trial. It was carried out by anaesthetists from the Department of Anaesthesiology and Intensive Care Medicine at one German University Hospital.

3.3 Questionnaire

For the consultation of the participants, a standardized questionnaire was designed (See 6.4: “Questionnaire”)
The questionnaire consisted of one DIN A4 sheet that is imprinted on both sides. Page 1 had to be filled out by the patient, while the page 2 had to be filled out by the treating anaesthetist.
On the first page of the questionnaire, the patient was asked about some epidemiological data (name, gender, date of birth) and then more special about the intervention, like date and time of the surgery. The patient was also asked about date and time, when he filled in the questionnaire.

After the more general part of the questionnaire, there followed the specific part, where the patient was asked, how he had witnessed the intervention and the side effects that eventually occurred.

The first question asked about postoperative pain and the location of this pain. The participants had the opportunity to choose between six different kinds of postoperative pain events. Further they had to classify these pain events, if they occurred, in 5 degrees of severity (degrees of severity: no pain/ mild pain/ moderate pain/ severe pain/ intolerable pain). The six pain events that we were asking of were:

Pain Events	
1	Sore Throat
2	Secondary Hyperalgesia
3	Muscle Pain
4	Back Pain
5	Headache
6	Primary Hyperalgesia

Tab. 01: Pain Events

Primary Hyperalgesia represents pain that developed directly at the surgical wound, secondary hyperalgesia the painful area around the surgical wound.

Next question asked about general reactions, which may have occurred within the intra- or postoperative period. Here, the participants had the opportunity, to choose between the six most common general reactions that appear after anaesthesia. These reactions should have been be classified by the rate of intense (grades of intense: no reaction/ little reaction/ medium reaction/ severe reaction/ intolerable reaction). The six general reactions that we were asking of were:

General Reactions	
1	PONV
2	Urinary Retention
3	Shivering
4	Thirst
5	Dizziness
6	Hoarseness

Tab. 02: General Reactions referring to Anaesthesia

PONV: Postoperative Nausea And Vomiting

At the end of page 1, the participants had the chance to mention problems or events that happened during anaesthesia but were not asked in the questionnaire. If the patient had an operation in general anaesthesia, he had to answer a question about awareness. The last question on page 1 asked, if the participant had been informed about the risks of anaesthesia and the problems that could have been occurred during anaesthesia.

Page 2 of the questionnaire had to be filled out by the responsible anaesthetist. On this page, the anaesthetist provided information about the type of intervention or surgery, the type of anaesthesia and postoperative troubles

First of all, the anaesthetist had to fill out the primary diagnosis of the patient and the type of surgery or intervention that was performed. Then, he filled out whether if it was an elective procedure, or if it was an urgent or emergency intervention.

Then, he had to fill out the medical discipline, in which the procedure took part. He had to choose between the following medical disciplines:

Medical Disciplines	
1	General Surgery
2	Trauma Surgery
3	Plastic Surgery
4	Orthopaedic Surgery
5	Gynaecology
6	ENT Surgery
7	Hand Surgery
8	Pain Therapy
9	Heart/ Thorax Surgery
10	Other Disciplines

Tab. 03: Medical Disciplines

ENT: Ears, Nose, Throat

The next question asked about the location of the procedure or surgery. The 11 possible locations provided, were the following:

Surgery Locations	
1	Pelvic Region/Hip/Thigh
2	Lower Leg/Foot/Knee
3	Arm/Hand
4	Spinal Column
5	Thorax
6	Abdomen
7	Head/Throat
8	Trunk/Shoulder
9	Retroperitoneal
10	Intracranial
11	Other Locations

Tab. 04: Surgery Locations

The next question asked for the type of the medical procedure. Fourteen procedure groups were provided:

Type of Procedure	
1	Diagnostic Procedure
2	Small Soft Tissue Surgery
3	Big Soft Tissue Surgery
4	Bone Surgery
5	Joint Replacement
6	Central vessel surgery
7	Peripheral vessel surgery
8	Removal of implants
9	Repositioning
10	Pace Maker
11	Pain Therapy
12	Replantation/ Free Flap Surgery
13	DHS/DCS/Endoprothetics
14	Others

Tab. 05: Type of Procedure

DHS: Dynamic Hip Screw
DCS: Dynamic Condyle Screw

The next question addressed the type of anaesthesia that had been chosen for that intervention. Here, we discriminated between general anaesthesia and regional anaesthesia. The general anaesthesia group was divided in five subgroups. These groups were:

General Anaesthesia Groups	
1	ITN
2	Mask
3	LMA
4	Stand by
5	Rapid Sequence Induction

Tab. 06: General Anaesthesia Groups

ITN: Intubation
LMA: Laryngeal Mask Airway

Regional anaesthesia was divided into five subgroups. Furthermore, the anaesthetist provided information, if the patient was sedated before induction of

anaesthesia, or if he received a regional catheter for postoperative pain management. The five groups were:

Regional Anaesthesia Groups	
1	PDA
2	Spinal Anaesthesia
3	Plexus Anaesthesia
4	Peripheral Regional Anaesthesia
5	Intravenous Regional Anaesthesia

Tab. 07: Regional Anaesthesia Groups

PDA: Peridural Anaesthesia

The last question addressed the patient's postoperative side effects as observed by the responsible anaesthetist. Five groups are provided. In these groups, the most common postoperative troubles were summarized.
If troubles appeared, the anaesthetist had to classify them into five degrees of severity, which were the following:

Grades of Severity	
Grade 1	Clinical Course of the patients treatment not affected/ no special treatment necessary
Grade 2	Special intervention by doctors or nurses needed to stop postoperative troubles
Grade 3	Prolonged monitoring necessary/ prolonged stay in hospital
Grade 4	Success of treatment affected/ transfer to ICU necessary
Grade 5	Danger to life/ permanent impairment/ death

Tab. 08: Grades of Severity

ICU: Intensive Care Unit

The five groups, in which the most common postoperative side effects are mentioned, were:

Postoperative Side Effects	
1. Airways/ Gas Exchange	
	Lung Oedema
	Pneumonia
	Other respiratory problems
2. Heart/ Circulation	
	Hypotension
	Hypertension
	Arrhythmia
	Tachycardia
	Bradycardia
	Decompensated Heart Failure
	Lung Embolia
	Circulatory Instability
	Angina Pectoris
	Myocardial Infarction
	Other Heart Problems
3. General Reactions	
	Renal Insufficiency
	Icterus
	Anaphylaxis
	Other General Reactions
4. CNS	
	Delayed Awakening
	Central Anticholinergic Syndrome
	Ischaemia
	Convulsion
	Postoperative Brain Dysfunction (POBD)
	Other Neurological Problems
5. Others	
	Peripheral Sensoric Neuropathy
	Postpunctural Headache
	.....

Tab. 09: Postoperative Side Effects

CNS: Central Nervous System

The Questionnaire was set up for easy use and limited to the most common postoperative troubles. So, it should have been easy for each participant to fill out the questionnaire in a short time and without any problems or uncertainties.
For sure, this was very important because the pool, out of which the participants were recruited, is a very heterogenic one. On the other hand, it was possible to recruit a lot of patients for the survey in a short time.

3.4 Statistical appraisal

The statistical analysis of the questionnaires was performed for each of the mentioned anaesthetic procedures. In the questionnaire, 10 different anaesthetic procedures were listed. They were combined to 5 groups, because some techniques were used too seldom for any useful statistical results. Each of the five groups were analysed by Chi Square tests. A $p < 0.05$ was considered significant.

Groups for the Statistical Appraisal		
Groups	Abbreviation	Anaesthetic Procedures
GA 1	General Anaesthesia 1	ITN; Rapid Sequence Induction
GA 2	General Anaesthesia 2	LMA; Mask Ventilation
CA	Combined General and Peripheral Anaesthesia	ITN; Rapid Sequence Induction; LMA; Mask Ventilation; Plexus; IVRA; Peripheral Regional Anaesthesia; Spinal Anaesthesia; PDA
RA_P	Peripheral Regional Anaesthesia	Plexus; IVRA; Peripheral Regional Anaesthesia
RA_C	Central Regional Anaesthesia	Spinal Anaesthesia; PDA

Tab. 10: Groups for the Statistical Appraisal

ITN: Intubation
LMA: Laryngeal Mask Airway
IVRA: Intravenous Regional Anaesthesia
PDA: Peridural Anaesthesia

The group “Monitoring” of the questionnaire was not mentioned in the statistic analysis because the number of cases was too little.
All statistical tests were performed using SPSS Statistics Software (SPSS GmbH Software, Theresienhöhe 13, D-80339 München).

4. Results

The survey was initiated in November of 1996 and ended in December of 2000. It ran over a time of 50 months. From the initial 10200 questionnaires, 955 had to be excluded due to data incompleteness, leaving 9245 questionnaires for the final analysis.

Unfortunately, during the initial anonymisation of the participants' data of the patient's gender was also anonymised. So we cannot make any statements about gender differences in our survey.

The pain events and other side effects occurred quite frequently in the five groups. Table 11 provides a short overview about the total percentages of each side effect in each group.

Minor Side Effects by Groups and their Incidences

Percentages

	GA 1	GA 2	CA	RA_P	RA_C	Total
Secondary Hyperalgesia	25	20.1	26.0	19.2	24.5	23.8
Primary Hyperalgesia	14.2	12.4	17.1	10.2	13.4	13.5
Thirst	13.4	8.4	14.3	7.4	11.2	11.7
Sore Throat	12.8	9.9	13.3	3.9	4.3	8.9
Back Pain	7.8	5.0	7.3	4.9	8.8	7.5
Shivering	7.2	5.5	4.6	3.5	6.9	6.4
PONV	7.2	4.5	5.6	3.0	4.1	5.5
Dizziness	6.0	4.2	6.2	3.9	4.9	5.3
Hoarseness	7.3	4.5	5.0	2.9	2.3	4.9
Muscle Pain	5.3	3.5	5.0	2.0	4.2	4.4
Headache	3.9	3.2	2.2	2.5	3.9	3.6
Urinary Retention	3.1	2.0	3.8	1.9	4.9	3.5
Recall	0.6	0.5	3.1			0.8

Tab. 11: Minor Side Effects by Groups and their Incidences

GA 1: General Anaesthesia, Group 1
GA 2: General Anaesthesia, Group 2
CA: Combined General and Regional Anaesthesia
RA_P: Peripheral Regional Anaesthesia
RA_C: Central Regional Anaesthesia
PONV: Postoperative Nausea And Vomiting

Yellow cells: $p > 0.05$
Blue cells: $p < 0.05$

Table 12 shows the incidences of the adverse events and side effects that we were asking of by their incidences per 10,000 people.

Incidences of Side Effects per 10,000 People

	GA 1	GA 2	CA	RA_P	RA_C	Total
Secondary Hyperalgesia	2500	2010	2600	1920	2450	2380
Primary Hyperalgesia	1420	1240	1710	1020	1340	1350
Thirst	1340	840	1430	740	1120	1170
Sore Throat	1280	990	1330	390	430	890
Back Pain	780	500	730	490	880	750
Shivering	720	550	460	350	690	640
PONV	720	450	560	300	410	550
Dizziness	600	420	620	390	490	530
Hoarseness	730	450	500	290	230	490
Muscle Pain	530	350	500	200	420	440
Headache	390	320	220	250	390	360
Urinary Retention	310	200	380	190	490	350
Recall	60	50	310			80

Tab. 12: Incidences of Side Effects per 10000 People

GA 1: General Anaesthesia, Group 1
GA 2: General Anaesthesia, Group 2
CA: Combined General and Regional Anaesthesia
RA_P: Peripheral Regional Anaesthesia
RA_C: Central Regional Anaesthesia
PONV: Postoperative Nausea And Vomiting

Blue cells: Lowest incidences
Yellow cells: Highest incidences

The following tables (13-25) show the detailed results of our survey. Side effects are presented by counts and by percentages. The highest incidences have been highlighted in yellow colour, while the lowest incidences are highlighted in blue colour. The results have been considered as significant ($p < 0.05$).

Postoperative side effects in general were reported only by a very small number of patients undergoing anaesthetic procedures. Over all, 4.5% of all the participants reported any postoperative side effects after anaesthesia. Table 12 provides an overview of the total numbers and percentages.

Postoperative Side Effects

Total Counts

	No	Yes	Total
GA 1	4022	228	4250
GA 2	387	16	403
CA	477	19	496
RA_P	1307	38	1345
RA_C	2635	116	2751
Total	8828	417	9254

Percentages

	No	Yes	Total
GA 1	94.6	5.4	100
GA 2	96.0	4.0	100
CA	96.2	3.8	100
RA_P	97.2	2.8	100
RA_C	95.8	4.2	100
Total	95.5	4.5	100

Chi-Square Statistics Section		
Chi-Square	17.425386	
Degrees of Freedom	4	
Probability Level	0.001598	Reject H0

Tab. 13: Postoperative Side Effects

GA 1: General Anaesthesia, Group 1
GA 2: General Anaesthesia, Group 2
CA: Combined General and Regional Anaesthesia
RA_P: Peripheral Regional Anaesthesia
RA_C: Central Regional Anaesthesia
H0: Zero Hypothesis

Blue cells: lowest incidences
Yellow cells: highest incidences

Postoperative sore throat was reported by 8.9% of all the participants. In group CA, 13.3% suffered from postoperative sore throat and in group GA 1, 12.8% were reporting about postoperative sore throat. There was a lower incidence of laryngeal pain in the RA_C and RA_P groups compared to all 3 general anaesthesia groups. In the RA_P group, only 3.9% and in the RA_C group only 4.3% suffered from sore throat.

Sore Throat

Total Counts

	No	Mild	Moderate	Severe	Intolerable	Total
GA 1	3706	446	82	16	0	4250
GA 2	363	32	6	2	0	403
CA	430	50	14	2	0	496
RA_P	1293	40	9	2	1	1345
RA_C	2634	88	26	3	0	2751
Total	8426	656	137	25	1	9245

Percentages

	No	Mild	Moderate	Severe	Intolerable	Total
GA 1	87.2	10.5	1.9	0.4	0.0	100
GA 2	90.1	7.9	1.5	0.5	0.0	100
CA	86.7	10.1	2.8	0.4	0.0	100
RA_P	96.1	3.0	0.7	0.1	0.1	100
RA_C	95.7	3.2	0.9	0.1	0.0	100
Total	91.1	7.1	1.5	0.3	0.0	100

Chi-Square Statistics Section		
Chi-Square	220.550962	
Degrees of Freedom	16	
Probability Level	0.000000	Reject H0

Tab. 14: Sore Throat

GA 1: General Anaesthesia, Group 1
GA 2: General Anaesthesia, Group 2
CA: Combined General and Regional Anaesthesia
RA_P: Peripheral Regional Anaesthesia
RA_C: Central Regional Anaesthesia
H0: Zero Hypothesis

Blue cells: lowest incidences
Yellow cells: highest incidences

Secondary Hyperalgesia was most commonly reported in the groups CA, GA 1 and RA_C with incidences of 26.0%, 25.0%, and 24.5%, respectively. The groups with the lowest incidences were RA_P and GA 2 with 19,2% (258 of 1345 patients) and 20.1% (xx of xxx patients), respectively.

Secondary Hyperalgesia

Total Counts

	No	Mild	Moderate	Severe	Intolerable	Total
GA 1	3189	453	419	178	11	4250
GA 2	322	36	33	11	1	403
CA	367	60	45	24	0	496
RA_P	1087	126	88	39	5	1345
RA_C	2078	285	265	115	8	2751
Total	7043	960	850	367	25	9245

Percentages

	No	Mild	Moderate	Severe	Intolerable	Total
GA 1	75.0	10.7	8.9	4.2	0.3	100
GA 2	79.9	8.9	8.2	2.7	0.2	100
CA	74.0	12.1	9.1	4.8	0.0	100
RA_P	80.8	9.4	6.5	2.9	0.4	100
RA_C	75.5	10.4	9.6	4.2	0.3	100
Total	76.2	10.4	9.2	4.0	0.3	100

Chi-Square Statistics Section		
Chi-Square	32.067489	
Degrees of Freedom	16	
Probability Level	0.009799	Reject HO

Tab. 15: Secondary Hyperalgesia

GA 1: General Anaesthesia, Group 1
GA 2: General Anaesthesia, Group 2
CA: Combined General and Regional Anaesthesia
RA_P: Peripheral Regional Anaesthesia
RA_C: Central Regional Anaesthesia
H0: Zero Hypothesis

Blue cells: lowest incidences
Yellow cells: highest incidences

Muscle pains were most common in the GA 1 and the CA group with incidences of 5.3% and 5.0%. Group RA_P reported the lowest incidence with 2.0%.

Muscle Pains

Total Counts

	No	Mild	Moderate	Severe	Intolerable	Total
GA 1	4024	131	67	26	2	4250
GA 2	389	7	5	2	0	403
CA	471	17	6	2	0	496
RA_P	1318	14	11	2	0	1345
RA_C	2636	73	34	8	0	2751
Total	8838	242	123	40	2	9245

Percentages

	No	Mild	Moderate	Severe	Intolerable	Total
GA 1	94.7	3.1	1.6	0.6	0.0	100
GA 2	96.5	1.7	1.2	0.5	0.0	100
CA	95.0	3.4	1.2	0.4	0.0	100
RA_P	98.0	1.0	0.8	0.1	0.0	100
RA_C	95.8	2.7	1.2	0.3	0.0	100
Total	95.6	2.6	1.3	0.4	0.0	100

Chi-Square Statistics Section		
Chi-Square	34.170592	
Degrees of Freedom	16	
Probability Level	0.005153	Reject HO

Tab. 16: Muscle Pains

GA 1: General Anaesthesia, Group 1
GA 2: General Anaesthesia, Group 2
CA: Combined General and Regional Anaesthesia
RA_P: Peripheral Regional Anaesthesia
RA_C: Central Regional Anaesthesia
H0: Zero Hypothesis

Blue cells: lowest incidences
Yellow cells: highest incidences

Also back pain occurred very frequently over all groups. Groups with the highest incidences of back pain were groups RA_C with 8.8%, GA 1 with 7.8% and CA with 7.3%. On the other hand group RA_P reported the lowest incidence with only 4.9%, following group GA 2 with only 5.0%.

Back Pain

Total Counts

	No	Mild	Moderate	Severe	Intolerable	Total
GA 1	3918	175	118	36	3	4250
GA 2	383	12	6	2	0	403
CA	460	21	11	4	0	496
RA_P	1279	37	21	7	1	1345
RA_C	2509	155	63	23	1	2751
Total	8549	400	219	72	5	9245

Percentages

	No	Mild	Moderate	Severe	Intolerable	Total
GA 1	92.2	4.1	2.8	0.8	0.1	100
GA 2	95.0	3.0	1.5	0.5	0.0	100
CA	92.7	4.2	2.2	0.8	0.0	100
RA_P	95.1	2.8	1.6	0.5	0.1	100
RA_C	91.2	5.6	2.3	0.8	0.0	100
Total	92.5	4.3	2.4	0.8	0.1	100

Chi-Square Statistics Section		
Chi-Square	33.554478	
Degrees of Freedom	16	
Probability Level	0.006235	Reject HO

Tab. 17: Back Pain

GA 1: General Anaesthesia, Group 1
GA 2: General Anaesthesia, Group 2
CA: Combined General and Regional Anaesthesia
RA_P: Peripheral Regional Anaesthesia
RA_C: Central Regional Anaesthesia
H0: Zero Hypothesis

Blue cells: lowest incidences
Yellow cells: highest incidences

The highest incidences of primary hyperalgesia occurred in the CA, GA 1 and RA_C group, with report incidences of 17.1% (95 of 496 patients), 14.2% (603 of 4250) and 13.4% (370 of 27521 participants), respectively.

On the other hand, the lowest incidences were reported in groups GA 2 and RA_P with incidences of 12.4% and 10.2%, respectively.

Primary Hyperalgesia

Total Counts

	No	Mild	Moderate	Severe	Intolerable	Total
GA 1	3647	273	221	103	6	4250
GA 2	353	25	18	6	1	403
CA	411	37	28	20	0	496
RA_P	1208	74	43	18	2	1345
RA_C	2381	173	131	63	3	2751
Total	8000	582	441	210	12	9245

Percentages

	No	Mild	Moderate	Severe	Intolerable	Total
GA 1	85.8	6.4	5.2	2.4	0.1	100
GA 2	87.6	6.2	4.5	1.5	0.2	100
CA	82.9	7.5	5.6	4.0	0.0	100
RA_P	89.8	5.5	3.2	1.3	0.1	100
RA_C	86.6	6.3	4.8	2.3	0.1	100
Total	86.5	6.3	4.8	2.3	0.1	100

Chi-Square Statistics Section		
Chi-Square	29.480569	
Degrees of Freedom	16	
Probability Level	0.020890	Reject HO

Tab. 18: Primary Hyperalgesia

GA 1: General Anaesthesia, Group 1
GA 2: General Anaesthesia, Group 2
CA: Combined General and Regional Anaesthesia
RA_P: Peripheral Regional Anaesthesia
RA_C: Central Regional Anaesthesia
H0: Zero Hypothesis

Blue cells: lowest incidences
Yellow cells: highest incidences

PONV showed its highest incidences in all general anaesthesia groups. The highest incidences were found in groups GA 1 with 7.2%, B with 5.6% and GA 2 with 4.5%. Both regional anaesthesia groups reported lower incidences than the general anaesthesia groups: only 3.1% in the RA_P group suffered from postoperative nausea and vomiting and 4.1% in the RA_C group.

PONV

Total Counts

	No	Mild	Moderate	Severe	Intolerable	Total
GA 1	3944	210	81	15	0	4250
GA 2	385	12	4	2	0	403
CA	468	22	5	1	0	496
RA_P	1304	18	17	5	1	1345
RA_C	2638	69	35	9	0	2751
Total	8739	331	142	32	1	9245

Percentages

	No	Mild	Moderate	Severe	Intolerable	Total
GA 1	92.8	4.9	1.9	0.4	0.0	100
GA 2	95.5	3.0	1.0	0.5	0.0	100
CA	94.4	4.4	1.0	0.2	0.0	100
RA_P	96.9	1.3	1.3	0.4	0.1	100
RA_C	95.9	2.5	1.3	0.3	0.0	100
Total	94.5	3.6	1.5	0.3	0.0	100

Chi-Square Statistics Section		
Chi-Square	67.735500	
Degrees of Freedom	16	
Probability Level	0.000000	Reject HO

Tab. 19: PONV

GA 1: General Anaesthesia, Group 1
GA 2: General Anaesthesia, Group 2
CA: Combined General and Regional Anaesthesia
RA_P: Peripheral Regional Anaesthesia
RA_C: Central Regional Anaesthesia
H0: Zero Hypothesis
PONV: Postoperative Nausea And Vomiting

Blue cells: lowest incidences
Yellow cells: highest incidences

Urinary retention was mentioned in the questionnaire by only 3.5% of all the participants. The highest incidence was seen in group RA_C with about 4.9% suffering from urinary retention.

Second highest incidence was found in group CA with 3.8% of all patients. Lowest incidences were found in groups RA_P with 1.9% and GA 2 with 2.0%.

Urinary Retention

Total Counts

	No	Mild	Moderate	Severe	Intolerable	Total
GA 1	4117	71	50	10	2	4250
GA 2	395	4	3	1	0	403
CA	477	11	6	2	0	496
RA_P	1319	15	7	4	0	1345
RA_C	2616	85	40	10	0	2751
Total	8924	186	106	27	2	9245

Percentages

	No	Mild	Moderate	Severe	Intolerable	Total
GA 1	96.9	1.7	1.2	0.2	0.0	100
GA 2	98.0	1.0	0.7	0.2	0.0	100
CA	96.2	2.2	1.2	0.4	0.0	100
RA_P	98.1	1.1	0.5	0.3	0.0	100
RA_C	95.1	3.1	1.5	0.4	0.0	100
Total	96.5	2.0	1.1	0.3	0.0	100

Chi-Square Statistics Section		
Chi-Square	37.999467	
Degrees of Freedom	16	
Probability Level	0.001514	Reject HO

Tab. 20: Urinary Retention

GA 1: General Anaesthesia, Group 1
GA 2: General Anaesthesia, Group 2
CA: Combined General and Regional Anaesthesia
RA_P: Peripheral Regional Anaesthesia
RA_C: Central Regional Anaesthesia
H0: Zero Hypothesis

Blue cells: lowest incidences
Yellow cells: highest incidences

Postoperative shivering appeared most frequently in the GA 1 and the RA_C group. The incidences were 7.2% and 6.9%, respectively.

The lowest incidence was reported in group RA_P with only 3.5%.

Shivering

Total Counts

	No	Mild	Moderate	Severe	Intolerable	Total
GA 1	3943	161	114	32	0	4250
GA 2	381	15	7	0	0	403
CA	473	15	2	6	0	496
RA_P	1298	27	16	4	0	1345
RA_C	2562	115	53	19	2	2751
Total	8657	333	192	61	2	9245

Percentages

	No	Mild	Moderate	Severe	Intolerable	Total
GA 1	92.8	3.8	2.7	0.8	0.0	100
GA 2	94.5	3.7	1.7	0.0	0.0	100
CA	95.4	3.0	0.4	1.2	0.0	100
RA_P	96.5	2.0	1.2	0.3	0.0	100
RA_C	93.1	4.2	1.9	0.7	0.1	100
Total	93.6	3.6	2.1	0.7	0.0	100

Chi-Square Statistics Section

Chi-Square	47.463244	
Degrees of Freedom	16	
Probability Level	0.000058	Reject HO

Tab. 21: Shivering

GA 1: General Anaesthesia, Group 1
GA 2: General Anaesthesia, Group 2
CA: Combined General and Regional Anaesthesia
RA_P: Peripheral Regional Anaesthesia
RA_C: Central Regional Anaesthesia
H0: Zero Hypothesis

Blue cells: lowest incidences
Yellow cells: highest incidences

Thirst is a very common side effect after surgical or interventional procedures. In our survey, it was reported by 11.6% of all participants. We found the highest incidences in groups CA, GA 1 and RA_C: 14.3%, 13.4% and 11.2%, respectively. In the other 2 groups, the incidences were lower: 8.4% in group GA 2 and 7.4% in group RA_P.

Thirst

Total Counts

	No	Mild	Moderate	Severe	Intolerable	Total
GA 1	3697	231	230	108	2	4250
GA 2	369	14	15	5	0	403
CA	425	34	26	11	0	496
RA_P	1245	52	36	12	0	1345
RA_C	2443	162	104	41	1	2751
Total	8161	493	411	177	3	9245

Percentages

	No	Mild	Moderate	Severe	Intolerable	Total
GA 1	86.6	5.4	5.4	2.5	0.0	100
GA 2	91.6	3.5	3.7	1.2	0.0	100
CA	85.7	6.9	5.2	2.2	0.0	100
RA_P	92.6	3.9	2.7	0.9	0.0	100
RA_C	88.8	5.9	3.8	1.5	0.0	100
Total	88.3	5.3	4.4	1.9	0.0	100

Chi-Square Statistics Section		
Chi-Square	60.210678	
Degrees of Freedom	16	
Probability Level	0.000000	Reject HO

Tab. 22: Thirst

GA 1: General Anaesthesia, Group 1
GA 2: General Anaesthesia, Group 2
CA: Combined General and Regional Anaesthesia
RA_P: Peripheral Regional Anaesthesia
RA_C: Central Regional Anaesthesia
H0: Zero Hypothesis

Blue cells: lowest incidences
Yellow cells: highest incidences

Dizziness occurred most frequently in group GA 1 and group CA: 6.0% and 6.2% of all members suffering from dizziness after anaesthesia, respectively. In all other groups, the incidence was quite lower: 4.9% in group RA_C, 4.2% in group GA 2 and 3.9% in group RA_P.

Dizziness

Total Counts

	No	Mild	Moderate	Severe	Total
GA 1	3993	197	52	8	4250
GA 2	386	10	7	0	403
CA	465	22	6	3	496
RA_P	1293	40	9	3	1345
RA_C	2617	98	31	5	2751
Total	8754	367	105	19	9245

Percentages

	No	Mild	Moderate	Severe	Total
GA 1	94.0	4.6	1.2	0.2	100
GA 2	95.8	2.5	1.7	0.0	100
CA	93.8	4.4	1.2	0.6	100
RA_P	96.1	3.0	0.7	0.2	100
RA_C	95.1	3.6	1.1	0.2	100
Total	94.7	4.0	1.1	0.2	100

Chi-Square Statistics Section		
Chi-Square	21.474048	
Degrees of Freedom	12	
Probability Level	0.043855	Reject HO

Tab. 23: Dizziness

GA 1: General Anaesthesia, Group 1
GA 2: General Anaesthesia, Group 2
CA: Combined General and Regional Anaesthesia
RA_P: Peripheral Regional Anaesthesia
RA_C: Central Regional Anaesthesia
H0: Zero Hypothesis

Blue cells: lowest incidences
Yellow cells: highest incidences

Patients claimed about hoarseness very frequently. We found the highest incidences of hoarseness in groups GA 1, CA and GA 2, with 7.3%, 4.5%, and 5.0%, respectively.

Hoarseness was less common in the regional anaesthesia groups: 2.9% in group RA_P and 2.3% in group RA_C.

Hoarseness

Total Counts

	No	Mild	Moderate	Severe	Total
GA 1	3941	268	36	5	4250
GA 2	385	14	4	0	403
CA	471	23	2	0	496
RA_P	1306	34	4	1	1345
RA_C	2688	53	5	5	2751
Total	8791	392	51	11	9245

Percentages

	No	Mild	Moderate	Severe	Total
GA 1	92.7	6.3	0.8	0.1	100
GA 2	95.5	3.5	1.0	0.0	100
CA	95.0	4.6	0.4	0.0	100
RA_P	97.1	2.5	0.3	0.1	100
RA_C	97.7	1.9	0.2	0.2	100
Total	95.1	4.2	0.6	0.1	100

Chi-Square Statistics Section		
Chi-Square	111.546644	
Degrees of Freedom	12	
Probability Level	0.000000	Reject HO

Tab. 24: Hoarseness

GA 1: General Anaesthesia, Group 1
GA 2: General Anaesthesia, Group 2
CA: Combined General and Regional Anaesthesia
RA_P: Peripheral Regional Anaesthesia
RA_C: Central Regional Anaesthesia
H0: Zero Hypothesis

Blue cells: lowest incidences
Yellow cells: highest incidences

Finally, participants were asked for postoperative recall of any form.

Recall

Total Counts

	Yes	No	Total
GA 1	12	2097	2109
GA 2	1	208	209
CA	8	246	254
Total	21	2551	2572

Percentages

	Yes	No	Total
GA 1	0.6	99.4	100
GA 2	0.5	99.5	100
CA	3.1	96.9	100
Total	0.8	99.2	100

Chi-Square Statistics Section		
Chi-Square	158.590184	
Degrees of Freedom	4	
Probability Level	0.000000	Reject HO

Tab. 25: Recall

GA 1: General Anaesthesia, Group 1
GA 2: General Anaesthesia, Group 2
CA: Combined General and Regional Anaesthesia
H0: Zero Hypothesis

Blue cells: lowest incidences
Yellow cells: highest incidences

Headache did not occur as frequently as the other side effects. Over all, 3.6% of all patients suffered from headache after anaesthesia. Groups with the highest incidence of headache were GA 1 and RA_C with an incidence of 3.9% in each group. However, there was not difference between all groups.

Headache

Total Counts

	No	Mild	Moderate	Severe	Intolerable	Total
GA 1	4085	128	26	10	1	4250
GA 2	390	10	2	1	0	403
CA	485	10	1	0	0	496
RA_P	1312	19	7	7	0	1345
RA_C	2643	83	16	9	0	2751
Total	8915	250	52	27	1	9245

Percentages

	No	Mild	Moderate	Severe	Intolerable	Total
GA 1	96.1	3.0	0.6	0.2	0.0	100
GA 2	96.8	2.5	0.5	0.2	0.0	100
CA	97.8	2.0	0.2	0.0	0.0	100
RA_P	97.5	1.4	0.5	0.5	0.0	100
RA_C	96.1	3.0	0.6	0.3	0.0	100
Total	96.4	2.7	0.6	0.3	0.0	100

Chi-Square Statistics Section		
Chi-Square	19.135103	
Degrees of Freedom	16	
Probability Level	0.261719	Accept HO

Tab. 26: Headache

GA 1: General Anaesthesia, Group 1
GA 2: General Anaesthesia, Group 2
CA: Combined General and Regional Anaesthesia
RA_P: Peripheral Regional Anaesthesia
RA_C: Central Regional Anaesthesia
H0: Zero Hypothesis

Blue cells: lowest incidences
Yellow cells: highest incidences

All the other reported side effects occurred in a very small number, with no statistical differences (see table 26).

Other Side Effects						
Percentages						
	GA 1	GA 2	CA	RA_P	RA_C	Total
Lung Oedema	0.2	0.2	0.0	0.1	0.2	0.2
Pneumonia	0.2	0.0	0.0	0.1	0.1	0.2
Other Respiratory Problems	1.8	1.5	0.6	1.0	0.8	1.3
Hypotension	2.0	1.2	1.8	0.7	1.6	1.7
Hypertension	0.4	0.5	0.0	0.3	0.2	0.3
Arrhythmia	0.4	0.5	0.8	0.2	0.4	0.4
Tachycardia	0.6	0.5	0.6	0.2	0.5	0.5
Bradycardia	0.2	0.2	0.0	0.1	0.1	0.2
Decompensated Heart Failure	0.4	0.2	0.0	0.1	0.4	0.3
Lung Embolia	0.1	0.0	0.0	0.1	0.0	0.1
Circulatory Instability	0.1	0.2	0.0	0.1	0.1	0.1
Angina Pectoris	0.1	0.0	0.0	0.1	0.1	0.1
Myocardial Infarction	0.1	0.0	0.0	0.1	0.0	0.1
Other Heart Problems	0.4	0.0	0.0	0.2	0.2	0.2
Renal Insufficiency	0.5	0.2	0.4	0.1	0.2	0.4
Icterus	0.1	0.0	0.2	0.1	0.1	0.1
Anaphylaxis	0.1	0.0	0.0	0.1	0.0	0.1
Other Allergic Response	0.2	0.2	0.0	0.1	0.1	0.1
Delayed Awakening	0.4	0.0	0.0	0.2	0.2	0.3
Central Anticholinergic Syndrome	0.1	0.0	0.0	0.1	0.0	0.1
Ischemia	0.1	0.0	0.0	0.1	0.0	0.1
Convulsion	0.2	0.0	0.0	0.1	0.0	0.1
PODB	0.5	0.0	0.4	0.1	0.2	0.3
Other Neurological Problems	0.2	0.0	0.2	0.1	0.1	0.2
Peripheral Sensoric Neuropathy	0.2	0.2	0.2	0.2	0.0	0.2
Postspinal Headache	0.2	0.0	0.0	0.0	0.1	0.1

Tab. 27: Other Side Effects

PODB: Postoperative Brain Dysfunction

Blue cells: lowest incidences
Yellow cells: highest incidences

In the last table, we compared the incidence of postoperative side effects by surgical location, reported from 8825 participants.

Postoperative Side Effects by Surgery Location

Total Counts

	Yes	No	Total
Abdomen	77	677	754
Arm/ Hand	40	1700	1740
Pelvic Region/ Hip/ Thigh	131	1682	1813
Head/ Throat	13	202	215
Trunk/ Shoulder	14	188	202
Thorax	24	507	531
Lower Leg/ Foot/ Knee	69	2929	2998
Spinal Column	35	364	399
Intracranial	0	6	6
Retroperitoneal	0	1	1
Other Locations	5	161	166
Total	408	8417	8825

Percentages

	Yes	No	Total
Abdomen	10.2	89.8	100
Arm/ Hand	2.3	97.7	100
Pelvic Girdle/ Hip/ Thigh	7.2	92.8	100
Head/ Throat	6.0	94.0	100
Trunk/ Shoulder	6.9	93.1	100
Thorax	4.5	95.5	100
Lower Leg/ Foot/ Knee	2.3	97.7	100
Spinal Column	8.8	91.2	100
Intracranial	0.0	100	100
Retroperitoneal	0.0	100	100
Other Locations	3.0	97.0	100
Total	4.6	95.4	100

Chi-Square Statistics Section

Chi-Square	159.556246	
Degrees of Freedom	10	
Probability Level	0.000000	Reject H0

Tab. 28: Postoperative Side Effects by Surgery Location

Blue cells: lowest incidences
Yellow cells: highest incidences

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5. Discussion

Our retrospective study shows that minor side effects after general and/ or regional anaesthesia appear quite frequently. However, nearly all of the minor complications have a low incidence and most often, they are from mild character.
Over all, the incidence of postoperative side effects was 4.5%, with little differences between the five groups. The most common complications were secondary hyperalgesia (pain area around surgical wounds) with an incidence of 23.8%, primary hyperalgesia (pain at the surgical wound) with an incidence of 13.5%, and thirst with 11.7%.
Those side effects with the lowest incidences of all 13 groups were recall after general anaesthesia with an incidence of 0,8%, urinary retention with an incidence of 3.5% and headache with an incidence of 3.6%.
One weakness of our investigation is our inability to make any gender considerations knowing that the incidence of postoperative complications in women and men are quite different. One study showed that compared with men, women have a 92% higher incidence of complications after surgery and anaesthesia, complications that have been classified as “minor” in the past (nausea and vomiting, sore throat, backache and headache) [10].

The most common side effect observed was secondary hyperalgesia. It occurred with a mean incidence of 23.8% and was found with similar incidences over all five groups. Only in groups RA_P and GA 2 with 19.2 and 20.1% respectively, of all patients suffering from secondary hyperalgesia, the incidence was a little lower.
Although, secondary hyperalgesia is seen as a result of central sensitising, interestingly there are no differences between regional or general anaesthesia. Possible explanations could be that in the GA 2 groups short lasting surgical cases were performed, and that in the RA_C group additional non-spinal pain pathways are activated. Evoked potentials can be measured in the brain during surgery under neuraxial blocks, even if the patients does not report or feel any pain [15].

Primary hyperalgesia had an over all incidence of 13.5%. Although primary hyperalgesia was reported only from half of the patients claiming about secondary hyperalgesia, it is still the second most common side effect that we observed. One of the reasons could be that primary hyperalgesia due to the “inflammatory soup” at the side of injury is easier to treat und shorter lasting than secondary hyperalgesia after full wind-up with activation of the NMDA receptor.
The highest incidences were found in group CA with 17.1% and in group GA 1 with 14.2%. An interesting fact is that the highest incidences of primary hyperalgesia occurred in group CA, a combination of regional and general anaesthesia. Patients in this group reported mild pain in 7.5%, moderate pain in 5.6% and severe pain in 4.0%. The lowest incidence appeared in group RA_P with 10.2% exclusively. A reason for this could be that in group CA, the more difficult and longer lasting surgical procedures were carried out.
Another interesting observation was, that group RA_C had the third highest incidences of primary hyperalgesia, close to the group’s mean value. Following our possible explanation for the higher probability of developing central sensitization, neuraxial blocks seem to better in preventing primary hyperalgesia, but not as good as peripheral blocks.

The third most common side effect reported was postoperative thirst with an incidence of 11.7% over all five groups. The highest incidences were seen in groups CA (14.2%) and GA 1 (13.4%), lowest in group RA_P (7.4%). For sure, the type and duration of the surgical procedure plays a major role in the appearance of thirst postoperatively. Of course, the type of anaesthesia that was chosen may also be a cause for postoperative thirst, like a restrictive fluid management after neuraxialblocks. And for sure, the perioperative fluid management in general plays a major role in developing thirst.

In contrast, urinary retention was found in 3.5% of all participants and was therefore the second most unfrequent side effect that patients reported. As expected, the highest incidence was reported in group RA_C, where the patients had whether a spinal or epidural anaesthesia. In this group, urinary retention and thirst are quite common, due to blocking the sympathetic system and therefore

making the patient unable to urinate, and due to the restrictive fluid management to avoid a catheterization of the patient's urinary bladder.
If you compare the incidences of urinary retention to those of thirst, especially groups RA_P and GA 2 show equivalent low values. This can be explained by the shorter lasting procedures in GA2, and the ability of RA_P patients to urge for fluids to drink and their anaesthesia unaffected consciousness or ability to urinate.

Postoperative sore throat is a very frequent side effect after general anaesthesia. In total, it was reported by 8.9% of all patients. Unsurprisingly, the highest incidence of sore throat and other airway related symptoms occurred in patients who had undergone endotracheal intubation [7]: In groups CA and GA 1, incidences were 13.3 and 12.8%, respectively. In other studies, the incidence of sore throat varied from 14.4% to 50% [7]. One survey reported incidences of 28% of the patients suffering from sore throat after endotracheal intubation [8]. Our results coincide with the data from one Canadian survey, where the incidence of sore throat was 28.2% [3].
After laryngeal mask airway induction, it varied from 5.8% to 34% [7]. Our data report an incidence of 9.9% in group GA 2, where laryngeal mask airways were used preferentially. For sure, the wide variation of sore throat in these surveys is due to different anaesthetic skills and techniques, and more likely due to the individual definition of sore throat of each patient. Sore throat appears, according to one study, 1.5 times more often in women than in men [10].

Close to sore throat is hoarseness. Once again, the highest incidences appeared in those groups, where general anaesthesia was performed. Our survey found an over all incidence of 4.9% and the incidences in groups GA 1, CA and GA 2 were 7.3%, 5.0%, and 4.5%, respectively. Another survey presented an incidence of 8.0% of postoperative hoarseness after general anaesthesia [8]. Nevertheless, laryngeal mask airways or other alternative airways show a lower incidence of sore throat as well as hoarseness (9.9% of sore throat and 4.5% of hoarseness in group GA_2) as groups where endotracheal intubation was the chosen method. This seems to make it clear, that those kinds of airways are causing laryngeal irritation than endotracheal tubes do. And we also know from studies that a

reduced tube-mucosal interface reduces the incidence of postoperative sore throat [7].

Interestingly, the group with the highest incidence of severe hoarseness was group RA_C. On the one hand, this is the group with the lowest over all incidence of hoarseness but on the other hand, out of 63 patients in this group who reported about hoarseness, 5 patients (7.9%) classified their hoarseness as severe. We found no data in medical literature, to compare our findings, but maybe, further investigations should be performed, to check these findings.

Muscle pain had an incidence of 4.4% over all groups. One survey reported incidences of 45% with more than 51.5% of those patients reporting moderate severity [3]. However, in this study, only general anaesthesia was performed, the participants were all female and only one specific surgical procedure was carried out. Our survey found the highest incidences of muscle pain in groups GA 1 and CA with incidences of 5.3% and 5.0%, respectively, and in group RA_C with 4.2%. The only group, with significantly lower numbers was group RA_P with an incidence of only 2.0%. Quite interesting is the gap between the peripheral and neuraxial regional anaesthesia group. Possible explanations could be the longer duration of surgical procedures in the GA 1 and CA group, and the long lasting effects of blocking the motor function after neuraxial blocks which restricts the patient to move out of an uncomfortable lying position. Further studies could help to enlighten this observation.

Postoperative nausea and vomiting is one of the most frequent postoperative side effects in anaesthesia. In one preoperative survey, patients ranked postoperative emesis as the most undesirable and nausea as the forth most undesirable of 10 negative postoperative outcome possibilities, while postoperative pain ranked third in this study. [12].

In comparison to other surveys, the incidences that we found were quite low. Over all, only 5.5% of all patients suffered from PONV. Unsurprisingly, the incidence in the general anaesthesia groups was higher compared to the regional anaesthesia groups; in groups GA 1 and CA, the incidences were 7.2% and 5.6%, respectively. Group GA 2 reported an incidence of 4.5%. In literature, the incidences of PONV

are widely spread with ranges from 4.6% up to 35.9% [4,5]. Apfel et al. reported that next to postoperative pain, PONV, with an average incidence of about 30%, is one of the most common side effects after anaesthesia [6]. This could be explained by the opioid-sparing effect of regional anaesthesia in the CA, RA_P, and RA_C groups.
Another interesting fact is that in group RA_P, where we have found the lowest incidence of PONV (3.1%), 12.2% of the patients suffered from severe PONV.
Here it also would have been interesting, what were the differences between men and women. According to other studies, women are 2.6 times more likely to report nausea and vomiting than men [10].

Back pain showed an incidence of 7.5% over all participants. The highest incidences were found in group RA_C with 8.8%. This may be explained by the fact that the puncture for spinal or epidural anaesthesia is made in the back, by patients lying awake and restrained during the surgical procedure, therefore increasingly likely reported the longer the surgery lasts, and postoperatively by the inability of patients to move out of an uncomfortable position due to the motor dysfunction as long as the neuraxial block lasts..
Considering the above stated notes, as aspected incidences in group RA_P were the lowest of all groups with only 4.9% of all patients suffering from postoperative back pain. The cause for these findings may be the fact, that peripheral regional blocks are often used for procedures of short duration and the ability of the patient to wriggle into a more comfortable position during and after anaesthesia.
High incidences of back pain are reported in the general anaesthesia groups also. The GA 1 group reported an incidence of 7.8%, and the CA group of 7.3%. Like PONV, back pain is also reported to appear more often in women than in men [10]. Summing up, back pain is a matter of the type of surgery, the type of anaesthesia and the duration of the whole surgical procedure.

Dizziness was the eight most common side effect that our patients reported, with an over all incidence of 5.3%. Most people, who suffered from dizziness, came out of the general anaesthesia groups. GA 1 reported an incidence of 6.0%, CA an

incidence of 6.2%. As expected, the lowest incidence was found in the RA_P group with 3.9%.
This observation could be explained by the use of several anaesthetic agents for anaesthesia induction and maintenance, or the length of general anaesthesia. These sedative and narcotic drugs can be spared in the regional anaesthesia groups. Furthermore, endotracheal intubation is preferred for risk patients and for long or major surgical procedures.

In one recent survey, patients were asked, what would be their most undesirable side effect after anaesthesia. Out of ten possible events, they ranked shivering as the seventh most undesirable event after undergoing anaesthesia [9]. In another survey with the same background, shivering was ranked the seventh most undesirable postanaesthesia outcome [12].
In our survey, shivering had the sixth highest incidence out of all 13 side effects. Over all, 6.4% of all patients suffered from postoperative shivering. We found the highest incidences in group GA 1 and RA_C with 7.2%, respectively 6.9%. One German survey, including 1000 participants found an over all incidence of moderate and severe shivering of 11.6% in patients undergoing general anaesthesia [17]. Shivering appeared most seldom in the RA_P group. So shivering seems to be related to the chosen method of anaesthesia. In GA 1 and RA_C, sympathicolysis opens the vessels at the body surface causing more warm blood flowing through them. Since the patient is unable to counteract this peripheral vasodilatation, the body core cools out.,The result is that patients undergoing neuraxial anaesthesia typically become hypothermic and do not sense the hypothermia [16]. One German study identified age, endoprosthetic surgery and core hypothermia as the three most important risk factors for developing postoperative shivering [17].
It may also be a matter of other factors, like the location and duration of the surgery, the temperature of the operating room, if the patient has been warmed up during the procedure, how effective this heating is, and the drugs being used perioperatively. This explains why in group CA with the most effective sympathicolysis due to the combined anaesthesia and with longest and major surgical procedures the highest incidence of severe shivering has been reported:

26.1% of all patients who experienced shivering in this group while we have the second lowest of all incidence of shivering in this group (4.6%).

Headache was one of the three most unfrequent side effects that we have seen in our questionnaire. It was the only side effect with no statistically significant differences between our five groups: over all 3.6% of our participants suffered from headache after their surgery. Headache appeared most often in groups GA 1 and RA_C with an incidence of 3.9% in each group. The lowest incidence we have seen in group RA_P with only 2.5% reporting about any headache events, maybe for similar reasons as stated in the discussion about back pain.

Patients were also asked, if they had any kind of recall during their surgical procedure. Out of the 2572 patients, who had undergone any form of general anaesthesia, 21 witnessed an episode of recall. The highest incidence was seen in group CA with 3.1% reported recalls, while groups GA 1 and GA 2 had lower incidences with 0.6%, respectively 0.5%. The overall incidence was 0.8%. One possible explanation for the higher incidence in the CA group can be a lower MAC being used for maintaining anaesthesia with the neuraxial block eliminating all the obvious painful and tactile surgical input. Another reason can be the use of propofol which makes recall or awareness postoperatively more likely [11]. Unfortenately, our initial data do not provide any information about the use of anesthetic gases or propofol intraoperatively to answer this question.
One Scandinavian survey with 1500 outpatients and 2343 inpatients found incidences of clear intraoperative recollections of 0.07% (outpatients), respectively 0.13% (inpatients) [18]. In one study involving 11785 patients who had received general anaesthesia, the incidence of awareness alone was 0.18% in cases in which neuromuscular blockers were used and 0.10% in absence of such drugs [13]. According to another Scandinavian study from 1998, awareness with recall during general anaesthesia occurred with a fairly constant incidence of 0.2 -0.3% [14].
Compared to these data from literature, our reported incidences are pretty high. There may have been a misunderstanding amongst patients and anaesthesiologists about the definition of recall. The main problem may have been

that the authors of the questionnaire asked about “memory of the surgery” instead of recall or awareness. Maybe it would have been necessary to provide better information about these terms.

More side effects, even some of them life threatening, appear after anaesthesia. The incidences are so low, that even our study with close to 10.000 patients was unable to detect any significances.

In relation to the surgical location, most of the side effects were reported after any kind of abdominal surgery, followed by orthopaedic or traumatological surgery at the spinal cord, pelvic girdle/hip, and trunk/shoulder. Surgery at the abdomen, spinal column, pelvis, and shoulder are well known as very painful procedures requiring intense pain therapy, an increased risk for PONV and intraoperative bleeding. All these reasons together may explain our result.
The lowest incidences are reported after intracranial or retroperitoneal procedures. Since these procedures were performed only in 7 patients, we consider these results for this study as irrelevant and neglectable. Surgery at the knee, lower leg, or foot shows a realistic low rate of side effects, with a high number of patients. These surgical locations are predestined for peripheral regional blocks explaining the good results.

Even if this study was designed as a prospective study, our data are contain are large interindividual bias due to the differential subjective experiences of our patients and range of interpretation of the whole anaesthesiological team. The value of this study is the high number of participants, reducing the influence of this bias. We demonstrated that minor side effects and general reactions on anaesthetic procedures are quite frequent in all anaesthetic disciplines, independently if regional or general anaesthetic procedures are performed.

Today’s patients are concerning about minor side effects, like PONV being the third most undesirable side effect of anaesthesia, together with pain (ranked Nr. 1) and gagging on endotracheal tube (ranked Nr. 2) [9]. Minor side effects after

anaesthesia may not be life threatening events, but they need to be addressed and prevented, as a part of every anaesthetist's daily routine.

6. Appendix

6.1 References

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6.3 List of abbreviations

AWR	Awareness with recall
GA 1	General Anaesthesia, Group 1
GA 2	General Anaesthesia, Group2
CA	Combined Regional and General Anaesthesia
CNS	Central Nervous System
DCS	Dynamic Condyle Screw
DHS	Dynamyc Hip Screw
ENT	Ears, Nose, Throat
HO	Zero Hypothesis
ICU	Intensive Care Unit
ITN	Intubation
IVRA	Intravenous Regional Anaesthesia
LMA	Laryngeal Mask Airway
PDA	Peridural Anaesthesia
PODB	Postoperative Brain Dysfunction
PONV	Postoperative Nausea and Vomiting
RA_P	Peripheral Regional Anaesthesia
RA_C	Central Regional Anaesthesia

6.4 Questionnaire

BERUFSGENOSSENSCHAFTLICHE KLINIKEN BERGMANNSHEIL • UNIVERSITÄTSKLINIK

Klinik für Anästhesiologie, Intensiv- und Schmerztherapie • Direktor: Prof. Dr. M. Zenz

Fragebogen *postoperative Verlaufsbeobachtung*

Patientenaufkleber	Tag der OP: _____ Tag der Befragung: _____ Befragung nicht möglich wegen: O Intensiv O Entlassung O desorientiert

Sehr geehrte Patientin,
sehr geehrter Patient,

die Klinik für Anästhesiologie ist bemüht, die Anästhesie (Narkose) so sicher und angenehm wie möglich für Sie zu gestalten. Hierzu benötigen wir Ihre Mithilfe.
Bitte kreuzen Sie an, welche Beschwerden Sie nach der Operation hatten oder noch haben.

Wir danken Ihnen bereits jetzt für Ihre Mithilfe.

Schmerzen:

	keine	leicht	mittel	stark	unerträglich
Halsschmerzen	O	O	O	O	O
Wundschmerzen	O	O	O	O	O
Muskelschmerzen	O	O	O	O	O
Rückenschmerzen	O	O	O	O	O
Kopfschmerzen	O	O	O	O	O
Operationsschmerzen	O	O	O	O	O

allgemeine Reaktionen:

	gar nicht	leicht	mittel	stark	unerträglich
Übelkeit/Erbrechen	O	O	O	O	O
Urinverhalt	O	O	O	O	O
Frieren / Zittern	O	O	O	O	O
Durst	O	O	O	O	O
Schwindel	O	O	O	O	O
Heiserkeit	O	O	O	O	O

Welche Beschwerden haben wir vergessen?

_____

_____

Wenn Sie in Allgemeinanästhesie (Vollnarkose) operiert wurden; können Sie sich an die Operation erinnern?

O nein, ich habe geschlafen O ja, ich war teilweise wach

Wurden Sie vor der Operation von einem Anästhesisten besucht und über die Narkoserisiken aufgeklärt?

O nein O ja

Bitte nicht ausfüllen - diese Seite wird vom Anästhesisten ergänzt!

Diagnose: _____

Operation: _____

O elektive OP
O dringende OP
O Notfall OP

Operationsbereich:
O Allgemeinchirurgie
O Unfallchirurgie
O plastische Chirurgie
O Orthopädie
O Gynäkologie
O HNO
O Handchirurgie
O Schmerztherapie
O Herz/Thorax
O sonstige

Eingriffslokalisation:
O Becken/Hüfte/OS
O US/Fuß/Knie
O Arm/Hand
O Wirbelsäule
O Thorax
O Abdomen
O Kopf/Hals
O Rumpf/Schulter
O retroperitoneal
O intrakraniell
O sonstige

Eingriffsart:
O Diagnostik
O kl. WT-OP
O gr. WT-OP
O Knochen OP
O Prothese
O große Gefäße
O periphere Gefäße
O ME
O Reposition
O Schrittmacher
O Schmerztherapie
O Repl./fr. Lappen
O DHS/DCS/End
O sonstige

Anästhesiemethode:

Allgemeinanästhesie:	O ITN	O Maske	O LM	O Überwachung	O Ileuseinleitung
Regionalanästhesie:	O PDA	O spinal	O Plexus	O periphere RA	O IVRA
mit Katheter:	O ja	O nein	*Sedierung:*	O ja	O nein

postoperative Beschwerden: O keine

	Schweregrad		Schweregrad
Atemwege/Gasaustausch:	1 2 3 4 5	*allgemeine Reaktionen:*	1 2 3 4 5
Lungenödem	OOOOO	Oligurie/Anurie/Nierenversagen	OOOOO
Pneumonie	OOOOO	Ikterus	OOOOO
andere respiratorische Störungen	OOOOO	allergische Reaktion	OOOOO
		andere allgemeine Reaktion	OOOOO
Herz/Kreislauf:		*zentrales Nervensystem:*	
Hypotension	OOOOO		
Hypertension	OOOOO	verzögertes Aufwachen	OOOOO
Arrhythmie	OOOOO	zentrales anticholinerges Syndrom	OOOOO
Tachykardie	OOOOO	Ischämie	OOOOO
Bradykardie	OOOOO	Krampfanfall	OOOOO
dekompensierte Herzinsuff.	OOOOO	Verwirrtheitszustand	OOOOO
Lungenembolie	OOOOO	andere zentral-neurolog. Störungen	OOOOO
Kreislaufstillstand	OOOOO		
Angina pectoris	OOOOO	Sonstiges:	
Myokardinfarkt	OOOOO		
andere Herz-/Kreislaufstörungen	OOOOO	periphere Sensibilitätsstörung	OOOOO
		postspinale Kopfschmerzen	OOOOO
		_____	OOOOO

Bei aufgetretenen Beschwerden bitte den entsprechenden Schweregrad ankreuzen.

1 - weiterer Verlauf der Behandlung nicht beeinträchtigt / keine besondere Betreuung notwendig
2 - über das normale Maß hinausgehende Intervention von Ärzten und/oder Pflegepersonal notwendig
3 - verlängerte Beobachtung erforderlich; ggf. Klinikaufenthalt verlängert
4 - Behandlungsergebnis insgesamt beeinträchtigt / Verlegung auf Intensivstation
5 - Dauerschaden / Lebensgefahr / Tod

Curriculum vitae

Personalien:

Name:	Simon Wilhelm Stöcklegger
Geburtsdatum:	01.06.1983
Anschrift:	Manzenreith 29, 4240 Freistadt, OÖ
Staatsbürgerschaft:	Österreich
Religionsbekenntnis:	Röm.-kath.

Schulbildung:

1989-1993: Volksschule in Freistadt, OÖ

1993-2001: Bundesgymnasium Freistadt; Abschluss mit Reifeprüfung

Zivilidienst:

2001-2002: Landeskrankenhaus Freistadt

Studium:

2002-2008: Studium der Humanmedizin, Medizinische Universität Graz; Abschluss mit dem akademischen Grad Dr. med. univ.