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**How to cite**

GANTER, Michael Thomas et al. Regional anaesthesia-related complications in Switzerland. In: European journal of anaesthesiology, 2025, vol. 42, n° 10, p. 924–933. doi: 10.1097/EJA.0000000000002220

This publication URL: https://archive-ouverte.unige.ch/unige:188146
Publication DOI: 10.1097/EJA.0000000000002220

EJA

*Eur J Anaesthesiol* 2025; **42:**924–933

OPEN

ORIGINAL ARTICLE

# Regional anaesthesia-related complications in Switzerland

## *Lessons learned from the national closed claims analysis over the past 30 years*

Michael Thomas Ganter, Thierry Girard, Vincent A. Stadelmann, Benno Rehberg-Klug, Sven Staender and Christoph Karl Hofer

**BACKGROUND** Regional anaesthesia is widely used in clinical practice, offering significant benefits but carrying risks such as nerve damage and other complications. Understanding medicolegal trends associated with regional anaesthesia is essential for improving patient safety and refining practices.

**OBJECTIVE(S)** To analyse closed claims related to regional anaesthesia in Switzerland over the past 30 years, identify trends in complications and assess their medicolegal implications.

**DESIGN** Retrospective analysis of the Swiss Anaesthesiology Closed Claims Analysis database, focusing on cases involving regional anaesthesia from 1992 to 2022.

**SETTING** The study was conducted using data from Swiss medical malpractice insurers and the Swiss Society of Anaesthesiology and Perioperative Medicine together with their Foundation for Patient Safety in Anaesthesia.

**PATIENTS** A total of 244 closed claims of patients were reviewed, of which 140 cases involved regional anaesthesia.

**INTERVENTION(S)** None.

**MAIN OUTCOME MEASURES** Key measures included patient demographics, type of anaesthesia, complications, adherence to best practices and legal outcomes such as liability acceptance and compensation amounts.

**RESULTS** The number of claims involving regional anaesthesia decreased significantly over three decades, from 69 (49%) in the first decade to 30 (21%) in the last. Nerve damage was the most common complication (76%), with a notable reduction in permanent injuries from 57 to 28%. Advances in ultrasound-guided techniques and improved documentation may have contributed to these trends. Male patients tended to have higher rates of nerve injuries, while female patients reported more nonspecific pain syndromes and posttraumatic stress disorders because of the health impairment associated with the liability case. Liability was accepted in 43% of cases, with compensation often exceeding CHF 100 000. The highest compensations seemed to have been paid to male patients.

**CONCLUSIONS** The decline in claims may reflect advancements in anaesthetic techniques and safety practices. This study underscores the importance of communication and training best practices in regional anaesthesia, including sufficient patient information and documentation to enhance patient safety and reduce medicolegal risks. Pain during performance, multiple attempts and re-injections should be avoided whenever possible.

**Published online 4 June 2025**

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**Received:** 20 December 2024; **Accepted:** 15 May 2025



DOI:10.1097/EJA.0000000000002220

## KEY POINTS

- Reduction in claims over time: Regional anaesthesia-related claims in Switzerland decreased from 69 cases (49%) in the first decade to 30 cases (21%) in the last, reflecting improved safety practices.
- Decreasing severity of nerve damage: Nerve damage accounted for 76% of complications, but permanent injuries dropped significantly from 57% in the first decade to 28% in the third.
- Advances in practice: The adoption of ultrasound-guided techniques and enhanced documentation may have improved patient outcomes and reduced litigation.
- Sex-specific trends in complications: More of the cases with nerve injury were in men, while female patients reported more nonspecific pain syndromes and posttraumatic stress disorders because of the health impairment associated with the liability case, with observed disparities in compensation amounts.
- Ongoing challenges: Persistent issues include nonadherence to best practices and sex disparities in outcomes and compensation, necessitating focused efforts on training and equitable patient care.

## Introduction

In recent decades, the field of anaesthesiology has seen a significant reduction in peri-operative and anaesthesia-related mortality, demonstrating the progress made in medical practices and patient safety protocols.[1] However, anaesthesiologists continue to face challenges in dealing with the complex nature of peri-operative anaesthesia complications, particularly in the area of regional anaesthesia. Regional anaesthesia, a mainstay of anaesthesia practice, involves techniques such as spinal and epidural anaesthesia and peripheral nerve blocks. It has been previously demonstrated that regional anaesthesia is performed in one-third of all anaesthetics.[2,3] Despite its clinical benefits, regional anaesthesia is not without risks, including complications such as nerve damage and medication-related side effects.[4–6]

Closed claims analysis is a crucial tool for identifying risks and developing preventive strategies in anaesthesiology. The American Society of Anaesthesiologists (ASA) [7] pioneered this approach,[8] which has since been adopted by the Swiss Society of Anaesthesiology and Perioperative Medicine (SSAPM; formerly Swiss Society of Anaesthesiology and Reanimation, SSAR).[2] Anaesthesia closed claims projects, while offering valuable insights, have advantages and limitations.[9,10] Its strengths lie in analysing uncommon events leading to serious patient injuries, providing a broad perspective on anaesthesia hazards, and enhancing situational awareness among practitioners. The data, subject to expert review, illuminate safety gaps and patterns in anaesthesia-related injuries. However, the limitations include a focus on cases filtered through the medicolegal system, potentially overlooking less severe or unreported events. In addition, the lack of denominator data limits the incidence analysis, and the project's methodology may not establish definitive causation, leading to outcome bias. Furthermore, the time lag in data collection due to the long duration of legal proceedings can delay insights into the current practice.[11]

This study presents a comprehensive follow-up to our previously published *Swiss Anaesthesiology Closed Claims Analysis 1987–2008* published in this journal,[2] with a specific focus on the patterns and nature of complications associated with regional anaesthesia over the last 30 years. Recent data and trends in closed claims have been analysed to provide a comprehensive understanding of the complications associated with regional anaesthesia leading to litigation and claims over the past three decades in Switzerland. Our study aimed to advance the understanding of the medicolegal implications of regional anaesthesia and to enhance patient safety by refining anaesthetic practices.

## Materials and methods

### Swiss anaesthesiology closed claims analysis

The SSAPM, in collaboration with the Foundation for Patient Safety in Anaesthesia (SPSA-FSPA), initiated the SACCA project to systematically analyse national closed claims in anaesthesiology. In collaboration with the Swiss Medical Association (Foederatio Medicorum Helveticorum, FMH) and its out-of-court review department, as well as Swiss medical malpractice insurers, the project gained access to anonymised anaesthesia claims records dating back to 1989. These records were meticulously reviewed by the SSAPM's closed claims commission and organised into a structured database. Further details of the project design, data sources and management can be found in a previous publication.[2]

### Ethics

Ethics approval for this study (BASEC No: Req-2024–00094) was provided by the Ethics Committee of Zurich, Switzerland (Kantonale Ethikkommission, Chairperson Prof. D. Nadal) on 23 January 2024. This study was conducted in compliance with the Declaration of Helsinki guidelines for the ethical conduct of human research. As this study used retrospective data from anonymised records, individual patient consent was not required and was formally waived by the committee.

### Data analysis

The SACCA database contains 244 records from 1992 to 2022. Of these, 140 cases (57%) involved regional anaesthesia, 81 (33%) involved general anaesthesia and 23 (10%) involved peri-operative positioning. This analysis

focused specifically on cases involving neuraxial and peripheral regional anaesthesia.

Data analysis included the following parameters: Year of event; patient-related data (sex, age, ASA physical status, comorbidities); surgery-related data (speciality, procedure, modalities); management before anaesthesia (documentation of patient information, presence of signed informed consent); anaesthesia management (methods and approaches used such as epidural, spinal and different peripheral nerve blocks; this also includes technical aspects such as combined anaesthesia, ultrasound-guided techniques, catheter insertion and adherence to the standard of care at the time of the event such as deviations from best practice, multiple attempts and changes in anaesthetic procedure); specific complications of neuraxial anaesthesia (paraparesis/paraplegia, cauda equina syndrome, total spinal anaesthesia and postspinal headache); specific complications of peripheral nerve blocks (nerve injury, pneumothorax); unspecific complications such as pain syndromes and pain exacerbation, posttraumatic stress disorder as a result of the health impairment associated with the liability case, infection, accidental handling, and other complications; Severity of Injury Score (SIS) as defined by the National Association of Insurance Commissioners,[7,12] and finally consequences of the claims (presence and results of expert reports, acceptance of liability, payments and the amount of compensation).

To facilitate readability and comprehensibility, the study period (1992 to 2022) was divided into three 10-year intervals: decade 1 (1992 to 2002), decade 2 (2003 to 2012) and decade 3 (2013 to 2022). Furthermore, the SIS was condensed into four categories: A, no physical injury (SIS 0 to 1); B, temporary injury (SIS 2 to 4); C, permanent mild to intermediate injury (SIS 5 to 6); D, permanent serious injury including death (SIS 7 to 9).

### Outcomes

The analysis focused on the following outcomes: sex differences, distribution of injuries, litigation and claims by type of regional anaesthesia and trends over three decades (1992 to 2022).

### Statistical analysis

Descriptive statistics for cohort demographics, case numbers and liability cases are summarised. Categorical variables are presented as number (%) and continuous variables as means ± SD stratified by sex. Group comparisons were conducted using Pearson's $\chi^2$ or Fisher's exact test, as appropriate. Temporal trends were assessed with Poisson regression, and changes in complication distribution across decades with $\chi^2$ tests.[13] To examine the relationship between the various factors and the likelihood of claim acceptance, multivariate logistic regression analyses were conducted. The initial models included all documented predictors outcomes and claims data. A stepwise elimination procedure was performed based on the Akaike Information Criterion (AIC).[14] AIC balances model fit and complexity, ensuring optimal performance while avoiding overfitting. The model was constrained to always include sex and type of anaesthesia, given their clinical relevance for the study, and only the predictors that provided a significant contribution to explain the variability. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated to quantify the strength of the associations between the predictors and dependant variable. All statistical analyses were performed using the R software version 4.3.1,[15] and the statistical significance level was set at 0.05.

## Results

### Sociodemographics and surgical services

Of the 140 cases in the SACCA database involving regional anaesthesia, 55% were female. The mean age of male patients was significantly higher than that of female patients (Table 1). Over the three decades, the total number of cases decreased significantly from 69 in the first decade to 41 in the second decade and 30 in the third decade ($P < 0.05$). This reduction was observed in both sexes, with no statistically significant sex differences in the number of cases ($P = 0.50$). The distribution of ASA classification was similar between male and female patients; however, notable differences were observed in comorbidities. Male patients were more likely to have cardiopulmonary disease, whereas mental health problems were more common in female patients. Over the three decades, there was a trend towards higher ASA physical status, a significant decrease of ASA I physical status and an increase of ASA II physical status,

**Table 1** Patients, setting and operations

| Characteristic | Overall[a] | Female[a] | Male[a] | *P*[b] |
|---|---|---|---|---|
| Demographics | *n* = 140 | *n* = 77 | *n* = 63 | |
| Age (years) | 51 ± 16 | 49 ± 17 | 54 ± 13 | 0.02 |
| ASA physical status | | | | |
| 1 | 73 (52) | 43 (56) | 30 (47) | 0.50 |
| 2 | 53 (38) | 28 (36) | 25 (40) | |
| 3 | 14 (10) | 6 (8) | 8 (13) | |
| Comorbidities | *n* = 140 | *n* = 77 | *n* = 63 | |
| Cardiopulmonary | 32 (23) | 11 (14) | 21 (33) | 0.01 |
| Gastrointestinal | 8 (6) | 5 (7) | 3 (5) | 0.73 |
| Endocrinological | 20 (14) | 11 (14) | 9 (14) | >0.99 |
| Urogenital | 4 (3) | 1 (1) | 3 (5) | 0.33 |
| Neurological | 11 (8) | 8 (10) | 3 (5) | 0.34 |
| Mental | 9 (6) | 8 (10) | 1 (2) | 0.04 |
| Obesity | 24 (17) | 14 (18) | 10 (16) | 0.72 |
| Other | 25 (18) | 16 (21) | 9 (14) | 0.32 |
| Setting | *n* = 40 | *n* = 77 | *n* = 63 | |
| In-patient | 128 (91) | 68 (88) | 60 (95) | 0.15 |
| Elective | 134 (96) | 71 (92) | 63 (100) | 0.03 |
| Surgery | *n* = 140 | *n* = 77 | *n* = 63 | |
| Orthopaedic | 95 (68) | 50 (65) | 45 (71) | 0.21 |
| Visceral/Vascular | 25 (18) | 12 (16) | 13 (21) | |
| Gynaecology/Urology | 17 (12) | 12 (16) | 5 (7.9) | |
| Other | 3 (2) | 3 (3.9) | 0 (0) | |

[a] Mean ± SD; *n* (%). [b] Wilcoxon rank sum test; Pearson's $\chi^2$ test; Fisher's exact test.

respectively (Appendix A, http://links.lww.com/EJA/B156). Orthopaedic surgery has emerged as the most common type of procedure associated with regional anaesthesia (orthopaedic specialties, see Appendix B, http://links.lww.com/EJA/B156). The proportion of orthopaedic cases increased from 58% in the first decade to 85 and 80% in the second and third decades, respectively. Despite this overall trend, there were no significant sex differences in the distribution of surgical procedures, except in specialties such as gynaecology and urology. Female patients were more likely to undergo emergency surgery (Table 1).

## Anaesthesia management

The analysis of peri-operative anaesthesia management showed no significant sex differences (Table 2). Over the past three decades, there has been a marked improvement in the quality of information and documentation related to planned anaesthetic procedures (Fig. 1). Neuraxial techniques were the most commonly used procedures in closed claims, followed by interscalene blocks. However, a significant trend towards increased use of peripheral regional anaesthesia was observed in the second and third decades (Appendix A, http://links.lww.com/EJA/B156). Notably, over one-third of the cases involved combined anaesthesia or catheter insertion (Table 2).

The introduction of ultrasound-guided regional anaesthesia in the second decade represents a major advance in practice. Adherence to best practice was uneven; however, breaches of best practice occurred in more than half of the cases in both sexes (Table 3). A significant reduction in these breaches has been observed over the last decade. Although this trend was observed in both the neuraxial anaesthesia and peripheral nerve blockade groups, the trend was only significant in the neuraxial group (Fig. 2). Interestingly, the rate of pain during performance and multiple attempts to achieve successful regional anaesthesia was higher in male patients (Table 3).

## Complications and severity of injury

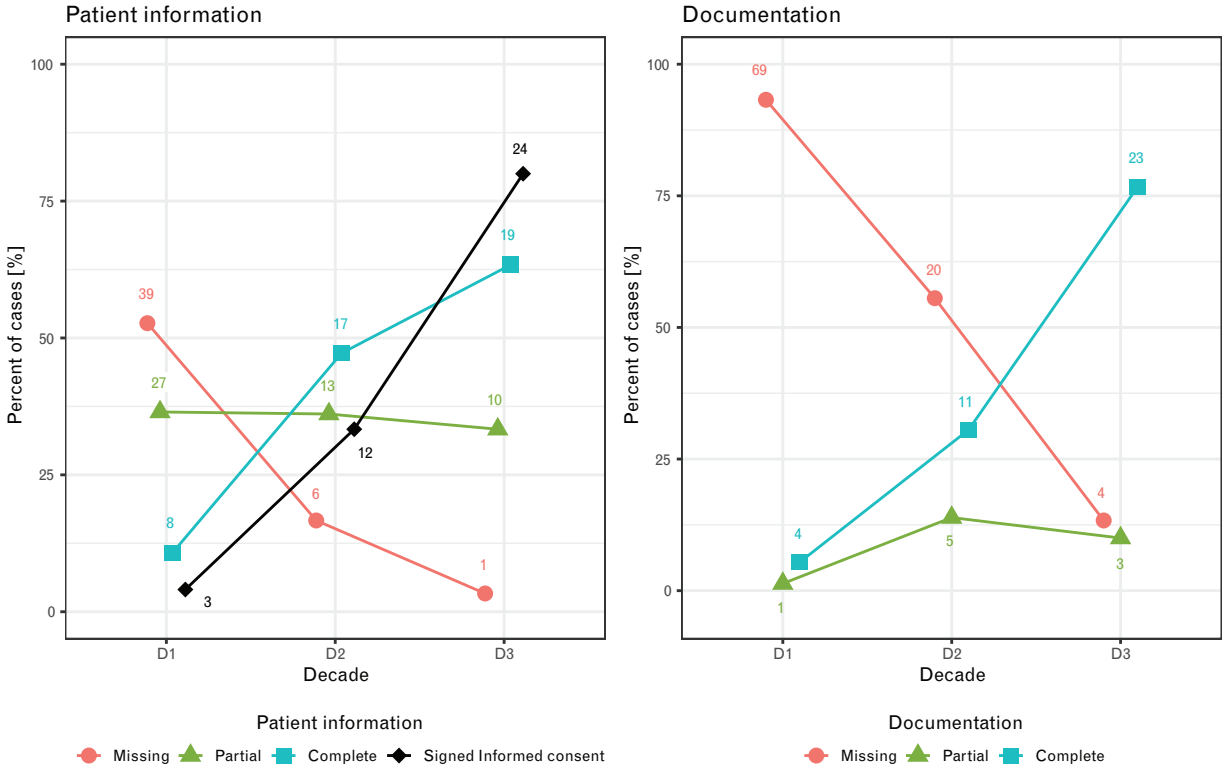
The main complications associated with neuraxial anaesthesia were paraparesis/paraplegia and cauda equina syndrome. In contrast, peripheral regional anaesthesia was dominated by nerve injury (Table 4). Pneumothorax is a specific complication associated exclusively with the infraclavicular and supraclavicular block techniques. Pain syndromes and exacerbation of pre-existing pain were also significant complications for both neuraxial and peripheral regional anaesthesia, with no observed sex differences. However, posttraumatic stress disorder because of the health impairment associated with the liability case has been reported exclusively in female patients. An encouraging trend was observed in the severity of the injury over time. In the first decade, 57% of cases were permanent; this rate decreased significantly to 28% in the following decades. This trend was observed for both neuraxial anaesthesia and peripheral nerve blockade, although it was only significant for the

**Table 2** Peri-operative anaesthesia management

| Characteristic | Overall[a] | Female[a] | Male[a] | *P*[b] |
|---|---|---|---|---|
| Patient information[c] | *n* = 140 | *n* = 77 | *n* = 63 | 0.48 |
| Missing | 46 (33) | 26 (34) | 20 (32) | |
| Partial | 50 (36) | 30 (39) | 20 (32) | |
| Complete | 44 (31) | 21 (27) | 23 (37) | |
| Written and signed informed consent | 39 (28) | 22 (29) | 17 (27) | 0.83 |
| Case documentation | *n* = 140 | *n* = 77 | *n* = 63 | 0.36 |
| Missing | 93 (66) | 51 (66) | 42 (67) | |
| Partial | 9 (7) | 3 (4) | 6 (9) | |
| Complete | 38 (27) | 23 (30) | 15 (24) | |
| Neuraxial anaesthesia | *n* = 76 | *n* = 43 | *n* = 33 | |
| Spinal anaesthesia | 39 (51) | 24 (56) | 15 (45) | 0.37 |
| Epidural anaesthesia | 36 (47) | 18 (42) | 18 (55) | 0.27 |
| Combined anaesthesia (RA + GA) | 20 (27) | 51 (37) | 11 (33) | 0.19 |
| Peripheral nerve block | *n* = 64 | *n* = 34 | *n* = 30 | |
| Interscalene | 25 (39) | 15 (44) | 10 (33) | 0.38 |
| Axillary | 14 (22) | 4 (12) | 10 (33) | 0.04 |
| Femoral | 12 (19) | 5 (15) | 7 (23) | 0.38 |
| Popliteal | 5 (8) | 3 (9) | 2 (7) | >0.99 |
| Supraclavicular | 4 (6) | 3 (9) | 1 (3) | 0.62 |
| Infraclavicular | 4 (6) | 2 (6) | 2 (7) | >0.99 |
| Sciatic | 3 (5) | 1 (3) | 2 (7) | 0.60 |
| Intravenous RA | 1 (2) | 1 (3) | 0 (0) | >0.99 |
| RA technique | *n* = 64 | *n* = 34 | *n* = 30 | |
| Catheter | 49 (76) | 26 (76) | 23 (76) | >0.99 |
| Combined anaesthesia | 31 (48) | 20 (59) | 11 (37) | 0.08 |
| Ultrasound guided | 11 (17) | 6 (18) | 5 (17) | 0.92 |

GA, general anaesthesia; RA, regional anaesthesia. [a] *n* (%). [b] Pearson's $\chi^2$ test; Fisher's exact test. [c] The charts were reviewed to see, if patient information was present and if all aspects were discussed (accordingly, this was categorised into 'missing, partial or complete' information). Furthermore, the charts were reviewed for a present written and signed informed consent.

**Fig. 1** Patient information and documentation per decade.




10-year intervals: decade 1 (D1, 1992 to 2002), decade 2 (D2, 2003 to 2012) and decade 3 (D3, 2013 to 2022). The y-axes show the relative numbers (percentage of cases); the absolute numbers of cases are given as figures within the chart. $P < 0.01$.

neuraxial group (Fig. 3). The severity of injury did not differ by sex (Table 5).

## Consequences: claims and payments

Expert reports were completed in over half of the cases. Interestingly, there was a disparity between the cases in which liability was accepted and where payments were made (Table 6). Although liability is not always accepted, payments are often agreed upon. Over the past three decades, the ratio of accepted liability, expert reports and compensation for neuraxial anaesthesia and peripheral nerve block cases showed no significant differences (Fig. 4, Appendix C, http://links.lww.com/EJA/B156). In terms of sex differences, our analysis did not reveal any significant differences in the rates of expert reports, acceptance of liabilities or payments. However, when looking at compensation amounts, there was a clear trend in the male patient group, with a higher proportion of patients receiving compensation in excess of CHF 100 000. In the multivariate analysis, factors such as working outside best practice, insufficient documentation and the presence of an expert report had the highest odds that liability was accepted (Table 6).

**Table 3** Reasons for claims and quality of anaesthesia performance

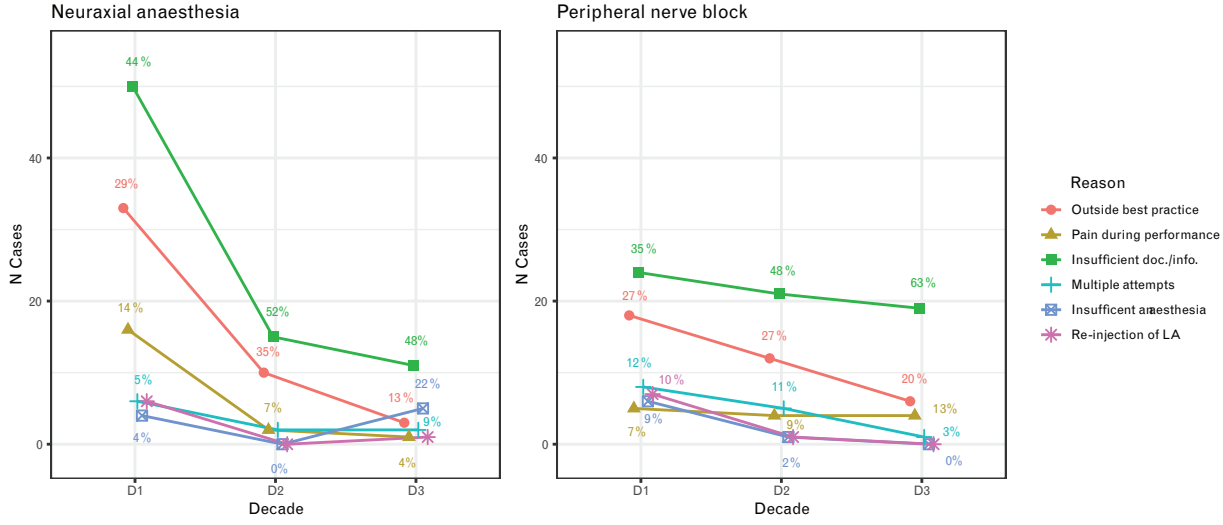
| | *n* (f/m)[a] |
|---|---|
| Neuraxial anaesthesia | 76 (43/33) |
| Outside best practice | 46 (27/19) |
| Pain during performance | 19 (6/13)* |
| Insufficient information | 19 (14/5) |
| Insufficient documentation | 13 (10/3) |
| Multiple attempts | 10 (2/8)** |
| Insufficient anaesthesia | 9 (4/5) |
| Peripheral nerve block | 64 (34/30) |
| Outside best practice | 36 (20/16) |
| Insufficient information | 15 (7/8) |
| Multiple attempts | 14 (5/9) |
| Insufficient documentation | 14 (9/5) |
| Pain during performance | 13 (6/7) |
| Re-injection of LA | 8 (3/5) |

LA, local anaesthetic. [a] *n* (f/m), number (female/male). There was no statistical difference assessed by Pearson's $\chi^2$ test or Fisher's exact test between the sexes ($P > 0.05$) except for 'Pain during performance' (*$P = 0.01$) and 'Multiple attempts' (**$P = 0.02$).

## Discussion

The main aim of this study was to advance the understanding of the medicolegal implications of regional anaesthesia and enhance patient safety by refining anaesthetic practices in Switzerland between 1992 and 2022. A total of 140 cases from our national SACCA database were analysed, with 43% of these cases resulting in liability being accepted by insurance companies. Our findings indicated that the main complication was nerve damage,

**Fig. 2** Nonadherence to best practice for neuraxial anaesthesia (a) and peripheral nerve block (b) per decade.




10-year intervals: decade 1 (D1, 1992 to 2002), decade 2 (D2, 2003 to 2012) and decade 3 (D3, 2013 to 2022). The y-axes show the absolute numbers of cases; the relative numbers (percentage of cases) are written as figures within the chart. $P = 0.02$ and $P = 0.13$, respectively.

accounting for 76% of cases, with 54% of permanent damage overall. Interestingly, this rate has decreased significantly over time, to 28% in the last decade. Our analysis suggested that reinjections into partially anaesthetised areas (subsequent blocks) present a significant risk of nerve damage. The study also revealed that neuraxial procedures resulted in permanent damage more frequently than peripheral nerve blocks. In cases in which documentation and information were insufficient and where treatment did not adhere to the standards valid at the time in Switzerland, compensation was more frequently granted.

**Table 4** Complications

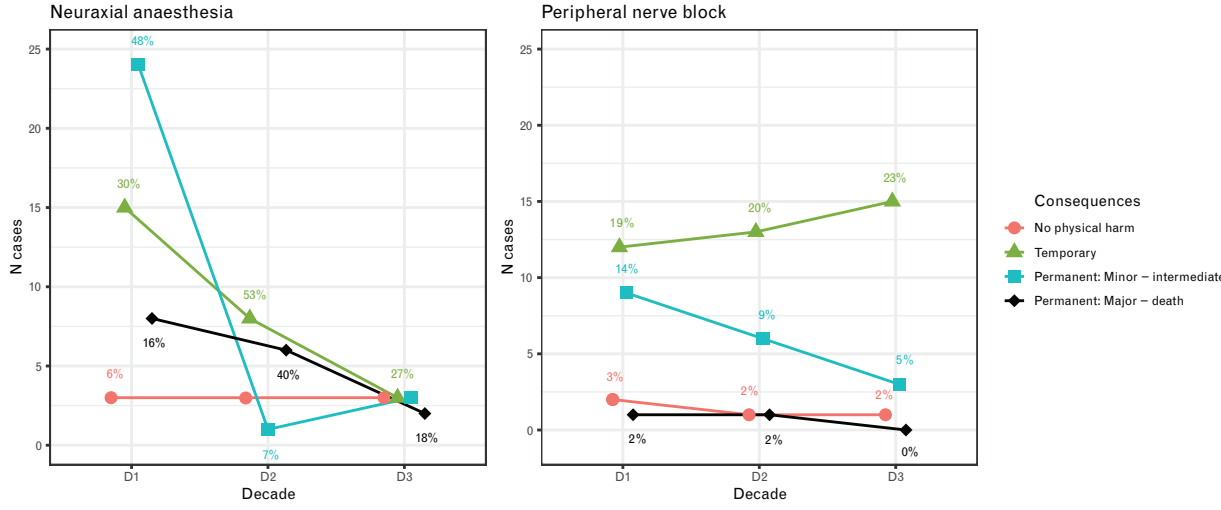
| | *n* (f/m)[a] |
|---|---|
| Neuraxial anaesthesia | 76 (43/33) |
| Paraplegia/paresis[b] | 30 (13/17) |
| Nerve lesion | 15 (7/8) |
| Pain syndrome | 12 (9/3) |
| Post spinal headache | 7 (6/1) |
| Other[c] | 5 (2/3) |
| Haematoma | 4 (3/1) |
| Infection | 4 (2/2) |
| Posttraumatic stress disorder | 3 (3/0) |
| Peripheral nerve block | 64 (34/30) |
| Nerve lesion | 45 (22/23) |
| Pneumothorax | 8 (6/2) |
| Other[c] | 4 (1/3) |
| Pain syndrome | 3 (2/1) |
| Infection | 1 (0/1) |

[a] *n* (f/m), number (female/male). There was no statistical difference assessed by Pearson's $\chi^2$ test or Fisher's exact test between the sexes ($P > 0.05$). [b] Includes cauda equina syndrome ($n = 8$). [c] Other includes burns ($n = 2$), tendon lesion ($n = 1$), sudden hearing loss ($n = 1$), awareness ($n = 1$), intra-operative pain ($n = 1$), Guillain-Barré syndrome ($n = 1$), local anaesthetic intoxication ($n = 1$), death due to anaphylactic shock ($n = 1$).

The SACCA database showed a clear decline in the number of closed claims over time. Notably, approximately half of the cases occurred during the first decade from 1992 to 2002. However, the lower incidence in subsequent years is unlikely to be due to incomplete closure of liability cases in the more recent cases. Instead, advancements in anaesthesia techniques, particularly the introduction of ultrasound-guided procedures, might have reduced complication rates. Enhanced medical training, stronger safety standards and adherence to clinical guidelines, including patient information and documentation (Fig. 3) might also have significantly improved practice safety.[16] Patient selection and risk assessment protocols have been refined to identify and mitigate potential risks more effectively. Furthermore, changes in legal and healthcare reporting environments have also contributed to this trend. New data protection laws might have made the exchange of health information much more challenging. The revised Data Protection Act in Switzerland, based on European Union regulations, strengthens in particular the self-determination of data participants' own data, by obliging data controllers to increase transparency and extending the rights of data participants.[17]

Orthopaedic patients accounted for approximately 80% of the regional anaesthesia-related claims in the SACCA database over the last two decades, with the majority of cases being elective inpatients. Outpatient cases accounted for only 9% of the total cases, which can be attributed to relatively simpler procedures and lower comorbidity rates. In addition, Switzerland ranks at the bottom for outpatient surgical procedures, with just under 20%, according to OECD data from 2007.[18] As in the ASA

**Fig. 3** Severity of injury after neuraxial anaesthesia and peripheral nerve block per decade.




10-year intervals: decade 1 (D1, 1992 to 2002), decade 2 (D2, 2003 to 2012) and decade 3 (D3, 2013 to 2022). The y-axes show the absolute numbers of cases, the relative numbers (percentage of cases) are inserted as figures within the chart. Overall decrease for neuraxial anaesthesia significant but for red line, ratio change: $P = 0.01$. No change over time for peripheral nerve block, no statistical change in ratios vs. time.

closed claims database from 1990 and later, approximately two-thirds of the peripheral nerve block claims are associated with temporary injury. Only one-third resulted in high-severity complications, and approximately half of these injuries were thought to be associated with the block itself.[4,11] Furthermore, in both the SACCA and the ASA database, around 40% of all cases involving peripheral regional anaesthesia are associated with interscalene block. This technique is more prone to regional nerve complications because of the proximity of critical neural structures, such as the phrenic nerve, sympathetic chain, the spinal cord with its spinal nerves which can be inadvertently affected during needle placement or by the spread of local anaesthetic.

The incidence of nerve damage reported in this study likely underestimated the actual incidence associated with regional anaesthesia. Rather, it highlights a potential area of critical adverse events and underscores the need for strategies to reduce the risk of such complications in the future. Regarding the evolution of puncture techniques over time, our results indicate advancements in regional anaesthesia, including the introduction of ultrasound-guided techniques offering potential advantages, such as higher success rates and reduced complications.[19] However, no technique has proven superior in preventing nerve damage. The study's findings on reinjections in partially anesthetised areas contributing significantly to nerve damage align with existing concerns in the

**Table 5** **Severity of injury**

| | Overall | Female | Male | *P*[a] |
|---|---|---|---|---|
| Neuraxial anaesthesia | *n* = 76 | *n* = 43 | *n* = 33 | |
| *Severity of injury* | | | | 0.67 |
| A no physical harm | 6 (8) | 3 (7) | 3 (10) | |
| B temporary | 26 (34) | 16 (37) | 10 (30) | |
| C permanent minor to intermediate | 28 (37) | 17 (40) | 11 (33) | |
| D permanent major to death[b] | 16 (21) | 7 (16) | 9 (27) | |
| Peripheral nerve block | *n* = 64 | *n* = 34 | *n* = 30 | |
| *Severity of injury* | | | | 0.12 |
| A no physical harm | 4 (6) | 4 (12) | 0 (0) | |
| B temporary | 40 (63) | 19 (56) | 21 (70) | |
| C permanent minor to intermediate | 18 (28) | 9 (26) | 9 (30) | |
| D permanent major to death[c] | 2 (3) | 2 (6) | 0 (0) | |

Data are *n* (%). To facilitate readability and comprehensibility, the Severity of Injury Score (SIS) was condensed into four categories: A, no physical injury (SIS 0-1); B, temporary injury (SIS 2-4); C, permanent mild to intermediate injury (SIS 5-6); D, permanent serious injury including death (SIS 7-9). [a] Fisher's exact. [b] Permanent paraplegia after epidural anaesthesia (*n* = 12), permanent paraplegia after spinal anaesthesia (*n* = 2), aseptic myelitis after epidural anaesthesia (*n* = 1), death due to anaphylactic shock after epidural anaesthesia (*n* = 1). [c] Permanent arm palsy (*n* = 2).

**Table 6** Overall consequences by sex (a) and multivariate model with variables having an influence on liability acceptance (b)

| | Overall | Female | Male | *P* |
|---|---|---|---|---|
| **a) Overall consequences** | n = 140 | n = 77 | n = 63 | |
| Expert report present | 76 (54) | 40 (52) | 36 (57) | 0.54 |
| Liability accepted | 60 (43) | 31 (40) | 29 (46) | 0.49 |
| Compensation made | 64 (46) | 32 (42) | 32 (51) | 0.28 |
| Payment without liability confirmed | 14 (10) | 9 (12) | 5 (8) | 0.46 |
| Compensation ≥CHF 100'000.- | 16 (28) | 4 (15) | 12 (39) | 0.05 |
| **b) Multivariate analysis for** | **OR (95% CI)** | | | ***P*** |
| **Liability accepted** | | | | |
| Outside best practice | 14.72 (4.98 to 53.15) | | | <0.01 |
| Insufficient documentation | 10.35 (2.42 to 63.97) | | | 0.01 |
| Expert report present | 4.46 (1.63 to 13.09) | | | 0.01 |
| Male sex | 2.49 (0.92 to 7.16) | | | 0.08 |
| Paraplegia | 0.30 (0.06 to 1.31) | | | 0.12 |
| Peripheral nerve blockade | 0.25 (0.07 to 0.76) | | | 0.02 |
| Pain Syndrome | 0.24 (0.04 to 1.33) | | | 0.11 |

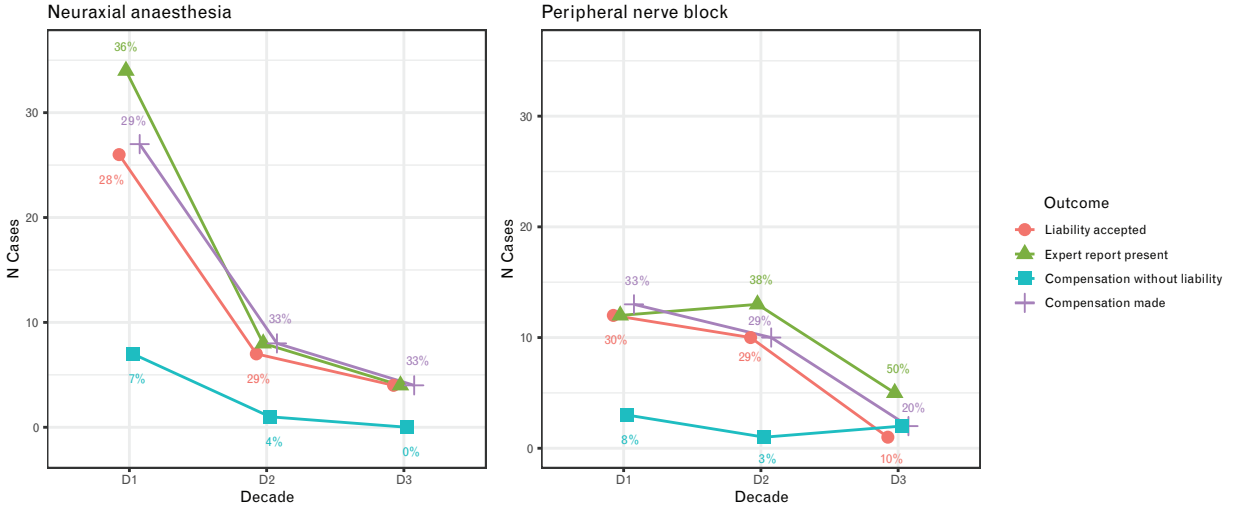
Data are odds ratio, OR (95% CI). CI, confidence interval

anaesthesia community. This practice should be approached with caution and avoided when alternative strategies are available.

Nonadherence to standards frequently leads to compensation claims, highlighting the need for rigorous training and adherence to current regional anaesthesia guidelines. This also underscores the medicolegal and ethical risks of deviating from standard procedures. In addition, structured, reliable and empathetic communication with the patient plays a crucial role in reducing errors, complications and litigation. Effective communication enhances patient-physician relation, leading to fewer misunderstandings, greater patient satisfaction, and a lower risk of legal challenges, while poor communication may increase medico-legal risks.[20]

In our patient population, male patients underwent regional anaesthesia with multiple attempts to achieve successful regional anaesthesia and pain during performance more frequently than female patients. But the complication rate and severity of injury did not statistically differ between both sexes. However, male patients tended to have higher rates of nerve injuries, while female patients reported more nonspecific pain syndromes and posttraumatic stress disorders. Although no difference in accepted liability and compensation was found, there was a trend that men received higher compensation levels. The issue of compensation in medical malpractice cases, particularly concerning women, is complex and varies by jurisdiction. However, there are indications that women, especially those who are not in the workforce or have lower incomes, may face challenges

**Fig. 4** Claims and payments after neuraxial anaesthesia and peripheral nerve block per decade.




10-year intervals: decade 1 (D1, 1992 to 2002), decade 2 (D2, 2003 to 2012) and decade 3 (D3, 2013 to 2022). The y-axes show the absolute numbers of cases, the relative numbers (percentage of cases) are inserted as figures within the chart. Decrease in outcomes significant: $P < 0.01$, no change in ratios.

in terms of obtaining equitable compensation. For example, caps on noneconomic damage in medical malpractice cases can disproportionately affect women. These caps often limit the amount that can be recovered for noneconomic losses such as pain and suffering, which do not directly correspond to lost wages or medical expenses. As women still undertake the majority of unpaid work at home, their noneconomic damage can be undervalued in these cases. This is especially impactful for stay-at-home mothers or elderly women, who might not have significant economic damage but suffer considerable noneconomic harm due to medical negligence.[21]

Several limitations of this study should be considered when interpreting its results. Firstly, a major limitation of this study is its reliance on closed liability cases, which do not represent the true incidence of nerve damage due to underreporting and cases settled without involving insurance companies. It also signifies that while the data provided indicate certain potential causes, for example ultrasound-guided techniques may have improved patient outcomes and reduced complications, a direct correlation remains unproven. Secondly, in clinical practice, it is often very difficult to point out the exact cause of nerve damage, as there are multiple possibilities apart from the nerve block, like a tourniquet, positioning, patient factors or surgical trauma itself. From our database, we could only analyse nerve injuries that were associated with regional anaesthesia. We do not have data on these other factors and cannot comment on nerve injuries occurring with solely general anaesthesia. Thirdly, owing to differences in international medical and legal practice, it is important to exercise caution when comparing our data with those of other nations. These limitations highlight the need for broader epidemiological studies and systematic reporting to understand better the true incidence and risk factors associated with regional anaesthesia. Future research should focus on long-term, large-scale epidemiological studies to provide a more comprehensive understanding of the risks associated with different regional anaesthesia techniques. In addition, exploring the impact of current localisation techniques such as ultrasound-guided needling on complication rates would be valuable.

## Conclusion

This 30-year analysis of closed claim cases of regional anaesthesia provides valuable insights into the complications associated with regional anaesthesia in Switzerland, particularly the risk of nerve damage. By analysing past closed claims, we can develop improved strategies for risk mitigation and enhance patient safety in regional anaesthesia. Actionable strategies for reducing complications and claims are communication and training best practice in regional anaesthesia, including sufficient patient information and documentation. Pain during the procedure, multiple attempts and re-injections should be avoided whenever possible. In addition, adherence to practice advice in situations of postoperative nerve injury, such as guidelines from ASRA or RA-UK,[22,23] may improve quality of care and further reduce the risk of legal consequences. Our findings underscore the importance of continued research to understand better the risks associated with various anaesthetic techniques and to develop effective strategies to mitigate these risks.

## Acknowledgments relating to this article

Assistance with the study: Ganter: Conceptualisation, investigation, methodology, formal analysis, validation, writing/reviewing, editing and revising of the manuscript.

Girard: Conceptualisation, investigation, methodology, formal analysis, validation, reviewing and editing of the manuscript.

Stadelmann: Methodology, formal analysis, visualisation, reviewing, editing and revising the manuscript.

Rehberg-Klug, Staender: Conceptualisation, investigation, methodology, reviewing and editing the manuscript.

Hofer: Conceptualisation, investigation, methodology, formal analysis, validation, writing/reviewing, editing and revising of the manuscript.

All authors read and approved the final manuscript

Financial support and sponsorship: none.

Conflicts of interests: none.

Presentation: none.

Data sets are available in the protected area on a server of the SSAPM or by direct contact with the corresponding author.

This manuscript was handled by Michele Carella.

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