**ISSN: 1607-8322, e-ISSN: 2220-5799** **Anaesthesia, Pain & Intensive Care**
Vol 26(3); June 2022 DOI: 10.35975/apic.v26i3.1914

**ORIGINAL RESEARCH** **PERIOPERATIVE MEDICINE**

# A multinational online survey on the current perioperative practice for the management of patients with diabetes mellitus: a descriptive study

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## Abstract

**Background & Objective:** Diabetes mellitus is widely prevalent and significantly impacts the perioperative outcome. We aimed to assess the perioperative practice for managing diabetes mellitus patients and variation across different establishments.

**Methodology:** A questionnaire-based online survey was conducted for the present cross-sectional, multinational study; data collection followed a snowball method and was conducted from November 2020 to January 2021. Responses were presented in absolute number and percentage scale, and response rates among the subgroups were analyzed using Fisher's exact test; $p < 0.05$ was considered significant.

**Results:** Responses from 556 out of 637 from six South Asian Association for Regional Cooperation countries were analyzed. A considerable amount of practice variation was noted; variation increased as the invasiveness of surgery increased. Perioperative insulin administration strategy and case postponement based on blood sugar level differed between the teaching and non-teaching sectors and private and public sectors. However, a majority (64.8%) of the respondents did not favor postponing a case based on the glycosylated hemoglobin (HbA1c) level. Confusion and diverse opinions were present even for emergency cases, including postponement based on blood sugar.

**Conclusion:** There is a wide variation in the perioperative practice for managing diabetes mellitus patients. The variation increases with the increasing invasiveness of surgery. Although there were similar practices between private versus public sectors and teaching versus non-teaching institutions, significant differences were noticed about case postponement, indicating that an authoritative guideline is the need of the hour.

**Key words**: HbA1c level; Sugar, Cut-off; Sugar level; Anesthesia; Perioperative practice; Hyperglycemia

**Trial Registration**: The study was an online survey and as per the clinical trial registry of India, it was not required to be registered.

**Citation**: Karim HMR, Sharma A, Khan TH, Abayadeera AU, Alam MR. A multinational online survey on the current perioperative practice for the management of patients with diabetes mellitus: a descriptive study. Anaesth. pain intensive care 2022;26(1):382-390. DOI: 10.35975/apic.v26i3.1914

**Received:** April 27, 2021; **Reviewed:** October 11, 2021; **Accepted:** December 16, 2021

 

# 1. Introduction

Adequate management of perioperative hyperglycemia is important in the practice of anesthesia as it is associated with increased morbidity and mortality. [1, 2] Diabetes mellitus (DM) is one of the most important causes of perioperative hyperglycemia and glycemic variability. It has also been found that hyperglycemia in diabetic patients is one of the reasons for the postponement of elective surgical cases on the day of surgery. [3] Although there is no robust evidence-based guideline or recommendation for managing such patients in the perioperative period, many reviews. [4, 5] and one practice guideline from the Society for Ambulatory Anesthesia are well accepted in the literature. [6] A recent survey conducted in Canada found that the practice variation is still there. [7] All this indicates that the scope for further refinement of the practice is still there. It is imperative to know the conventional methods being used in our countries and their limitations. Therefore, a survey was needed to enable us to document the current practice and help the anesthesiologists formulate a better perioperative healthcare delivery plan in the future. The present survey was aimed to find out the current practice, issues, or problems in the perioperative management of diabetic patients in our countries.

# 2. Methodology

The present cross-sectional, descriptive, multinational survey was conducted from February 2019 to May 2020. The study reporting follows 'Standards for Reporting Qualitative Research' (SRQR) to enhance the quality and transparency of health research. Permission to conduct the study was obtained from institutional research ethical boards, and Indian Council of Medical Research. Further, the study was also approved by the Health Ministry Screening Committee of the Government of India, regarding data sharing. Survey did not require registration as per the clinical trial registry in India. The survey was conducted through electronic communication and was created and conducted using an online cloud-based survey tool - SurveyMonkey (www.surveymonkey.com). The primary investigator developed the draft questionnaire, revised by a co-investigator and edited by other co-investigators. The draft was developed based on a previously conducted survey. [7] The questions were open-ended wherever applicable. [8]] and complied with the[ SURGE guidelines. [9] The draft questionnaire was submitted to the institutional research board for review and finalized as per suggested modifications. The approved questionnaire tool was further subjected to a pilot survey with a few participants for validation regarding relevance, simplicity, clarity, and ambiguity, where the questionnaire scored 90% and above with favorable responses for all questions. The final questionnaire consisted of specific aspects of workplace information about the practitioner's hospital and country, including the type of practice; regarding perioperative management of oral hypoglycemic agents, insulin use, and blood sugar levels accepted for routine and emergency surgeries (Annexure 1).

The study was planned based on a survey with similar intent, which showed 50% uniformity with their policy. [7] We, therefore, expected a 50% variation in the practice. The sample was calculated for a finite population (i.e., anesthesiologists of 20,000) with an absolute precision of 5%. A design effect of 1.4 was added for the non-randomized nature of sampling, which gave a sample size of 528 for a 95% confidence level. We added a 5% margin for incomplete data. It added up to a sample size of 555. Online epidemiological tool OpenEpi version 3 (Open-Source Epidemiologic Statistics for Public Health; http://www.openepi.com) was used for calculating the sample size. However, if the number of responses crossed 555 before two months, it was decided not to stop the recruitment/sampling/data collection until two months and include those extra responses. It was also pre-decided that if the number of responses do not reach 555 in two months, we will recirculate the link and extend the data collection for one more month. Furthermore, to represent the data from countries other than India, at least 20 responses from Nepal and Sri Lanka and 30 from Bangladesh and Pakistan were targeted before concluding the data collection process.

We included anesthesiologists having a recognized anesthesia qualification and trainee anesthesiologists undergoing training in recognized anesthesia courses (residents) in India, Bangladesh, Nepal, Pakistan, and Sri Lanka. Nurse anesthetists, anesthesia technicians, and non-anesthesiologist physicians practicing anesthesia

**Table 1: Distributions of residents and qualified anesthesia practitioners expressed in number and percentage scale**

| Country / category | Total | Anesthesiologists | Residents | P-value |
|---|---|---|---|---|
| India | 456 | 418 (91.67) | 38 (8.33) | 0.530 |
| Pakistan | 30 | 26 (86.67) | 4 (13.33) | |
| Bangladesh | 19 | 16 (84.21) | 3 (15.79) | |
| Nepal | 25 | 24 (96.0) | 1 (4.0) | |
| Sri Lanka | 24 | 20 (83.33) | 4 (16.67) | |
| Bhutan | 2 | 2 (100.0) | 0 (0.00) | |

Data presented as n (%)

 

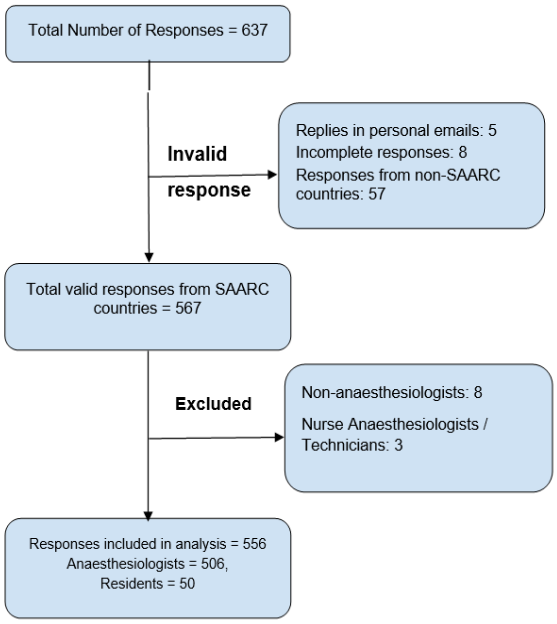


**Figure 1: Response collection and analysis flow diagram**

were excluded. The data collection followed a snowball method. An email with a link to the online survey was sent to the anesthesiologists of the mentioned countries. The link was also posted and forwarded to the different WhatsApp groups of anesthesiologists. The participation was voluntary, and an online implied consent was taken. Reminder emails and WhatsApp requests were sent to potential respondents for two weeks. Responses were collected anonymously; the participant's name or the institute at which he/she is working was not collected.

Response data were directly downloaded as an Excel master chart (Microsoft Corporation, Washington, United States) and processed for grossly incomplete and duplicate responses for exclusion from analysis and apparent discrepancy for possible correction. The cohort was then sub-grouped based on the workplace, e.g., public sector versus private sector and teaching versus non-teaching institutions.

### Statistical analysis

Responses were calculated as absolute numbers and percentage scale as required for further analysis. Statistical analysis of the data was done using INSTAT software (GraphPad Software Inc™, La Jolla, California, United States). Appropriate statistical tests were used based on the distribution of the data (k-test) and the number of subgroups. If any subgrouping had data of less than or equal to five, Fisher's exact test was used. A two-tailed P-value was to be considered, and $P < 0.05$ was considered significant.

## 3. Results

We received 637 responses during the study period. After removing invalid responses and meeting the exclusion criteria, 556 responses were included in the final analysis, as presented in Figure 1.

Responses from six South Asian Association for Regional Cooperation (SAARC) countries (India, Pakistan, Bangladesh, Nepal, Sri Lanka, and Bhutan) were available for final analysis. Most responses were from India, and most were qualified practicing anesthesiologists, as shown in Table 1. Although the percentage of residents was different across the countries, the difference was statistically insignificant (Table 1).

The respondent's workplace in context to funding; e.g., public sector vs private sector was almost similar, 283 (50.9%) vs 273 (49.1%). The majority, 390 out of 556 (70.14%) respondents, worked in teaching institutions. The work nature and workplace of respondents are presented in Figure 2.

The clinical practice trends in the perioperative management of oral hypoglycemic agents (OHA) in diabetic patients differed based on the invasiveness of the surgery. In minor and intermediate surgeries: a vast majority (80.7%) of the respondents indicated that they continued OHA till the night before surgery and omitted the dose on the morning of surgery. In major surgeries,

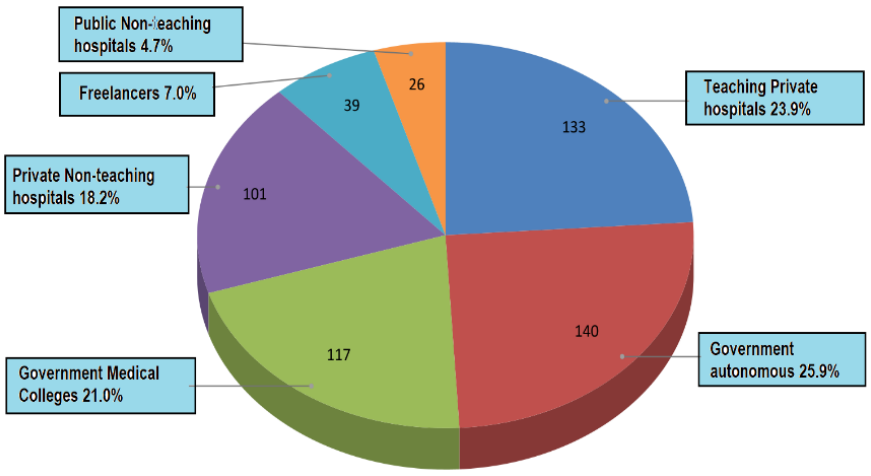


**Figure 2: Work and workplace of the respondents**

 

**Table 2: Comparative analysis of the respondents' responses working in private and public sectors.**

| Parameters / Questions with options | All | Public | Private | P |
|---|---|---|---|---|
| **Do you routinely start insulin the day before surgery in a patient on OHA?** | [N = 555] | [N = 282] | [N = 273] | |
| Yes | 92 (16.58) | 51 (18.09) | 41 (15.02) | 0.361 |
| No | 463 (83.42) | 231 (81.91) | 232 (84.98) | |
| **If you start insulin the day before surgery in a patient on OHA – what method do you follow?** | [N = 536] | [N = 272] | [N = 264] | |
| Sliding scale | 401 (74.81) | 196 (72.06) | 205 (77.65) | 0.163 |
| Variable rate insulin infusion | 104 (19.40) | 60 (22.06) | 44 (16.67) | 0.126 |
| Basal bolus | 31 (5.79) | 16 (5.88) | 15 (5.68) | 1.000 |
| **If the patient was on insulin, what do you practice for the night before the surgery dose?** | [N = 549] | [N = 281] | [N = 268] | |
| No change in the dose | 171 (31.15) | 83 (29.54) | 88 (32.84) | 0.408 |
| insulin specific management | 280 (51.00) | 145 (51.60) | 135 (13.06) | 0.798 |
| Dose reduced to 50-75% | 98 (17.85) | 53 (18.86) | 45 (54.10) | 0.577 |
| **If the patient was on insulin, what is your routine for the morning of the surgery dose?** | [N = 549] | [N = 280] | [N = 269] | |
| No change in the dose | 25 (4.55) | 16 (5.71) | 9 (3.35) | 0..221 |
| Omit insulin | 414 (75.41) | 214 (76.42) | 200 (74.35) | 0.620 |
| Dose reduced to 75% | 21 (3.83) | 10 (3.57) | 11 (4.09) | 0.825 |
| Dose reduced to 50% | 89 (16.21) | 40 (14.29) | 49 (18.21) | 0.246 |
| **What do you do with blood sugar level of 215-400 mg% the night before surgery?** | [N = 553] | [N = 281] | [N = 272] | |
| Reschedule the surgery to another day | 191 (34.54) | 113 (40.21) | 78 (28.68) | 0.005 |
| Shift the patient to HDU/ICU and control (a) | 185 (33.45) | 89 (31.67) | 96 (35.29) | 0.369 |
| Increase insulin dose and manage in the ward (b) | 142 (25.68) | 56 (19.93) | 86 (31.62) | 0.001 |
| Others | 35 (6.33) | 23 (8.19) | 12 (4.41) | 0.080 |
| (a) + (b) | 327 (59.13) | 145 (51.60) | 182 (66.91) | 0.0003 |
| **What do you do to the cases with the morning of the surgery blood sugar level of 180 - 215mg% planned for noncardiac surgery?** | [N = 551] | [N = 279] | [N = 272] | |
| Postpone the case | 50 (9.07) | 30 (10.75) | 20 (7.35) | 0.183 |
| Start the case with insulin infusion | 330 (59.89) | 171 (61.29) | 159 (58.46) | 0.543 |
| Start the case without insulin | 153 (27.77) | 68 (24.37) | 85 (31.25) | 0.086 |
| Others | 18 (3.27) | 10 (3.59) | 8 (2.94) | 0.811 |
| **At what Blood sugar level do you postpone an elective noncardiac case?** | [N = 556] | [N = 283] | [N = 273] | |
| 140-180 mg% | 7 (1.26) | 6 (2.12) | 01 (0.37) | 0.123 |
| > 180-215 mg% | 55 (9.89) | 32 (11.31) | 23 (8.42) | 0.260 |
| 216 - 400 mg% | 348 (69.06) | 187 (66.08) | 161 (58.97) | 0.095 |
| > 400 mg% | 136 (24.46) | 55 (19.43) | 81 (29.67) | 0.005 |
| > 500 mg% | 7 (1.26) | 1 (0.35) | 6 (2.19) | 0.123 |
| Blanks (No response) | 3 (0.54) | 2 (0.71) | 1 (0.37) | 1.000 |
| **At what level of Blood sugar level do you postpone an urgent noncardiac case?** | [N = 556] | [N = 283] | [N = 273] | |
| 140 - 215 mg% | 8 (1.44) | 3 (1.06) | 5 (1.83) | 0.497 |
| 216 - 400 mg% | 92 (16.55) | 50 (17.67) | 42 (15.38) | 0.494 |
| > 400 mg% | 319 (57.37) | 175 (61.84) | 144 (52.75) | 0.032 |
| > 500 mg% | 129 (23.20) | 50 (17.67) | 79 (28.94) | 0.001 |
| Blanks (No response / No postponement) | 8 (1.44) | 5 (1.76) | 03 (1.10) | 0.497 |

 

**Table 2: Comparative analysis of the respondents' responses working in private and public sectors (Contd.)**

| Parameters / Questions with options | All | Public | Private | P |
|---|---|---|---|---|
| **At what level of Blood sugar level do you postpone an emergency noncardiac case?** | [N = 556] | [N = 283] | [N = 273] | |
| 140 - 215 mg% | 4 (0.72) | 2 (0.71) | 2 (0.73) | 1.000 |
| 216 - 400 mg% | 44 (7.91) | 33 (11.66) | 11 (4.03) | 0.0009 |
| > 400 mg% | 271 (48.74) | 127 (44.88) | 144 (52.75) | 0.074 |
| > 500 mg% | 221 (39.75) | 112 (39.58) | 109 (39.93) | 1.000 |
| Blanks (No response / No postponement) | 16 (2.88) | 9 (3.18) | 07 (2.54) | 0.801 |
| **Do you postpone a case based on HbA1C?** | [N = 551] | [N = 279] | [N-272] | |
| Yes | 194 (35.21) | 116 (42.65) | 78 (28.68) | 0.001 |
| No | 357 (64.79) | 163 (58.42) | 194 (31.32) | |
| **If you were to postpone a case based on HbA1C – what would be the level?** | [N = 437] | [N = 220] | [N = 217] | |
| 6.5-8% | 22 (5.03) | 13 (5.91) | 9 (4.15) | 0.512 |
| > 8-9% | 102 (23.34) | 59 (26.82) | 43 (19.82) | 0.090 |
| > 9% | 313 (71.63) | 148 (67.27) | 165 (76.03) | 0.044 |
| **Do you routinely ask for serum K+ on the morning of surgery in patients on insulin?** | [N = 554] | [N = 281] | [N = 273] | |
| Yes | 384 (69.31) | 209 (74.38) | 175 (64.10) | 0.009 |
| No | 170 (30.69) | 72 (25.62) | 98 (35.90) | |

54.1% of respondents preferred to hold the OHA a day before surgery and convert the management to parenteral insulin; 40.6% of the respondents preferred to continue OHA until the day before surgery and not to change to insulin. Further, 83.4% of respondents did not practice routine insulin administration the day before surgery in a patient taking OHA. If used, 72.1% of respondents preferred to use a sliding scale insulin management strategy preoperatively (please see annexure for the definitions and descriptions of the terms used for this survey).

When patients were already on insulin and are planning for surgery, 50.7% of our respondents preferred insulin specific management. Other respondents either did not change the dose of insulin (30.9%) or reduced the dose to 75-80% of the regular dose (18.29%). On the day of surgery, 75.4% preferred to omit the dose of insulin.

Serum potassium monitoring might be one of the critical components of perioperative DM and insulin management, and 69.3% of our respondents preferred to do routine monitoring of serum potassium levels on the morning of surgery for patients on insulin.

The practice of proceeding with scheduled elective cases also varied widely depending on the blood sugar levels. If the blood sugar level on the night before surgery was between 215 and 400 mg/dL on the night before surgery, 34.5% of respondents generally preferred to postpone the elective surgery. However, the majority of the respondents still preferred to continue on the scheduled day by modifying the management; 33.4% transferred the patient to a high dependency unit of an ICU and start on insulin infusion, and 25.6% would increase the dose of insulin and monitor the patients in the wards. If the blood sugar level was between 180 and 215 mg% on the morning of the surgery, the majority (87.65%) generally took up the case for surgery. In such cases, some (27.7%) respondents took up the case without insulin infusion, whereas others (59.8%) continued with the case at the scheduled time and started an insulin infusion.

Most of our respondents (62.9%) believe that elective noncardiac surgery should be postponed when the blood sugar is more than 216 mg%; however, 24.5% would only postpone elective surgery when the blood sugar was more than 400 mg%. In urgent or emergent surgery, the majority would postpone the surgery only when the blood sugar is more than 400 mg%. However, most (64.8%) of the Anesthesiologists would not postpone a case based on HbA1c. Out of those who would postpone, 73.1% of the respondents would postpone when the HBA1c was above 9%.

The choice of intravenous fluids in the perioperative period also varied a lot; 41% preferred both normal saline and lactated Ringer's solution, 28.6% normal saline only, 14% Lactated Ringer's solution, 8.2% normal saline with potassium supplement, and others used balanced salt solutions. The responses for the

 

**Table 3: Comparative analysis of the responses from teaching and non-teaching institutions**

| Parameters | All | Teaching | Non-teach | P-value |
|---|---|---|---|---|
| **Do you routinely start insulin the day before surgery in a patient on OHA?** | [N = 555] | [N = 389] | [N = 166] | |
| Yes | 92 (16.58) | 66 (16.97) | 26 (15.66) | 0.803 |
| No | 463 (83.42) | 323 (83.03) | 140 (84.34) | |
| **If you start insulin the day before surgery in a patient on OHA – what method do you follow?** | [N = 536] | [N = 375] | [N = 161] | |
| Sliding scale | 401 (74.81) | 270 (72.00) | 131 (81.37) | 0.022 |
| Variable-rate insulin infusion | 84 (15.67) | 79 (21.07) | 5 (3.10) | < 0.0001 |
| Basal bolus | 51 (9.52) | 26 (6.93) | 25 (15.53) | 0.003 |
| **If the patient was on insulin, what do you practice for the night before the surgery dose?** | [N = 552] | [N = 386] | [N = 166] | |
| No change in the dose | 171 (30.98) | 113 (29.27) | 58 (34.94) | 0.193 |
| Insulin specific management | 232 (42.03) | 202 (52.33) | 30 (18.07) | < 0.0001 |
| Dose reduced to 50-75% | 149 (26.99) | 71 (18.39) | 78 (46.99) | < 0.0001 |
| **If the patient was on insulin, what do you practice routinely for the morning of the surgery dose?** | [N = 549] | [N = 386] | [N = 163] | |
| No change in the dose | 25 (4.55) | 22 (5.70) | 3 (1.84) | 0.070 |
| Omit insulin | 414 (75.41) | 289 (74.87) | 125 (76.68) | 0.745 |
| Dose reduced to 75% | 31 (5.64) | 12 (3.11) | 9 (5.53) | 0.222 |
| Dose reduced to 50% | 89 (16.20) | 63 (16.32) | 26 (15.95) | 1.000 |
| **What do you do to the cases with the night before surgery blood sugar level of 215 – 400 mg%?** | [N = 553] | [N = 388] | [N = 165] | |
| Reschedule the surgery to another day | 191 (34.54) | 136 (35.05) | 55 (33.33) | 0.769 |
| Shift the patient to HDU/ICU and control | 185 (33.45) | 122 (31.44) | 63 (38.18) | 0.139 |
| Increase insulin dose and manage in the ward | 142 (25.68) | 100 (25.77) | 42 (25.45) | 1.000 |
| Others | 35 (6.33) | 30 (7.74) | 5 (3.04) | 0.037 |
| **How do you manage morning of the surgery blood sugar of 180 -215 mg% for noncardiac surgery?** | [N = 551] | [N = 385] | [N = 166] | |
| Start the case with insulin infusion | 50 (9.07) | 35 (9.09) | 15 (9.04) | 1.000 |
| Start the case without insulin | 330 (59.89) | 237 (61.56) | 93 (56.02) | 0.255 |
| Others | 153 (27.77) | 102 (26.49) | 51 (30.72) | 0.350 |
| | 18 (3.27) | 11 (2.86) | 7 (4.22) | 0.437 |
| **At what level of Blood sugar level you postpone an elective non-cardiac case?** | [N = 556] | [N = 390] | [N = 166] | |
| 140-180 mg% | 7 (1.26) | 7 (1.79) | 0 | 0.109 |
| > 180-215 mg% | 55 (9.89) | 38 (9.75) | 17 (10.24) | 0.877 |
| 216 – 400 mg% | 348 (62.59) | 250 (64.10) | 98 (59.04) | 0.292 |
| > 400 mg% | 136 (24.46) | 88 (22.56) | 48 (28.92) | 0.131 |
| > 500 mg% | 7 (1.26) | 4 (1.03) | 3 (1.80) | 0.431 |
| Blanks (No response) | 3 (0.54) | 3 (0.77) | 0 | 0.558 |
| **At what level of Blood sugar level you postpone an urgent non-cardiac case?** | [N = 556] | [N = 390] | [N = 166] | |
| 140 – 215 mg% | 8 (1.44) | 5 (1.28) | 3 (1.80) | 0.701 |
| 216 – 400 mg% | 92 (16.55) | 58 (14.87) | 34 (20.49) | 0.106 |
| > 400 mg% | 319 (57.37) | 232 (59.49) | 87 (52.41) | 0.134 |
| > 500 mg% | 129 (23.20) | 88 (22.56) | 41 (24.70) | 0.584 |
| Blanks (No response / No postponement) | 8 (1.44) | 7 (1.79) | 1 (0.60) | 0.446 |

 

**Table 3: Comparative analysis of the respondents' responses working in teaching and non-teaching institutions (Contd.)**

| Parameters | All | Teaching | Non-teach | P-value |
|---|---|---|---|---|
| **At what level of Blood sugar level do you postpone an emergency noncardiac case?** | [N = 556] | [N = 283] | [N = 273] | |
| 140 - 215 mg% | 4 (0.72) | 2 (0.71) | 2 (0.73) | 1.000 |
| 216 - 400 mg% | 44 (7.91) | 33 (11.66) | 11 (4.03) | 0.0009 |
| > 400 mg% | 271 (48.74) | 127 (44.88) | 144 (52.75) | 0.074 |
| > 500 mg% | 221 (39.75) | 112 (39.58) | 109 (39.93) | 1.000 |
| Blanks (No response / No postponement) | 16 (2.88) | 9 (3.18) | 07 (2.54) | 0.801 |
| **Do you postpone a case based on HbA1C?** | [N = 551] | [N = 279] | [N-272] | |
| Yes | 194 (35.21) | 116 (42.65) | 78 (28.68) | 0.001 |
| No | 357 (64.79) | 163 (58.42) | 194 (31.32) | |
| **If you were to postpone a case based on HbA1C – what would be the level?** | [N = 437] | [N = 220] | [N = 217] | |
| 6.5-8% | 22 (5.03) | 13 (5.91) | 9 (4.15) | 0.512 |
| > 8-9% | 102 (23.34) | 59 (26.82) | 43 (19.82) | 0.090 |
| > 9% | 313 (71.63) | 148 (67.27) | 165 (76.03) | 0.044 |
| **Do you routinely ask for serum K+ on the morning of surgery in patients on insulin?** | [N = 554] | [N = 281] | [N = 273] | |
| Yes | 384 (69.31) | 209 (74.38) | 175 (64.10) | 0.009 |
| No | 170 (30.69) | 72 (25.62) | 98 (35.90) | |

different options in the different aspects of the questions varied among the consultants as well.

The subgroup analysis of responses from the participants working in private vs. public sectors showed that the practice patterns were almost similar, except the private hospital practitioners accepted a significantly higher blood sugar level (Table 2). The difference between teaching and non-teaching was insignificant except for insulin management, when teaching institute practitioners used significantly higher variable rates and insulin-specific management in the perioperative period (Table 3).

# 4. Discussion

The present survey highlights two critical aspects. First, the extreme variation of practice trends in the perioperative management of OHA, insulin, and blood sugar levels triggers case postponement in DM patients. The variation was based on the invasiveness of surgery and the type of insulin used. Most practitioners were concerned about perioperative blood sugar, predominantly low blood sugar levels, in major surgeries and using long-acting or ultra-long-acting insulin. The agreement with continuation or discontinuation of OHA before minor and intermediate surgery was the highest. However, the practice varied in case of the planned major surgery.

The anesthetists changed the dose of long-acting insulin, but not of the intermediate or short-acting one. There is a need for evidence-based national guidelines and recommendations. Although the variation in the practice is not uncommon in the perioperative period d

espite having recommendations on testing.[10] There are recommendations for blood sugar and HbA1c cut-off level to be accepted for elective surgeries,[11, 12] and postpone a non-urgent surgery.[4] Even these recommendations are not consistent, and rather than the exact value of blood sugar, complications related to DM are advocated for decision making on the postponement of an elective surgery.[6] Our respondents favored postponing an urgent and even emergency surgery at a cut-off level of 400 or 500 mg% blood sugar level. In this context, it is also notable that both immediate and urgent categories of surgeries require intervention within minutes to hours to save a limb, organ, or life, which questions the feasibility of cancellation or postponement of such a case. Therefore, it is advisable to follow an emergent path with concomitant resuscitation, insulin therapy, frequent monitoring of blood sugar, and take up the case. [13] One of the difficulties for consistent practice or guidelines is variable types of OHA and insulin and

variable invasiveness of surgery. Moreover, the number of patients with very high blood sugar levels requiring emergency surgery is minimal. A properly designed study to answer such aspects might not be feasible, but consensus-based recommendations might play a role.

 

Our survey results echo the findings of a Canadian survey evaluating the perioperative diabetes medications and blood glucose control. [7] Variation was also noted in the insulin pump management in pediatric patients. [14] In our subgroup analysis, there were minor differences in the practice of case acceptance for surgery at a given blood sugar level between the private and public sectors and insulin management in the teaching and non-teaching sectors. Preoperative investigation and case postponement depend not only on the comorbidity but also on the patient's physical

status and the type of surgery planned. [10] The type and invasiveness grades of the surgeries performed in the teaching hospitals are likely to be more severe as these hospitals are usually more equipped and larger. [15, 16] Further, most of the aspects of the practices were similar among the sub-groups. Our observations echo the findings and conclusion of a systematic review on the performance comparison between private and public healthcare settings in low- and middle-income countries.[17]

# 5. Limitations

Although our survey was a multinational survey, the response from smaller countries was not good. A subgroup analysis of practice variation in different

countries was not performed because more than 82% of respondents were from India. Further, our survey did not differentiate between type 1 and type 2 DM, whose management differs from variable rate insulin infusion (VRII) for immediate or urgent surgery.

# 6. Conclusion

Our survey result indicates a considerable variation in the perioperative practice for managing diabetic patients. The variation increases with the increasing invasiveness of surgery. Although there were similar practices between private versus public sectors and teaching versus non-teaching establishments, significant differences were noted concerning case postponement, indicating an authoritative guideline is the need of the hour.

## 7. Financial support

The primary investigator is affiliated with the All India Institute of Medical Sciences and has used the institute's facilities and infrastructure as needed. No funding was received from any third party, either private or government sector.

## 8. Conflicts of interests

None declared by the authors.

## 9. Data availability

The numerical data regarding this study is available with the authors and can be seen on request.

## 10. Authors contribution

All authors took part in the conduct of the survey in their respective countries.

HMRK and AS completed the statistical analysis and drafted the manuscript.

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