The importance of postoperative quality of recovery: influences, assessment, and clinical and prognostic implications

L'importance de la qualité de récupération postopératoire: influences, évaluation et implications cliniques et pronostiques

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Abstract *Quality of recovery is a complex construct whose definition is influenced heavily by the opinions and biases of the individual patient, clinician, or institution. As a result, recovery assessment tools differ in their fundamental definitions of recovery, breadth, and assessment time frame. Accurate assessment of recovery is essential as suboptimal recovery has both economic and prognostic implications. Quality of care is often substituted as a surrogate at the institutional level for quality of recovery, but it is ideologically distinct from patients' perceived quality of care, recovery, and satisfaction. Recovery tools also differ in their assessment of recovery as a continuous vs dichotomous variable and in their focus at the group vs individual level. Ideally, recovery measures should assess outcomes in a simple dichotomous fashion and maintain relevancy by assessing in multiple domains at various time points. Assessment of recovery in a dichotomous fashion also has both clinical and research applications. It allows identification of suboptimal*

recovery at both individual and group levels, respectively, and when performed in real time, it allows the opportunity for timely targeted intervention specific to individual patients as well as for resource rationalization.

Résumé *La qualité de récupération est un construit complexe dont la définition est fortement influencée par les opinions et les biais du patient, du clinicien, voire de l'établissement. Dès lors, les outils d'évaluation de la récupération diffèrent de par la définition-même de la récupération, leur envergure, et le cadre temporel de l'évaluation. Une évaluation précise de la récupération est essentielle; en effet, une récupération sous-optimale a des implications tant économiques que pronostiques. Au niveau institutionnel, on utilise souvent la qualité des soins comme substitut de la qualité de récupération mais, d'un point de vue idéologique, ce concept se distingue de la qualité des soins, de la récupération et de la satisfaction telles que perçues par les patients. Les outils de récupération diffèrent également dans leur évaluation de la récupération en tant que variable continue ou dichotomique et dans leur emphase sur le groupe ou l'individu. Dans l'idéal, les mesures de la récupération devraient évaluer les pronostics de manière dichotomique simple et maintenir leur pertinence en évaluant plusieurs domaines à différents moments dans le temps. L'évaluation dichotomique de la récupération a également des applications cliniques et en recherche. Elle permet d'identifier une récupération sous-optimale tant au niveau du groupe que de l'individu. D'autre part, lorsque ce type d'évaluation est réalisé en temps réel, elle nous donne la possibilité d'intervenir d'une manière ciblée et opportune spécifique à chaque patient tout en rationalisant les ressources.*

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The abstract nature of both “quality” and “recovery” does not lend either to a universal definition; hence, their definitions and scope are heavily influenced by the perspective of the user. This often results in a lack of connection between the perception of perioperative recovery viewed by patient, clinician, and institution and the use of performance indicators and quality of care as surrogate markers for recovery.

Institution-focused recovery

At the institutional level, quality of recovery is often used interchangeably with quality of care; however, it is a discrete entity. Quality of care is defined as evidence-based treatment that maximizes the likelihood of desired health outcomes.¹ It is often the preferred institutional standard for assessment of patient experience as it is inherently measurable using performance indicators that in turn link perceived quality of care to policy formation and healthcare funding.² Nevertheless, this ignores the complex nature of recovery and erroneously assumes a direct causal relationship between both adherence to performance indicators and provision of high-quality healthcare and ultimate patient recovery.

The utility of an indicator is limited by the extent to which it can detect a true difference in quality, whether it is for quality of patient care or recovery. Performance indicators are direct measures of service provision but not necessarily patient care or recovery.³ They reflect high quality of care only by inference that it is correlated with adherence to selected indicators (e.g., absence of complications or a length of stay below the average equates to optimal quality of care).⁴ Although differences in performance indicators may represent true differences in quality of care, these differences do not necessarily equate to differences in recovery, and they are also influenced by variations in patient case mix, data measurement, or chance.²

Performance indicators relating to anesthesia primarily assess patient safety and effectiveness in the recovery room and immediate postoperative period,⁵ and they address occurrences of adverse symptomatology (e.g., postoperative nausea and vomiting, severe pain, hypothermia, respiratory distress) and increased resource utilization (e.g., unplanned admission to the intensive care unit [ICU], delayed stay in the postanesthesia care unit, epidural assessment).⁵ Nevertheless, although these indicators may influence patient status, they do not fully define either quality of care or recovery. Complications, as with other performance measures, are important in their own right, but they are contextual and form just one component of a multidimensional recovery construct. For

example, they are unable to help differentiate between postoperative pain being either crucial or a transient tolerable inconvenience to a patient undergoing palliative vs curative surgery, respectively. Furthermore, quality of recovery can be independent of the quality of care received. For instance, patients can recover to previous function despite the provision of suboptimal care, while patients can receive excellent high-quality care yet experience suboptimal recovery.

There are fundamental issues regarding the use of performance indicators for assessment of both quality of care and recovery, specifically, they are unidimensional, lack context, and rarely improve patient status when used in isolation.^{6,7} Thus, they are only surrogate measures of quality of care, which in turn is a surrogate marker of quality of recovery. Furthermore, neither performance indicators nor quality of care address the contextual nature of the direct and indirect influences on ultimate patient recovery. It is important to emphasize that outcome performance indicators can assess unidimensional recovery (e.g., ambulation, independent activities of daily living [ADLs]) and can have direct implications in their own right on both the patient and the institution, impacting on patient experience and discharge readiness, respectively. Nevertheless, they cannot facilitate assessment of contextual multidimensional recovery, are often underpowered to help in the detection of rare clinical events,² and lack sensitivity and specificity.⁸

Patient-focused recovery

At the institutional level, the focus on adherence to performance indicators as a measure of quality of care and a surrogate for recovery differs sharply from that of patients. Patients define recovery as a return to previous “normality” in their various daily roles, and the quality of their recovery is defined by the level of “normality” they attained and the process they experienced to reach their goal.^{9–11} Although patient-defined recovery often has an emphasis on the traditional parameters of return of physiological and physical function, its scope is often broadened to include nociceptive, emotive, social, satisfaction, and cognitive domains.^{9,12} Furthermore, recovery is not just the absence of complications or negative symptoms but the return to a resemblance of their previous life.³ Nevertheless, there is often a disconnect between patient perceived quality of recovery and traditional indicators, with the former being heavily influenced by individual patient personality traits, knowledge regarding normal recovery trajectory, preparedness, coping strategies, and a global sense of security.⁹

Patient satisfaction

Patient satisfaction, while important in its own right, must not be used as a surrogate for quality of recovery. Five dimensions have been identified as impacting on patient satisfaction: provision of information, physical comfort/discomfort, emotional support, involvement in care, and privacy.¹³ When compared with traditional quality indicators, satisfaction has been shown to correlate with large hospitals, high surgical volumes, and a low mortality index ($P < 0.001$) but not with other process indicators or patient outcomes (length of stay, complications ($P = 0.491$), and readmission ($P = 0.056$)).^{9,10} It is heavily influenced by culture and institution and has a stronger correlation with patient expectations, subsequent patient experience, strong therapeutic relationships,^{14,15} work activity, and procedural outcome rather than with professionalism or anesthetic outcome.^{16,17} The discriminate utility of satisfaction as an indirect measure of quality of recovery is also limited by its lack of a uniform definition or assessment tool, rapid early recovery,^{18,19} and an inconsistent relationship with traditional recovery markers (nociceptive complications). Thus, a disconnect remains between an institution's unidimensional performance indicators and patients' perceived multidimensional recovery.

Implications of poor recovery

The importance of quality of recovery assessment lies in the fact that recovery itself is often incomplete and correlates with long-term morbidity and mortality.²⁰ Delayed physical recovery is present in up to 60% and 50% of patients at three and six months, respectively.^{21,22} Cognitive recovery can be delayed at postoperative day 3 in 14% of the general population²³ and can persist, especially in the elderly population.²⁴ Cognitive and non-cognitive recovery are also intertwined, with failure of recovery in one being predictive of suboptimal recovery in the other.^{25,26} Incomplete early recovery is also predictive of long-term adverse outcomes. Long-term functional recovery is reduced in patients with longer initial hospital stay or early readmission.²⁷ Similarly, significant acute postoperative pain is associated with poorer long-term nociceptive recovery.²⁸⁻³¹ Cognitive dysfunction occurring at any point in the postoperative period is associated with increased short- and long-term sequelae, with postoperative cognitive dysfunction at discharge and three months being associated with increased mortality at three and 12 months, respectively.²⁰ This does not prove causality between early cognitive dysfunction and long-term sequelae but is

consistent with the increased mortality associated with rapid cognitive decline in the non-surgical community.^{32,33} Thus, the direct clinical utility of accurate early assessment of multidimensional recovery is the ability to identify those patients who are at risk of increased morbidity and mortality and may benefit from intervention. Nevertheless, early intervention to modulate quality of recovery is a new concept, and therefore, there are few data to validate this concept.

Measurement of recovery

Inherent in the assessment of recovery is the need for clear definitions and quantification. As recovery is defined by the stakeholder, current clinical recovery assessment tools differ in their definition of recovery, their breadth and timing of assessment, and overall validation, all of which reflect the original focus for developing the tool.³⁴ Traditional recovery assessment tools were institutional and focused on the provider, limiting assessment to addressing restitution of physiological parameters in the immediate postoperative period.³⁵ Historically, factors with a direct impact on discharge readiness and institutional cost were assessed—nausea and vomiting, severe pain,³⁶⁻³⁹ psychological distress,^{37,38,40-42} and basic physiological function.⁴³⁻⁴⁵ With the advent of patient-centred care, recovery has developed into a multidimensional construct, with recovery assessment tools addressing physical (nociceptive),³⁶⁻³⁹ psychological (emotive, satisfaction),^{37,38,40-42} functional (ADLs),^{36-42,46} and more recently, cognitive domains. The latter has become more pertinent in the advent of an aging population and increasing awareness of the interplay between the perioperative inflammatory state, anesthetic agents, and neurodegenerative processes.⁴⁷⁻⁵¹ Assessment of cognitive recovery has thus progressed from simple assessments of orientation and comprehension^{38,41,46} to more formal neuropsychological-based assessment.^{26,37,52,53} More recent clinical recovery assessment tools, such as the Postoperative Quality of Recovery Scale (PostopQRS),³⁷ assess cognitive recovery by applying formal neuropsychological tests in truncated form and assessing patient recovery in relation to individual baseline function both in real time and over multiple time points.

The timing of recovery assessment differs amongst tools, which directly affects clinical utility, as a tool is validated only for the time period (and patient group) for which it was originally designed. Ambulatory anesthesia requires patient recovery to be quantified in the short term, while subsequent recovery tools focus on quantifying factors that influence patient discharge on the first postoperative day^{38,46} or one week following surgery.^{36,40,42} While initial reporting of surgical

recovery was comprehensive, it was principally focused on the provider and limited to in-hospital and 30-day performance indicators.²² Enhanced Recovery After Surgery (ERAS) pathways now extend recovery to include three phases (up to discharge from the postanesthesia care unit, hospital discharge, and restitution of normal function), but they are still primarily focused on performance indicators in the immediate postoperative period. In comparison, the development of recovery assessment tools that address early (over days),^{38,46} intermediate (over weeks),^{39,41} and late (over months)^{37,54} recovery allow for a broader and contextual assessment of persistent adverse symptoms, functional impairment, and cognitive decline beyond the traditional postoperative period.

Recovery involves the restitution of physiological processes, comprising an acute deterioration (surgery), followed by a time-dependent improvement in function, resolution of adverse symptomatology, and a return to baseline.^{10,12,22} Thus, an important advantage of a recovery assessment tool is its ability to aid in the assessment of recovery at multiple clinically relevant time points. By using validated repeat measures,^{36,37,41} it can model the trajectory of recovery over time, from discharge (early recovery), to resumption of basic social activities (intermediate recovery), to resolution of full cognitive function (late recovery).

It is essential for all stakeholders, namely, institutions, clinicians, and patients, to broaden the assessment time frame for recovery, as it enables clinical management to be judged in the context of both short- and long-term outcomes. For example, implementation of ERAS pathways has been associated with favourable short-term benefits, including a reduction in direct costs (anesthetic, nursing, laboratory medicine), hospital length of stay, readmission rates, and complications.⁵⁵⁻⁵⁸ Nevertheless, it is yet to be definitively determined whether this is an overall reduction or a reduction at the expense of cost transfer to the community through increased indirect costs due to delayed complications, losses in productivity (i.e., delayed return to employment), and utilization of community resources.^{21,22}

Dichotomizing recovery

A fundamental difference in recovery tools is their assessment of recovery as a dichotomous *vs* a continuous variable at an individual *vs* a group level. Traditionally, recovery assessment was the domain of research and hence involved assessment of a continuous variable at the group level with differences in recovery between groups being quantified by the corresponding difference in mean change

scores. Nevertheless, while continuous composite scores allow an assessment of the difference in the magnitude of recovery between groups, this approach neither identifies the specific domains in which recovery is suboptimal nor differentiates between statistical *vs* clinical significance.

In comparison, dichotomization of recovery facilitates identification of poor recovery at the group, individual, and domain levels. Individuals are scored to “recovered” or “not recovered” according to whether their postoperative performance meets or exceeds a predetermined value, the latter preferably their own preoperative performance. At the group level, recovery is assessed by a comparison of the incidence of recovery between groups. Dichotomized recovery can thus be assessed overall (recovery in all domains assessed) or “drilled down” to the domain (i.e., functional, cognitive, nociceptive), sub-domain, and raw data level. While the magnitude of recovery (or failure thereof) is not immediately evident with dichotomization, this can be mitigated by collecting data in its raw continuous form (where relevant) for assessment during the “drill down”. Thus, the inherent value in dichotomization of recovery is the potential to allow assessment of both individual and group recovery, both overall and at multiple levels.

The importance of patients functioning as their own preoperative control

It is integral to the assessment of patients’ recovery for them to function as their own preoperative controls. Recovery implies comparison of postoperative function with a control population, threshold value, or, ideally, individual patient preoperative function. Use of threshold values restricts the clinical utility and internal validity⁵⁹ of an assessment tool or study results to the time period for which that threshold is valid (e.g., a patient with systolic blood pressure [SBP] 145 mmHg is “hypertensive” as long as the definition of hypertension is SBP >120 mmHg). Conversely, dichotomizing recovery by defining it as “a return to a patient’s own baseline or better” mitigates this restriction by assessing individual patients in relation to their preoperative function for that unique perioperative experience, independent of future events or patient ability. The use of population standard threshold values can thus be reserved for emergent perioperative experiences when baseline patient data cannot be collected. Having a patient function as their own immediate preoperative control for each perioperative experience also minimizes subjective bias resulting from response shift,⁶⁰ an assumed equal difference of ordinal scales, and perioperative subjective impairment.^{38,54,61,62}

Essential components for the future of quality of recovery

Real-time recovery (RTR)

The future of recovery assessment encompasses that which is multidimensional, patient focused, and occurring at multiple clinically relevant postoperative time points and in real time. Real-time recovery (or concurrent recovery monitoring), the synchronous collection, analysis, and reporting of data, is beneficial in any multifaceted time-dependent system as it minimizes the time delay in implementing a corrective intervention in response to any error or deviation from the expected norm.⁶³ Real-time recovery can itself be classified as a clinical intervention, as it allows identification of those patients with poor recovery at the time the lapse occurs, thus minimizing the delay between identification and implementation of treatment. It is complimentary to, but distinct from, clinical care pathways, with the latter referring to an overarching document delineating proposed patient care based on best practice, ultimate care received, the indication for variances between the two, and ultimate patient outcome.⁶⁴ Thus, the clinical utility of RTR is dependent on two factors, specifically, identification of poor recovery at the individual patient level and an effective corrective treatment to help the patient return to the expected recovery trajectory. The clinical utility of RTR is in its ability to optimize treatment and resource utilization. Real-time identification of patients with suboptimal recovery facilitates the possibility of rationalizing finite resources and targeting treatment to those patients who would most benefit in a time frame that maximizes clinical impact. Conversely, patients with acceptable recovery can be fast tracked and thus avoid exposure to unnecessary interventions and use of finite resources.

Domain-specific assessment

Optimal patient care is dependent on timely and targeted intervention that requires identifying the presence of suboptimal recovery as well as the domain(s) where it occurs. Recovery assessment tools that define recovery as a multidimensional dichotomized variable allow identification of suboptimal performance (failure to recover) as well as the particular domain AND the individual patients. Furthermore, recovery domains are interrelated, and it is only by this subsequent “drilling down” and assessing other recovery domains that appropriate clinical intervention targeted to the cause of suboptimal recovery can be instituted. For example, failure of overall recovery may be due to a myriad of factors, but it

is only by drilling down and identifying persistent pain and its cause (e.g., anastomotic bowel leak or bile duct injury) that timely targeted treatment can be instituted to restore the recovery trajectory.^{65,66}

Clinical vs research recovery assessment

Real-time recovery also highlights the difference between assessments of recovery in the research vs clinical setting. Research is inherently retrospective, thus inducing a necessary time delay between identification of poor recovery and timely intervention for the original study population. Comparison of mean change scores between groups indicates whether there is a statistical difference between groups, but it does not identify changes in individuals unless further analysis is performed. In comparison, a tool that performs RTR has both clinical and research applications. The ability to identify domain-specific recovery failure and implement targeted therapies to improve recovery is a new area for perioperative medicine. It requires a tool for early identification of recovery failure as well as for assessment of the outcomes following the interventions. As an example, the online PostopQRS has the facility to assess individual recovery in real time through automated scoring of the recovery data (www.PostopQRS.com), and the scale can be used to assess recovery after the interventions. Future directions in real-time recovery could involve automation that alerts clinicians, or even patients, that recovery has failed and specifies the recovery domain where the failure occurred.

Using recovery assessment to change patient outcome

There is a fundamental need for recovery to be assessed in real time because current risk stratification tools can identify only those patients at high risk of poor postoperative outcomes but not those patients in whom these events actually occur. Postoperative complication rates do parallel preoperative risk stratification, with cardiorespiratory complications increasing from 11–41% of patients in the first and fifth quintiles, respectively.⁶⁷ Resource utilization and its associated costs also parallel preoperative risk, with base ICU rates increasing from 6–25% in patients in the first and fifth quintiles, respectively, correlating with a base increase of \$5,909 per patient.⁶⁷ When poor recovery and complications occur, mean total in-hospital costs increase twofold.⁶⁸ Nevertheless, complications occur in all perioperative risk groups, with the majority (by number) occurring in lower-risk patients and being heavily influenced by factors other than perioperative risk, namely, patient age, comorbidities, and individual institutions.⁶⁹ In addition, highest postoperative mortality is not limited only to those with

high preoperative risk, it also includes those requiring an unanticipated transfer from a postoperative ward to ICU admission.⁷⁰⁻⁷² This highlights that recovery is a multifactorial concept that preoperative risk stratification cannot predict in its entirety at the individual patient level.^{73,74} Thus, it is essential that there is real-time assessment of patient recovery in order to detect those patients who might benefit from a timely intervention.

Conclusion

Quality of recovery is an abstract construct whose definition, scope, and timing of assessment are heavily influenced by the user. At the institutional level, quality of recovery is often substituted by quality of care, which is measured using performance indicators but lacks the contextual milieu that is central to that of patient-perceived recovery. Quality of recovery has prognostic and economic implications and is best measured as a dichotomized multidimensional variable at multiple clinically relevant time points and, importantly, in real time, thus enabling both clinical and research applications.

Conflicts of interest None declared.

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