



# Prehabilitation to enhance postoperative recovery for an octogenarian following robotic-assisted hysterectomy with endometrial cancer

## Préadaptation destinée à améliorer la convalescence postopératoire d'une octogénaire après hystérectomie assistée par robot pour cancer de l'endomètre

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Received: 30 January 2012 / Accepted: 8 May 2012 / Published online: 26 May 2012  
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### Abstract

**Purpose** Postoperative complications represent a major concern for elderly patients. We report a case of a medically complex and frail 88-yr-old woman with endometrial cancer who was scheduled for a robotic-assisted total abdominal hysterectomy. In addition to her cardiac morbidity she presented with several risk factors for neurocognitive decline, including prior episodes of postoperative delirium.

**Clinical features** The patient underwent functional, nutritional, and neuropsychological assessments prior to a

three-week prehabilitation home-based program consisting of strength and endurance exercises as well as nutritional optimization. Remarkably, there were no episodes of postoperative confusion, and over the following eight weeks, she continued to show sustained improvement in exercise tolerance (as per the six-minute walk test), cognitive function (as per the Repeatable Battery for the Assessment of Neuropsychological Status), and overall functional capacity (Short Form-36).

**Conclusion** This report provides suggestive evidence that a prehabilitation program optimized the health of this elderly patient and may have prevented a further episode of postoperative delirium. Prehabilitation protocols should be evaluated in clinical trials to evaluate their efficacy and the target populations who may benefit and to elucidate the underlying mechanisms responsible for enhanced recovery in the perioperative setting.

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**Author contributions** Franco Carli evaluated the patient, contributed to the design of the prehabilitation protocol, and participated in the data collection. Franco Carli, Russell Brown, and Stephan Kennepohl performed the data analysis and participated in manuscript preparation. Stephan Kennepohl contributed to the neuropsychological testing and data interpretation.

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This work was supported in part with funds from the Canadian Anesthesiologists' Society – Organon Canada Ltd Canadian Research Award in Anesthesia project: "Enhancing Outcomes after Colonic Surgery: Role of Prehabilitation", and in part by the Montreal General Hospital Department of Anesthesia

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### Résumé

**Objectif** Les complications postopératoires représentent une préoccupation majeure chez les patients âgés. Nous décrivons le cas, médicalement complexe, d'une femme âgée de 88 ans, fragile, atteinte d'un cancer de l'endomètre et qui devait subir une hystérectomie totale par voie abdominale assistée par robot. En plus d'une morbidité cardiaque, elle présentait plusieurs facteurs de risque de déclin neurocognitif, y compris des épisodes antérieurs de delirium postopératoire.

**Caractéristiques cliniques** La patiente a bénéficié d'évaluations fonctionnelle, nutritionnelle et neuropsychologique avant un programme de préadaptation à domicile d'une durée de trois semaines consistant en des

*exercices d'endurance et de renforcement musculaire, associés à une optimisation nutritionnelle. De façon remarquable, elle n'a pas eu d'épisode confusionnel postopératoire et elle a progressivement récupéré pendant les huit semaines suivantes avec une amélioration de la tolérance à l'effort (mesurée par le test de marche de six minutes), des fonctions cognitives (d'après le RBANS - Batterie répétable de tests pour l'évaluation de l'état neuropsychologique) et de la capacité de fonctionnement global (Formulaire abrégé-36).*

**Conclusion** *Ce compte rendu procure des données probantes indiquant qu'un programme de préadaptation a optimisé la santé de cette patiente âgée et peut avoir évité la survenue d'un nouvel épisode de delirium postopératoire. L'efficacité des protocoles de préadaptation doit être évaluée dans le cadre d'études cliniques, ainsi que les populations cibles qui pourraient en bénéficier; ces études pourraient également évaluer les mécanismes sous-jacents responsables d'une meilleure récupération périopératoire.*

Despite advances in surgical technology and improved anesthetic techniques, particular sub-populations of patients remain especially vulnerable to postoperative complications, including cardiac, respiratory, venothrombotic, and cognitive impairment, delaying recovery.<sup>1-4</sup> Risk factors include a pre-existing history of dementia, low preoperative serum albumin,<sup>5</sup> poor exercise tolerance, and frailty.<sup>3,5,6</sup>

Currently, most physiotherapy and dietary interventions aimed to promote recovery are carried out postoperatively. This approach coincides with a period of emotional vulnerability and fatigue such that patients have difficulty complying with intense recovery programs. One published protocol has been designed to prepare knee arthroplasty patients for surgery through education and positive reinforcement.<sup>7</sup> In contrast, relatively few programs systematically target the enhancement of functional capacity and physiological reserves preoperatively by using the same human resources, including physiotherapists and nutritionists, who would otherwise have been consulted postoperatively. Preliminary evidence suggests that *prehabilitation*, a process designed to enhance functional capacity before exposure to surgical stressors, improves wound healing, reduces postoperative complications, and shortens hospital length of stay.<sup>8-10</sup>

The following report describes the perioperative care, including prehabilitation, of a frail elderly woman diagnosed with endometrial cancer who demonstrated significantly impaired baseline function. Prior to surgery, she completed a three-week home-based prehabilitation

program to minimize possible deleterious effects of surgery and to promote recovery. The patient gave written consent for publication of this report.

## Case report

### Medical history

An 88-yr-old Caucasian woman was scheduled to undergo a robotic-assisted total abdominal hysterectomy. Her medical history was significant for coronary artery disease (coronary artery triple bypass graft, 30 years prior), two previous small myocardial infarcts requiring coronary artery stenting (six years and two years previously), and mixed valvular disease, including severe mitral regurgitation and moderate aortic stenosis. She had chronic hypertension and congestive heart failure with the most recent exacerbation occurring several months prior to the preoperative evaluation. In addition, she had lost over 30 lbs during the previous year, had suffered chronic diarrhea of unknown etiology, had recurrent urinary tract infections, and was recently diagnosed with mild cognitive impairment (MCI). Her medications included oral daily doses of the following: atenolol 50 mg, clodipogrel 75 mg, irbesartan 300 mg, pantoprazole 40 mg, amlodipine 5 mg, vitamin D 1,000 IU, memantine 10 mg, and donepezil 10 mg.

In terms of her psychosocial history, the patient was widowed and a mother of seven children. Her highest academic degree was a Master's degree in theology obtained at the age of 60 (in addition to other undergraduate degrees). At the time of the initial assessment, she was residing in an assisted living facility that provided meals and integrated nursing care.

On two previous occasions, she had experienced significant postoperative delirium. The first occurrence lasted approximately two months following a right total knee arthroplasty (seven years previously). The second somewhat milder event occurred after a laparoscopic cholecystectomy (two years previously), and in the context of her newly diagnosed MCI, she was deemed to be at a particularly higher risk for experiencing a further episode of delirium.<sup>2,11</sup> Surgery was recommended as the preferred option to treat her endometrial cancer in spite of the high risk for further postoperative cognitive dysfunction. The patient's family physician was aware of our group's work with prehabilitation studies and asked our multidisciplinary team to evaluate and treat this patient.

### Baseline assessment and outcome measures

The patient underwent a standard medical assessment in the preoperative unit in order to optimize her health status.

Her cardiologist had been consulted preoperatively with an echocardiogram performed two months prior to surgery revealing a normal ejection fraction (64%) and no progression of her valvular disease. In addition, the patient was invited and gave informed consent to participate in a prehabilitation program three weeks before surgery. The program involved a multidisciplinary team which included a kinesiologist, a nutritionist, and a psychologist.<sup>1</sup> The program included an assessment of her functional capacity and physical strength, her nutritional, psychological, and cognitive status, as well as a self-report measure of her overall general functioning. The patient's baseline performance of the six-minute walk test, which is a measure of cardiovascular health and functional exercise capacity, was poor, well below her predicted value (Table 1).<sup>1,12,13</sup> The nutritional assessment identified chronic and severe protein-energy malnutrition (baseline serum albumin = 29 g·L<sup>-1</sup>) attributed to poor-quality intake measured using a standard 24-hr dietary recall.

The patient's cognitive function was assessed using Form A of the *Repeatable Battery for the Assessment of Neuropsychological Status* (RBANS<sup>TM</sup>),<sup>14</sup> a 20-min test designed to measure changes in neurocognitive status over time. The RBANS also examines specific domains of cognitive functioning, including attention, memory, language, and visuospatial skills, and scores are reported as RBANS indexes. The results confirmed the presence of clinically important memory deficits consistent with her prior diagnosis (MCI) as well as more generalized cognitive dysfunction (Table 2). Her total score obtained on this measure was notably poor (< 1<sup>st</sup> percentile rank for her age), particularly when considering her educational background (i.e., Master's degree).

On the Short Form-36 (SF-36®) health-related quality of life survey, the patient obtained lower scores compared with other women of her age on scales assessing both physical and mental health (see Table 1). Further, her SF-36 scores were consistent with the clinical psychologist's reports identifying a number of depressive symptoms, including a lack of motivation, low energy, and a certain indifference concerning her own death.

### Prehabilitation program

Following the initial evaluation, a three-week home-based prehabilitation program was designed, consisting mainly of exercises with additional nutritional optimization. The patient was trained three times per week for an hour by a kinesiologist with an exercise program that emphasized three elements, namely i) strengthening of the upper and lower extremities, ii) abdominal breathing exercises, and iii) improving cardiovascular function (Table 3). The patient performed the strengthening exercises with low-

**Table 1** Results of the individual and cumulative SF-36 scores and the six-minute walk test taken at three time points using standardized methods and compared with normative data for elderly women

Time of assessment:	SF-36 component scores										6 Minute Walk Test
	Physical Functioning	Role Physical	Bodily Pain	General Health	Energy/Vitality	Social Functioning	Role Emotional	Mental Health	Physical Component Scale	Mental Component Scale	
Initial assessment	27.8 (-1.0)	28.0 (-0.7)	62.7 (-0.2)	35.9 (-2.0)	42 (-0.9)	24.6 (-2.5)	44.9 (-1.0)	52.7 (-1.7)	33.7 (-0.7)	47.2 (-0.8)	91.2 m
4 weeks after surgery	27.8 (-1.0)	28 (-0.7)	62.7 (-20)	53.2 (-1.0)	44.3 (-0.7)	30.2 (-2.3)	34.2 (-1.3)	55 (-1.5)	39.6 (-0.1)	45.4 (-1.0)	136.8 m
8 weeks after surgery	19.6 (-1.3)	55.4 (-0.1)	60.6 (-0.29)	41.5 (-1.7)	55.1 (-0.2)	57 (-1.1)	55 (-0.7)	59.5 (-1.2)	37.3 (-0.4)	65.3 (1.2)	144.8 m
Normative mean (SD)	55.5 (26.9)	59.5 (42.6)	67.8 (25.1)	71.4 (17.8)	58.9 (19.6)	82.2 (23.0)	79 (35.4)	78.4 (15.6)	40.9 (10.2)	54.3 (8.9)	382 (66.5)

SD = standard deviation

**Table 2** Neuropsychological testing score indexes from Repeatable Battery or the Assessment Neuropsychological Status (RBANS) measured at three time points

	Immediate Memory	Visuospatial/ constructional	Language	Attention	Delayed Memory	TOTAL SCALE
Initial assessment (Form A)	44 (< 1)	92 (30)	64 (1)	94 (34)	44 (< 1)	58 (< 1)
4 weeks after surgery (Form B)	61 (< 1)	87 (19)	95 (37)	100 (50)	56 (< 1)	75 (5)
8 weeks after surgery (Form B)	57(< 1)	112 (78)	80 (9)	118 (88)	60 (< 1)	81 (10)

**Table 3** Prehabilitation exercise regime carried out three times per week

Target Systems	Types of exercises; 1-2 sets of each exercise consisting of 10-15 repetitions
Strength (Upper)	shoulder flexion horizontal abduction shoulder blades squeezing seated row biceps and triceps curls
Strength (Lower)	hamstring curls ankle pronation static quads bridging hip abduction exercises
Breathing	abdominal breathing
Cardiovascular	ambulation (15-20 min) after 60 min of rest

resistance Thera-Band® and completed one to two sets of each exercise consisting of 10-15 repetitions, as tolerated. Abdominal breathing exercises reinforced the importance of the diaphragm for relaxation. After resting for 60 min, she walked with her four-wheel walker in the hallways of her residence for 15-20 min, resting as needed, without any significant difficulty or discomfort. She was also encouraged to increase her dietary intake of protein and calories, including a 30 g daily supplement of soy kefir.

#### Perioperative course

The patient was admitted to hospital the day before surgery. Her preoperative electrocardiogram and chest *x-ray* were unremarkable, i.e., hemoglobin 114, white blood cell count 3.4, platelets 193, creatinine 145. With the exception of clopidogrel and irbesartan, the patient received her routine medications on the morning of surgery. On the day of surgery, following application of routine monitors, general anesthesia was induced with propofol 150 mg, sufentanyl 2.5 µg, and rocuronium 50 mg. Monitoring included an arterial line and a 5-lead electrocardiogram for ST changes. Anesthesia was maintained with desflurane (end-tidal concentration 3.5-6.1) supplemented with sufentanil (total dose 10 µg). Timentin 3.1 g *iv* was

administered 20 min before skin incision, and antiemetic stockings were applied before positioning the patient on the operating table. A laparoscopy was performed to establish the pneumoperitoneum, which was maintained with carbon dioxide insufflation to a pressure of 12 mmHg. The procedure was achieved using a 12-mm untipped Hasson cannula inserted under direct vision into the peritoneal cavity through a small vertical infra-umbilical incision. Four additional 5-mm trocars were inserted under laparoscopic vision. The patient was gradually placed in a steep Trendelenburg position for the remainder of the surgery. Over the course of the three-hour procedure, the patient received < 1L of intravenous fluids. There were no significant variations in her blood pressure (target mean arterial pressure > 75) and no ST-segment variations suggestive of myocardial ischemia. Oxygen saturation remained > 95% throughout, and end-tidal carbon dioxide concentrations were maintained in the range of 35-45 mmHg. Upon completion of the case, residual neuromuscular block was reversed with neostigmine 2.5 mg and glycopyrrolate 0.4 mg. Bupivacaine 0.25% with epinephrine 1:200000 was injected into the trocar ports. The patient's lungs were ventilated with 100% oxygen and her trachea was extubated uneventfully as soon as she awoke. The estimated total blood loss was < 25 mL since this was a robotic approach. Final pathology results confirmed a surgical stage 1A grade 1 endometrial adenocarcinoma.

The patient was then transferred to the postanesthesia care unit where she was hemodynamically stable, peripherally warm, awake, and comfortable without any notable deficits. Acetaminophen was the only analgesic she required postoperatively. Four hours after her arrival in the postanesthesia care unit, the patient was transferred to the surgical ward on room air; drugs administered were kept to a minimum. The patient's hospital stay was unremarkable with minimal pain except for mild and transient urinary retention. She was discharged to an assisted living facility on postoperative day two.

#### Postoperative assessment and progression

The patient resumed her exercise regimen in her home one week following surgery, and subsequent assessments were

conducted at four and eight weeks postoperatively (Tables 1, 2). Ongoing improvements were documented in her six-minute walk test, although below normal values. Nutritional evaluation revealed marginal dietary improvements, although energy and protein intake remained suboptimal during the recovery period.

Continued improvements were noted on both the physical and mental components of the SF-36 (Table 1), including striking gains on measures assessing her mental health at eight weeks post-surgery. Once again, this was consistent with the treating psychologist's postoperative observations. Subjectively, she reported greater pleasure in her activities of daily living and improved concentration, allowing her to resume reading short newspaper and magazine articles. She attributed these improvements to her physical activity and increased social support (including regular visits by the kinesiologist). A nutritional evaluation revealed marginal dietary improvements, although her energy and protein intake remained suboptimal during the recovery period.

## Discussion

This case highlights the potential benefits of using a prehabilitation program in elderly patients who have significant risk factors for experiencing postoperative delirium. Moreover, this approach not only increased the patient's functional capacity, but it was also associated with improved cognitive function. Although limited, previous prehabilitation studies have shown a protective effect of physical training against further functional deterioration in patients undergoing abdominal and thoracic surgery.<sup>1,15</sup>

Individualized interpretation of several common functional tests, including the six-minute walk test, RBANS, and SF-36, is aided by the direction of the changes, and clinically important changes can be defined by minimal difference thresholds.<sup>16</sup> Although this patient's baseline function remained below that of age-matched controls, as measured using the six-minute walk test (144.8 m vs 382 m),<sup>13</sup> the documented improvement in our patient's capacity (> 50 m) over the recovery period was well above previously published thresholds for substantial meaningful change.<sup>13,16,17</sup> This improvement corresponded with gains in cardiovascular and respiratory function and provided an indication of her capacity to perform her activities of daily living independently (as confirmed with the SF-36). The 6- and 15-point increases in both the physical and mental components of the SF-36 are also impressive since 5- to 9-point increases represent the minimum important differences threshold.<sup>16</sup> There were meaningful cognitive improvements which are notable for a number of reasons.<sup>16</sup> First, the patient had two documented previous episodes of postoperative delirium

that lasted several weeks, and this clearly did not occur following the most recent surgery despite receiving the same medications for general anesthesia. Second, these changes occurred in several cognitive domains. The most significant and steady increases were measured on tasks assessing attention, an aspect of cognition that appears particularly sensitive to postoperative changes.<sup>18</sup> Further, these improvements occurred in the context of a diagnosed cognitive disorder (MCI), which may even predispose individuals to develop postoperative cognitive deficiencies.<sup>2</sup> However, it is important to point out that this patient exhibited minimal gain on measures of explicit memory, findings consistent with her prior diagnosis of MCI.

An important question surrounds the possible mechanisms contributing to the measured improvements. We believe physical training played a large role. Increasing evidence has documented the benefits of physical activity for many disabling medical conditions as well as for limiting cognitive decline.<sup>19</sup> For example, in elderly patients, a four-week exercise program accelerated wound healing in healthy individuals,<sup>10</sup> and resistance training enhanced executive cognitive function. Few studies are available in surgical populations. Preoperative training in renal transplant patients led to significant improvements in SF-36 scores.<sup>20</sup>

Alternate explanations for the observed improvements might include the natural resolution of an underlying depressive episode leading to improvements in the patient's mood. Minimally invasive surgical approaches (laparoscopy vs laparotomy) may also have contributed by reducing the inflammatory response, as similar early improvements in the SF-36 have been reported in patients at one month following a hysterectomy for endometrial cancer.<sup>21</sup> It is uncertain whether diet played any role given the lack of any change in serum albumin.

Although the exact mechanisms remain uncertain, the present case report suggests that a preoperative prehabilitation program may decrease the risk of postoperative cognitive dysfunction and improve functional recovery in high-risk surgical populations. This should be confirmed with well-conducted and appropriately powered clinical trials.

**Acknowledgements** We are grateful to Berson Augustin BSc, Research Coordinator, Do Jun Kim MSc Kinesiology, Michele Iskander PhD Nutrition, and Jodie Richardson PhD Psychology for their assessment and prehabilitation of this patient.

**Competing interests** None declared.

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