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The Intensive Care Muscle imaging study

Submission date
22/05/2015

Recruitment status
No longer recruiting

Registration date
08/07/2015

Overall study status
Completed

Last Edited
04/08/2017

Condition category
Musculoskeletal Diseases

[ ] Prospectively registered
[ ] Protocol
[ ] Statistical analysis plan
[ ] Results
[ ] Individual participant data
[ ] Record updated in last year

Plain English summary of protocol

Background and study aims
Intensive care unit (ICU) patients are more likely to survive today than a decade ago, however they continue to suffer damage to their muscles that leads to long term weakness despite advances in treatment. Muscle injury in ICU patients is characterised by reduced muscle fibre size, areas of muscle cell death, fluid retention (oedema), and general muscle wasting. This leads to profound weakness, a reduction in muscle cross-sectional area and alterations in the graininess (echogenicity) of ultrasound pictures. Various treatments (including drugs, nutrition, and physiotherapy) aimed at preventing muscle damage have been tested in clinical studies but none have led to long term improvements in physical function. It's still not known which treatments can prevent or treat ICU-related muscle injury, or when to apply these treatments so that they are most effective. This is because the changes in structure, volume and function of skeletal muscle in response to critical illness are not fully understood. It's also not understood how these characteristics change over time. Also, it's not known how damaged muscle responds to therapies, such as physiotherapy, over time. Finally, the measurements used to measure changes in muscle characteristics in response to treatment are not very precise. Studies of the muscles of ICU patients have so far used clinical assessment, ultrasound, and muscle biopsy. Successful clinical assessment of muscle function relies on patient cooperation and self-reporting, which prevents accurate assessment of muscle function in isolation of other external factors. Ultrasound is unable to differentiate between muscle fat and water, and this makes measurement of muscle volume unreliable. Finally, muscle biopsy is reliant on sampling the correct part of the muscle. Magnetic resonance imaging (MRI) has emerged as a potentially useful tool in the assessment and tracking of ICU-related muscle injury. MRI techniques allow assessment of changes in muscle volume that has not been possible using other methods. This study of ICU survivors with weak muscles, ICU survivors with strong muscles, and a control group of healthy post-surgical patients will use some established MRI techniques, in addition to some new MRI techniques, to provide detailed information on the structure and function of muscles in recovering ICU patients. The aim of this study is to identify differences in the muscles that will allow clinicians to predict how patients will recover after ICU, and also to identify dynamic changes in the muscle that might allow the recovery of muscle injury to be tracked.

Who can participate?
Adult ICU survivors who are expected to make a poor physical recovery, those expected to make a good physical recovery and healthy adults who have undergone surgery.

What does the study involve?
Participants are non-randomly allocated into one of three groups. Those in group 1 (intervention group) are adult ICU survivors expected to make a poor physical recovery. Those in group 2 (intervention group) are adult ICU survivors expected to make a good physical recovery. Those in group 3 (control group) are healthy adults who are matched by age, gender and body mass index (BMI) to participants in group 1 and 2. All participants undergo various tests in order to obtain detailed information about the structure and function of their muscles. The tests used include MRI, 2D ultrasound imaging, various clinical assessments and blood tests. For participants in group 1, measurements are taken at the start of the study and again 3 months later. For participants in group 2 and 3, measurements are taken at the start of the study only.

What are the possible benefits and risks of participating?
Participating patients will be transferred to an MRI scanner during the first 7 days of ICU discharge. Patients at this stage are likely to be clinically stable, however, it is possible that they are unstable and so an assessment will be carried out by research nurses, and if necessary medical staff prior to transfer and scans deferred or cancelled if the transfer will pose undue risk to the patient. Some discomfort is expected due to prolonged MRI scanning, as this can take longer than other types of scan. Discomfort is minimal but may become tiresome if prolonged. Discomfort will be minimised by a research nurse (or doctor) escort who will be there to ensure that if the patient experiences discomfort, the study can be terminated. Furthermore the duration of scanning will be limited to less than 1 hour which should be tolerable for most patients. For the healthy controls, and those patients that are returning some months after an ICU stay, the study will involve a return visit to the hospital. Refreshments will be provided, and taxi transport provided to ensure that this does not put the patient out unduly. Blood samples will be taken by venepuncture, a low risk procedure that can be uncomfortable and cause localised bleeding. There is a low risk of other complications (inadvertent arterial puncture, nerve damage, infection).

Where is the study run from?
1. Royal Infirmary of Edinburgh (UK)
2. University of Edinburgh (UK)

When is the study starting and how long is it expected to run for?
October 2014 to December 2017

Who is funding the study?
Edinburgh Critical Care Research Group (UK)

Who is the main contact?
1. Ms D Campbell
2. Dr D Griffith

Contact information

Type(s)
Public

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Scientific

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Additional identifiers

Protocol serial number
0.2

Study information

Scientific Title
A pilot observational study to investigate the structure and function of skeletal muscle in survivors of critical illness using magnetic resonance imaging (MRI)

Acronym
IC Muscle

Study objectives
Objectives:
1. To test the feasibility and tolerability of MRI imaging as a method of assessment of critical illness-induced muscle lesions
2. To establish MRI protocols for the assessment of injury and rehabilitation from critical illness induced muscle injury
3. To compare skeletal muscle volume between ICU survivors and healthy controls
4. To compare the viscoelastic properties of ICU survivors with healthy controls
5. To assess the presence or absence of focal skeletal muscle necrosis and fibrosis in ICU patients with significant clinical muscle weakness using MRI

6. To assess whether ultrasound measurements of skeletal muscle correlate with MRI findings in patients with significant weakness after critical illness
7. To assess whether MRI measurements correlate with clinical assessment of physical function
8. To test the association between inflammation (CRP concentration) and MRI appearances of muscle injury in ICU survivors

Ethics approval required
Old ethics approval format

Ethics approval(s)
South East Scotland Research Ethics Committee 2, 14/04/2015, ref: 15-SS-0056.

Primary study design
Observational

Study design
Pilot observational study

Study type(s)
Diagnostic

Health condition(s) or problem(s) studied
Intensive care unit acquired weakness

Interventions
The skeletal muscle of survivors of critical illness will be studied using 3 broad approaches:
1. Magnetic resonance imaging (MRI)
2. 2D ultrasound imaging
3. Clinical assessment (quadricpes dynamometry; Medical Research Council sum-score of global muscle strength; 6 minute walk test)
4. Blood samples will be drawn for serological analysis

Intervention Type
Other

Primary outcome(s)
For group 1 all measurements will be taken at baseline and 3 months; for groups 2 and 3 all measurements will be taken at baseline only:
1. Quadriceps muscle volume.

Key secondary outcome(s)
For group 1 all measurements will be taken at baseline and 3 months; for groups 2 and 3 all measurements will be taken at baseline only:
1. Qualitative assessment of muscle oedema and focal inflammation
2. Relative fat fraction (measured by the three-point Dixon method)
3. Mean elasticity (measured in KPa using magnetic resonance elastography)
4. Quadriceps strength (quadriceps dynamometry)

Completion date
31/12/2017

Eligibility

Key inclusion criteria
Group 1 (10 patients):
1. Adult ICU survivors
2. Ventilated for 48 hours or more
3. Good level of physical function prior to hospital admission (Rivermead Mobility Index (RMI) > /14 at any time in the week prior to hospital admission)
4. Within 7 days of ICU discharge
5. Evidence of very poor physical recovery (RMI ≤8)
Group 2 (10 patients):
1. Adult ICU survivors
2. Paired by age, gender and body mass index (BMI) to Group 1
3. Ventilated for 48 hours or more
4. Good level of physical function prior to hospital admission (RMI =15 at any time in the week prior to hospital admission)
5. Within 7 days of ICU discharge
6. Evidence of very good physical recovery (RMI ≥ 9)
Group 3 (10 patients):
1. A healthy community based sample derived from patients presenting for day case surgery.
2. Paired by age, gender, and BMI to groups 1 and 2
3. Good level of physical function (RMI = 15)

Participant type(s)
Patient

Healthy volunteers allowed
No

Age group
Adult

Sex
All

Key exclusion criteria
Exclusion criteria for groups 1 and 2:
1. <18 years of age
2. Patient receiving palliative care
3. Patient has a contraindication to MRI imaging
4. Neurological diagnosis
5. Background chronic neuromuscular disease
6. Patient lacks mental capacity
7. Malignancy
8. Chronic inflammatory disease
9. Clinical instability
Exclusion criteria for group 3
1. <18 years
2. Malignancy
3. Chronic inflammatory disease
4. Background chronic neuromuscular disease

5. Neurological diagnosis
6. Presenting for lower limb arthroplasty
7. Patient lacks mental capacity

Date of first enrolment
01/06/2015

Date of final enrolment
31/05/2016

Locations

Countries of recruitment
United Kingdom

Scotland

Study participating centre
Royal Infirmary of Edinburgh
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Study participating centre
University of Edinburgh
Clinical Research Imaging Centre (CRIC)
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Sponsor information

Organisation
University of Edinburgh

Organisation
NHS Lothian

Organisation
University of Edinburgh

ROR
https://ror.org/01nrxwf90

Funder(s)

Funder type
Charity

Funder Name
Edinburgh Critical Care Research Group

Results and Publications

Individual participant data (IPD) sharing plan

IPD sharing plan summary
Stored in repository