Miltenyi Biotec

Isolation of CD4$^+$CD25$^+$CD127$^{dim/-}$ regulatory T cells from non-human primate PBMCs

Contents

The below mentioned reagents are applicable for the separation of cells from rhesus monkey (*Macaca mulatta*). The antibodies have been tested to cross-react with cynomolgus monkey (*Macaca fascicularis*). Cross-reactivity has not been tested with other non-human primates.

1. Description

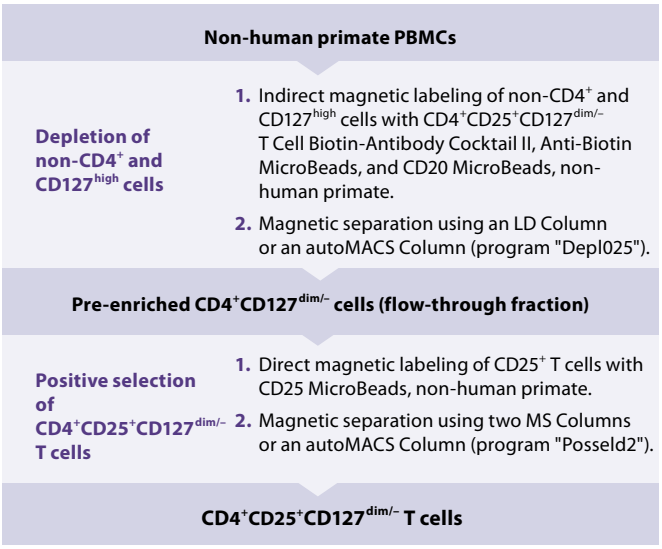
1.1 Principle of the MACS® Separation

The isolation of CD4$^+$CD25$^+$CD127$^{dim/-}$ T cells can be performed by using three reagents:

- CD4$^+$CD25$^+$CD127$^{dim/-}$ T Cell Isolation Kit, human (# 130-094-775), which contains a Biotin-Antibody Cocktail and Anti-Biotin MicroBeads,
- CD20 MicroBeads, non-human primate (# 130-091-105),
- CD25 MicroBeads, non-human primate (# 130-091-095).

The isolation of non-human primate CD4$^+$CD25$^+$CD127$^{dim/-}$ regulatory T cells is performed in a two-step procedure. First, the non-CD4$^+$ and CD127^{high} cells are indirectly magnetically labeled with a cocktail of biotin-conjugated antibodies, Anti-Biotin MicroBeads, and CD20 MicroBeads, non-human primate. The labeled cells are subsequently depleted by separation over a MACS® Column, which is placed in the magnetic field of a MACS Separator. In the second step, the CD4$^+$CD25$^+$CD127$^{dim/-}$ regulatory T cells are directly labeled with CD25 MicroBeads, non-human primate and isolated by positive selection from the pre-enriched CD4$^+$ T cell fraction by separation over a MACS Column, which is placed in the magnetic field of a MACS Separator.

After removing the column from the magnetic field, the magnetically retained CD4$^+$CD25$^+$CD127$^{dim/-}$ regulatory T cells can be eluted as the positively selected cell fraction. To increase the purity, the positively selected cell fraction containing the CD4$^+$CD25$^+$CD127$^{dim/-}$ regulatory T cells is separated over a second column.



1.2 Background information

Regulatory CD4$^+$ T cells are suppressor cells that neutralize other immune cells by various mechanisms.[1] Their characteristic marker is the transcription factor FoxP3. CD4$^+$CD25$^+$ regulatory T cells were originally discovered in mice, but a population with identical phenotype has also been identified in humans.[2–6] CD25 is the interleukin-2–receptor α-chain, which is not only expressed by regulatory T cells but also by activated effector T cells.
CD127, the α-chain of the IL-7 receptor, is expressed on most mature T cells and plays an important role in their proliferation and differentiation.[7] However, on regulatory T cells CD127 is absent and its expression inversely correlates with FoxP3 expression.[8,9] Thus, CD127 can be used as an additional marker to discriminate between human regulatory and activated T cells.

1.3 Applications

- Isolation of CD4$^+$CD25$^+$CD127$^{dim/-}$ regulatory T cells from non-human primate peripheral blood mononuclear cells (PBMCs) for further phenotypical or functional characterization.

1.4 Reagent and instrument requirements

- Buffer: Prepare a solution containing phosphate-buffered saline (PBS), pH 7.2, 0.5% bovine serum albumin (BSA), and 2 mM EDTA by diluting MACS BSA Stock Solution (# 130-091-376) 1:20 with autoMACS® Rinsing Solution (# 130-091-222). Keep buffer cold (2–8 °C). Degas buffer before use, as air bubbles could block the column.

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Miltenyi Biotec GmbH
Friedrich-Ebert-Straße 68, 51429 Bergisch Gladbach, Germany
Phone +49 2204 8306-0, Fax +49 2204 85197
macs@miltenyibiotec.de
www.miltenyibiotec.com

Miltenyi Biotec Inc.
2303 Lindbergh Street, Auburn, CA 95602, USA
Phone 800 FOR MACS, +1 530 888 8871, Fax +1 530 888 8925
macs@miltenyibiotec.com

▲ **Note:** EDTA can be replaced by other supplements such as anticoagulant citrate dextrose formula-A (ACD-A) or citrate phosphate dextrose (CPD). BSA can be replaced by other proteins such as human serum albumin, human serum, or fetal bovine serum (FBS). Buffers or media containing Ca^{2+} or Mg^{2+} are not recommended for use.

- MACS Columns and MACS Separators: Depletion of non-$CD4^+$ and $CD127^{high}$ cells can be performed on an LD Column. The subsequent positive selection of $CD4^+CD25^+CD127^{dim/-}$ T cells can be performed on two MS Columns. Positive selection and depletion can also be performed by using the autoMACS Pro or the autoMACS Separator.

Column	Max. number of labeled cells	Max. number of total cells	Separator
Depletion			
LD	10^8	5×10^8	MidiMACS, QuadroMACS, VarioMACS, SuperMACS
Positive selection			
MS	10^7	2×10^8	MiniMACS, OctoMACS, VarioMACS, SuperMACS
Depletion and positive selection			
autoMACS	2×10^8	4×10^9	autoMACS Pro, autoMACS

▲ **Note:** Column adapters are required to insert certain columns into the VarioMACS™ or SuperMACS™ Separators. For details see the respective MACS Separator data sheet.

- (Optional) Fluorochrome-conjugated antibodies for flow cytometric analysis, e.g., CD4-FITC (# 130-080-501), CD25-APC (# 130-092-858), and CD127-PE (# 130-094-889) For more information about fluorochrome-conjugated antibodies see www.miltenyibiotec.com.
- (Optional) Anti-FoxP3-APC (# 130-093-013) or Anti-FoxP3-PE (# 130-093-014) and FoxP3 Staining Buffer Set (# 130-093-142).
- (Optional) Propidium Iodide Solution (# 130-093-233) or 7-AAD for flow cytometric exclusion of dead cells.
- (Optional) Dead Cell Removal Kit (# 130-090-101) for the depletion of dead cells.
- (Optional) Pre-Separation Filters (# 130-041-407) to remove cell clumps.

2. Protocol

2.1 Sample preparation

When working with anticoagulated peripheral blood or buffy coat, peripheral blood mononuclear cells (PBMCs) should be isolated by density gradient centrifugation, for example, using Ficoll-Paque™.

▲ **Note:** To remove platelets after density gradient separation, resuspend cell pellet in buffer and centrifuge at 200×g for 10–15 minutes at 20 °C. Carefully aspirate supernatant. Repeat washing step.

When working with tissues or lysed blood, prepare a single-cell suspension using standard methods.

For details see the protocols section at www.miltenyibiotec.com/protocols.

▲ Dead cells may bind non-specifically to MACS MicroBeads. To remove dead cells, we recommend using density gradient centrifugation or the Dead Cell Removal Kit (# 130-090-101).

2.2 Magnetic labeling of non-$CD4^+$ and $CD127^{high}$ cells

▲ Work fast, keep cells cold, and use pre-cooled solutions. This will prevent capping of antibodies on the cell surface and non-specific cell labeling.

▲ Volumes for magnetic labeling given below are for up to 10^7 total cells. When working with fewer than 10^7 cells, use the same volumes as indicated. When working with higher cell numbers, scale up all reagent volumes and total volumes accordingly (e.g. for 2×10^7 total cells, use twice the volume of all indicated reagent volumes and total volumes).

▲ For optimal performance it is important to obtain a single-cell suspension before magnetic labeling. Pass cells through 30 µm nylon mesh (Pre-Separation Filters, # 130-041-407) to remove cell clumps which may clog the column. Moisten filter with buffer before use.

▲ The recommended incubation temperature is 2–8 °C. Working on ice may require increased incubation times. Higher temperatures and/or longer incubation times may lead to non-specific cell labeling.

1. Determine cell number.
2. Centrifuge cell suspension at 300×g for 10 minutes. Aspirate supernatant completely.
3. Resuspend cell pellet in 40 µL of buffer per 10^7 total cells.
4. Add 10 µL of $CD4^+CD25^+CD127^{dim/-}$ T Cell Biotin-Antibody Cocktail II per 10^7 total cells.
5. Mix well and incubate for 10 minutes in the refrigerator (2–8 °C).
6. Add 10 µL of buffer, 20 µL of Anti-Biotin MicroBeads, and 20 µL of CD20 MicroBeads, non-human primate per 10^7 total cells.
7. Mix well and incubate for 15 minutes in the refrigerator (2–8 °C).
8. Wash cells by adding 1–2 mL of buffer per 10^7 cells and centrifuge at 300×g for 10 minutes. Aspirate supernatant completely.
9. Resuspend up to 10^8 cells in 500 µL of buffer.
   ▲ **Note:** For higher cell numbers, scale up buffer volume accordingly.
10. Proceed to magnetic separation (2.3).

2.3 Magnetic separation: Depletion of non-$CD4^+$ and $CD127^{high}$ cells

▲ Choose an appropriate MACS Column and MACS Separator according to the number of total cells and the number of $CD4^+CD25^+CD127^{dim/-}$ cells. For details see table in section 1.4.

▲ Always wait until the column reservoir is empty before proceeding to the next step.

Depletion with LD Columns

1. Place LD Column in the magnetic field of a suitable MACS Separator. For details see LD Column data sheet.
2. Prepare column by rinsing with 2 mL of buffer.
3. Apply cell suspension onto the column.

4. Collect unlabeled cells that pass through and wash column with 2×1 mL of buffer. Collect total effluent; this is the unlabeled pre-enriched $CD4^+$ cell fraction. Perform washing steps by adding buffer two times. Only add new buffer when the column reservoir is empty.
5. Proceed to 2.4 for the isolation of $CD4^+CD25^+CD127^{dim/-}$ cells.

Depletion with the autoMACS® Pro Separator or the autoMACS® Separator

▲ Refer to the respective user manual for instructions on how to use the autoMACS® Pro Separator or the autoMACS Separator.

▲ Buffers used for operating the autoMACS Pro Separator or the autoMACS Separator should have a temperature of ≥ 10 °C.

▲ Program choice depends on the isolation strategy, the strength of magnetic labeling, and the frequency of magnetically labeled cells. For details refer to the section describing the cell separation programs in the respective user manual. Program recommendations below refer to separation of human PBMCs.

Magnetic separation with the autoMACS® Pro Separator

1. Prepare and prime the instrument.
2. Apply tube containing the sample and provide tubes for collecting the labeled and unlabeled cell fractions. Place sample tube in row A of the tube rack and the fraction collection tubes in rows B and C.
3. For a standard separation choose the following program:
   Depletion: "Depl025"
   Collect negative fraction in row B of the tube rack.
4. Proceed to 2.4 for the isolation of $CD4^+CD25^+CD127^{dim/-}$ cells.

Magnetic separation with the autoMACS® Separator

1. Prepare and prime the instrument.
2. Apply tube containing the sample and provide tubes for collecting the labeled and unlabeled cell fractions. Place sample tube at the uptake port and the fraction collection tubes at port neg1 and port pos1.
3. For a standard separation choose the following program:
   Depletion: "Depl025"
   Collect negative fraction from outlet port neg1.
4. Proceed to 2.4 for the isolation of $CD4^+CD25^+CD127^{dim/-}$ cells.

2.4 Magnetic labeling of $CD4^+CD25^+CD127^{dim/-}$ regulatory T cells

▲ Volumes for magnetic labeling given below are for an initial starting cell number of up to 10^7 total cells. For higher initial cell numbers, scale up all volumes accordingly.

1. Centrifuge cell suspension at 300×g for 10 minutes. Aspirate supernatant completely.
2. Resuspend cell pellet in 80 µL of buffer per 10^7 total cells.
3. Add 20 µL of CD25 MicroBeads, non-human primate per 10^7 total cells.
4. Mix well and incubate for 15 minutes in the refrigerator (2–8 °C).
5. Wash cells by adding 1–2 mL of buffer and centrifuge at 300×g for 10 minutes. Aspirate supernatant completely.
6. Resuspend up to 10^8 cells in 500 µL of buffer.
   ▲ **Note:** For higher cell numbers, scale up buffer volume accordingly.
7. Proceed to magnetic separation (2.5).

2.5 Magnetic separation: Positive selection of $CD4^+CD25^+CD127^{dim/-}$ regulatory T cells

Positive selection with MS Columns

▲ To achieve highest purities, perform two consecutive column runs.

1. Place MS Column in the magnetic field of a suitable MACS Separator. For details see MS Column data sheet.
2. Prepare column by rinsing with 500 µL of buffer.
3. Apply cell suspension onto the column. Collect flow-through containing unlabeled cells.
4. Wash column with 3×500 µL of buffer. Collect unlabeled cells that pass through and combine with the effluent from step 3.
   ▲ **Note:** Perform washing steps by adding buffer aliquots only when the column reservoir is empty.
5. Remove column from the separator and place it on a suitable collection tube.
   ▲ **Note:** To perform a second column run, you may elute the cells directly from the first onto the second, equilibrated column instead of a collection tube.
6. Pipette 1 mL of buffer onto the column. Immediately flush out the magnetically labeled cells by firmly pushing the plunger into the column.
7. To increase purity of $CD4^+CD25^+CD127^{dim/-}$ cells, the eluted fraction can be enriched over a second MS Column. Repeat the magnetic separation procedure as described in steps 1 to 6 by using a new column.

Positive selection with the autoMACS® Pro Separator or the autoMACS® Separator

Magnetic separation with the autoMACS® Pro Separator

1. Prepare and prime the instrument.
2. Apply tube containing the sample and provide tubes for collecting the labeled and unlabeled cell fractions. Place sample tube in row A of the tube rack and the fraction collection tubes in rows B and C.
3. For a standard separation choose the following program:
   Positive selection: "Posseld2"
   Collect positive fraction in row C of the tube rack. This is the enriched $CD4^+CD25^+CD127^{dim/-}$ T cell fraction.

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Magnetic separation with the autoMACS® Separator

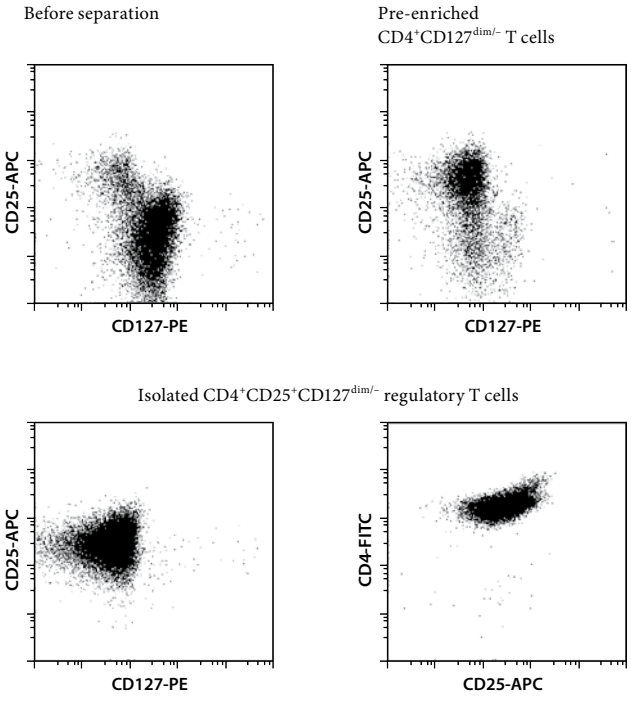
1. Prepare and prime the instrument.
2. Apply tube containing the sample and provide tubes for collecting the labeled and unlabeled cell fractions. Place sample tube at the uptake port and the fraction collection tubes at port neg1 and port pos2.
3. For a standard separation choose one of the following programs:

   Positive selection: "Posseld2"
   Collect positive fraction from outlet port pos2. This is the enriched $CD4^+CD25^+CD127^{dim/-}$ T cell fraction.

3. Example of a separation of $CD4^+CD25^+CD127^{dim/-}$ regulatory T cells from non-human primate PBMCs

$CD4^+CD25^+CD127^{dim/-}$ regulatory T cells were isolated from non-human primate PBMCs by using the $CD4^+CD25^+CD127^{dim/-}$ Regulatory T Cell Isolation Kit II, CD20 MicroBeads,non-human primate, an LD and two MS Columns, a MidiMACS™ Separator and a MiniMACS™ Separator. The cells were fluorescently stained and analyzed by flow cytometry using the MACSQuant® Analyzer. Cell debris and dead cells were excluded from the analysis based on scatter signals and propidium iodide fluorescence.
Gating was performed according to CD4-expression.

A)



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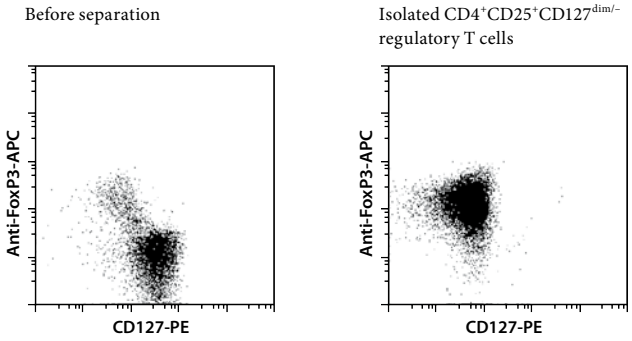

4. References

1. Sakaguchi, S. *et al.* (2008) Regulatory T cells and immune tolerance. Cell 133: 775–787.
2. Levings, M. K. *et al.* (2001) $CD4^+CD25^+$ regulatory cells suppress naive and memory T cell proliferation and can be expanded *in vitro* without loss of function. J. Exp. Med. 193: 1295–1302.
3. Dieckmann, D. *et al.* (2001) *Ex vivo* isolation and characterisation of $CD4^+CD25^+$ T cells with regulatory properties from human blood. J. Exp. Med. 193: 1303–1310.
4. Jonuleit, H. *et al.* (2001) Identification and functional characterisation of human $CD4^+CD25^+$ T cells with regulatory properties isolated from peripheral blood. J. Exp. Med. 193: 1285–1294.
5. Taams, L. S. et al. (2001) Human anergic/suppressive $CD4^+CD25^+$ T cells: a highly differentiated and apoptosis-prone population. Eur. J. Immunol. 31: 1122–1131.
6. Stephens, L. A. *et al.* (2001) Human $CD4^+CD25^+$ thymocytes and peripheral T cells have immune suppressive activity *in vitro*. Eur. J. Immunol. 31: 1247–1254.
7. Plum, J. *et al.* (1996) Interleukin-7 is a critical growth factor in early human T-cell development. Blood 88: 4239–4245.
8. Seddiki, N. *et al.* (2006) Expression of interleukin (IL)-2 and IL-7 receptors discriminates between human regulatory and activated T cells. J. Exp. Med. 203: 1693–1700.
9. Liu, W. *et al.* (2006) CD127 expression inversely correlates with FoxP3 and suppressive function of human $CD4^+$ T reg cells. J. Exp. Med. 203: 1701–1711.

All protocols and data sheets are available at **www.miltenyibiotec.com**.

Warnings

Reagents contain sodium azide. Under acidic conditions sodium azide yields hydrazoic acid, which is extremely toxic. Azide compounds should be diluted with running water before discarding. These precautions are recommended to avoid deposits in plumbing where explosive conditions may develop.

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